Global Hydrogen Mobility Applications

NASEM Webinar

James Kast
Toyota Motor North America
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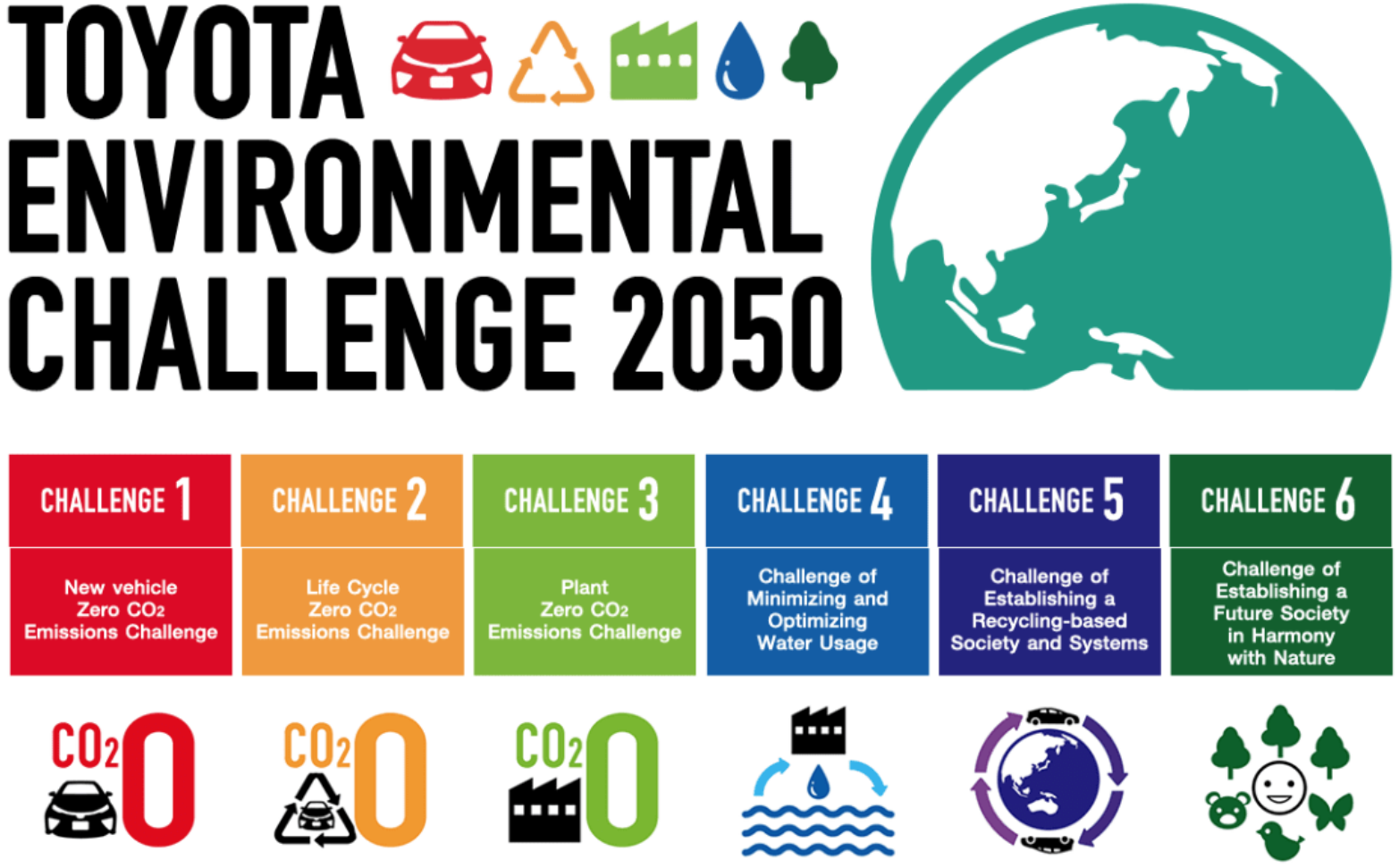
TOYOTA

Toyota Sustainable Mobility Philosophy

6 CHALLENGES TOWARD 2050



ZEV technologies are just one pillar of Toyota's global commitment to sustainability

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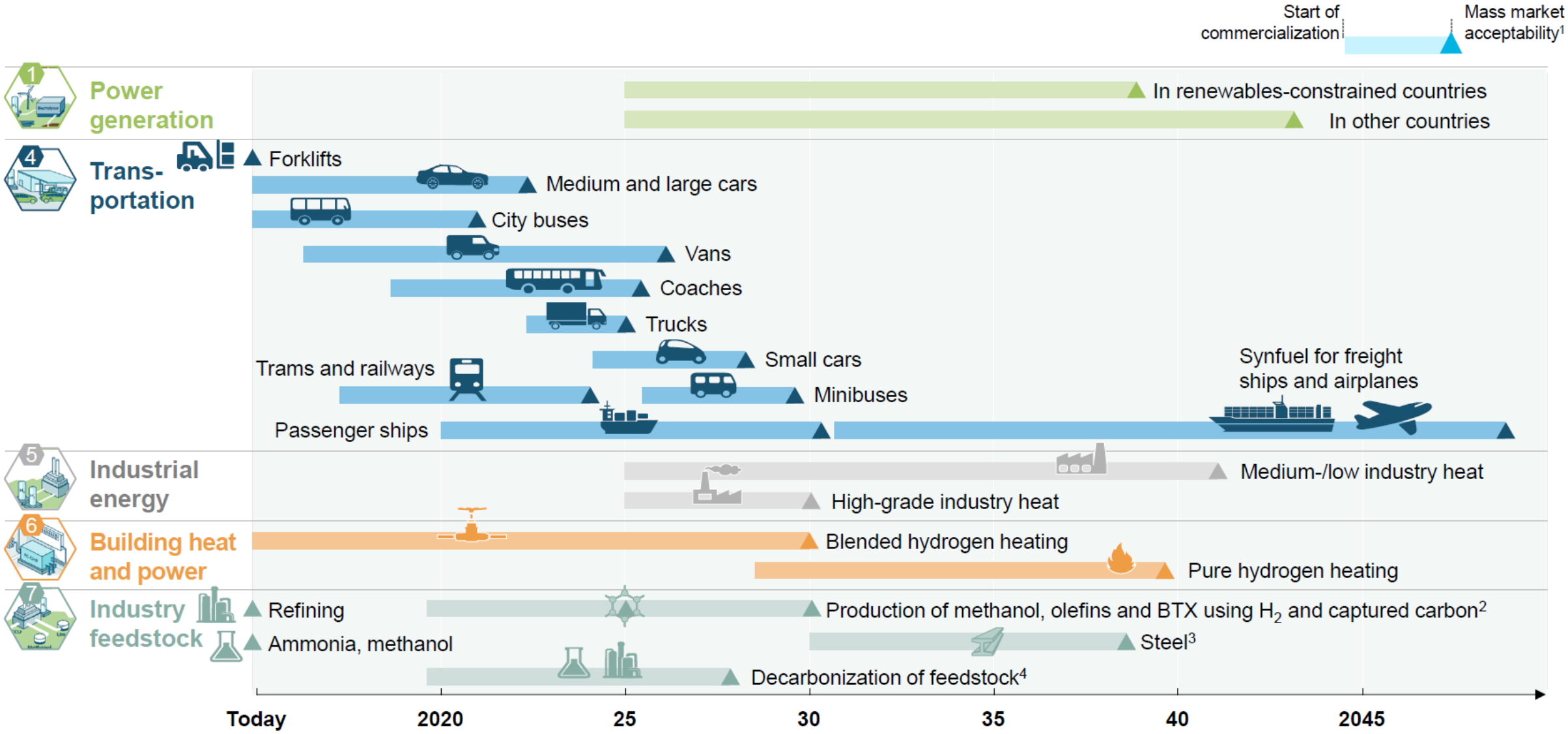
Technology Development Timelines



Source: McKinsey & Company: Survey and Interview with H2 Council

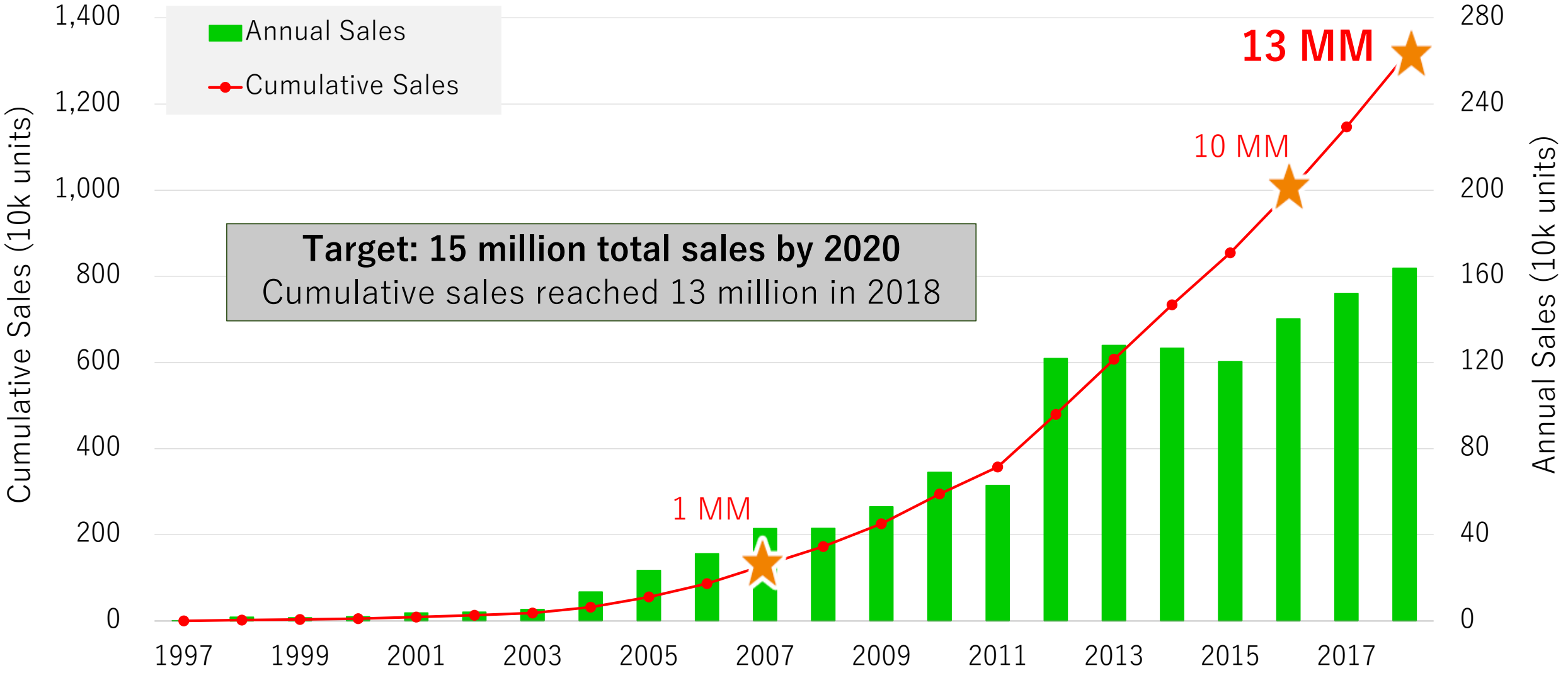
Many FC mobility applications will be developed and commercialized by 2030

Toyota Fuel Cell Development

25+ Years

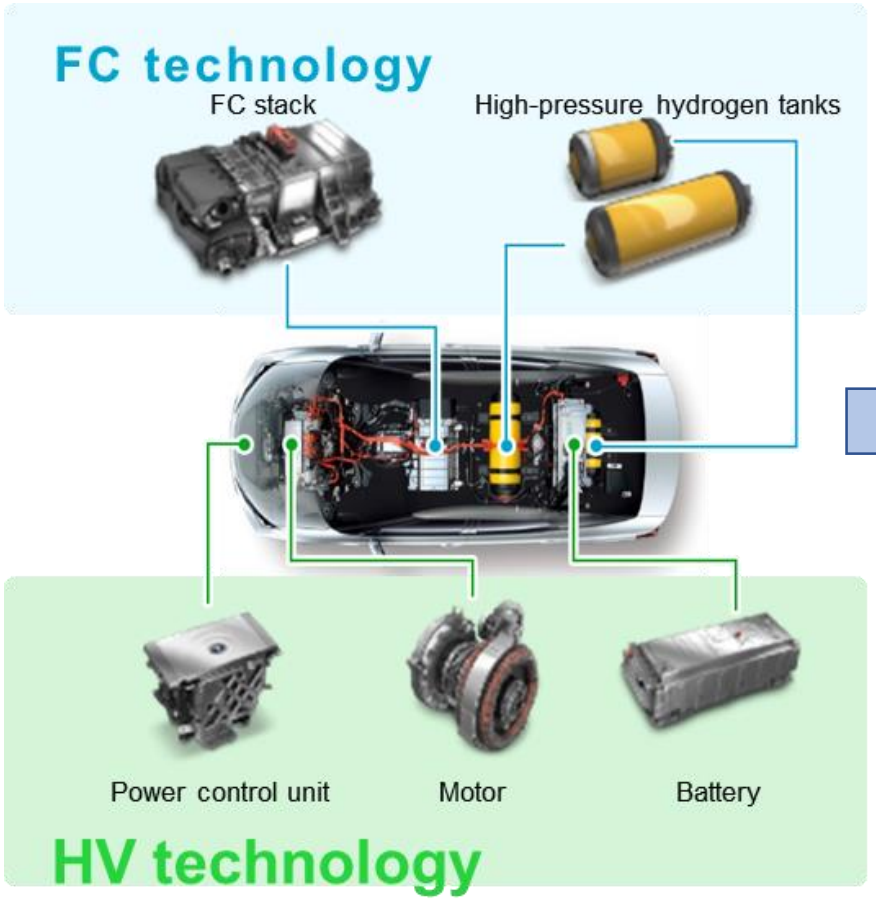
Toyota has 25+ years of FC development for multiple vehicle platforms

Toyota Hybrid Sales for 20+ Years



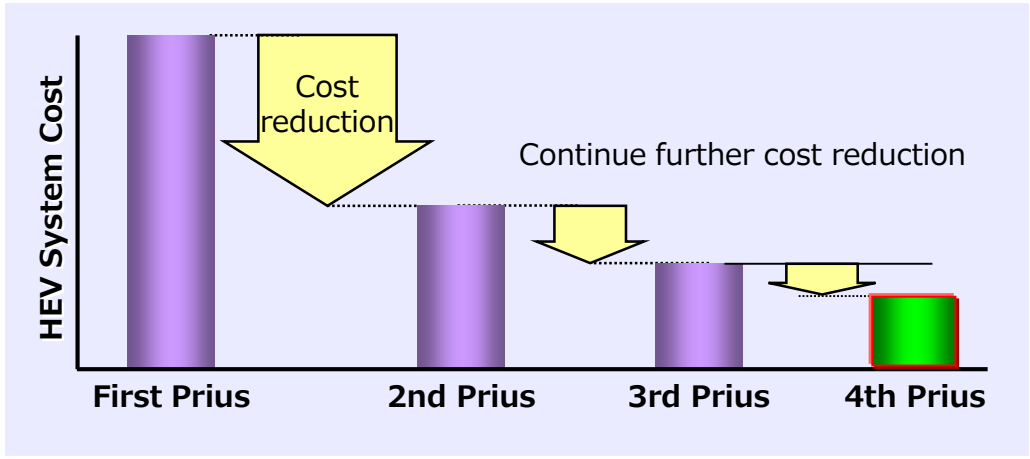
Mass adoption takes time; Mirai following similar methodical scale up as Prius

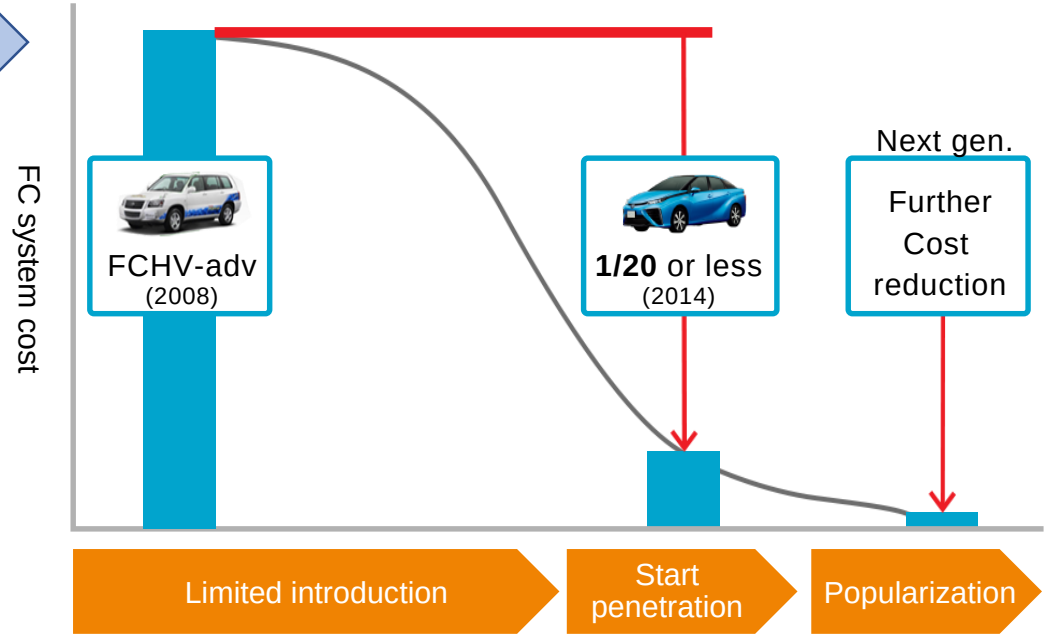
Electrified Powertrain Cost Reduction



Generations of Technology Development and Scale

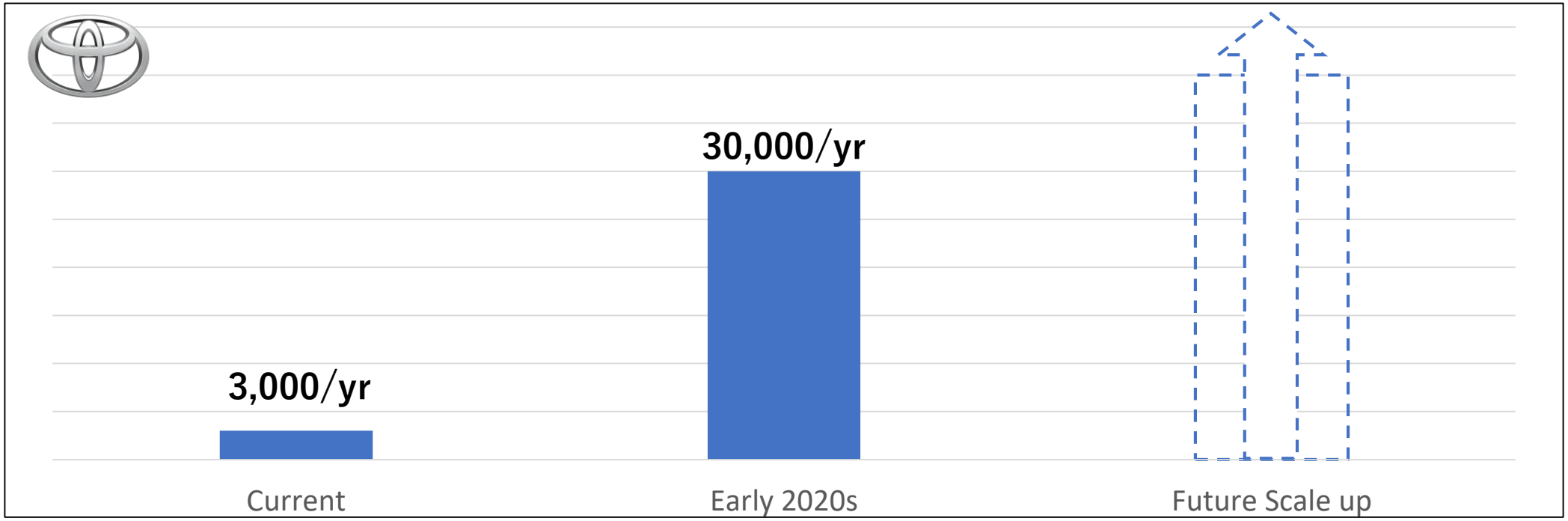
Enables Cost Reduction





Mirai leverages cost reduction from Prius development; further cost reduction expected

Global FC Production Capacity



Hyundai is making similar production ramp up plans

- 40,000 by 2022
- 700,000 by 2030 (500,000 passenger/commercial, 200,000 other applications)
- Intent to leverage FC technology for diverse mobility applications

FC global production capacity greatly increasing in the future as Toyota and other OEMs expand

Other Light-Duty OEMs

Available Today

In Development (or available outside U.S.)

Multiple OEMs have entered the market; others to launch in early 2020s

Global Toyota ZEV Approach

EUROPE
Balanced BEV & FCEV approach

CANADA
Balanced BEV & FCEV approach

JAPAN
Primary: FCEV
Secondary: BEV
*largest market

UNITED STATES
Primary: FCEV
Secondary: BEV
*largest market

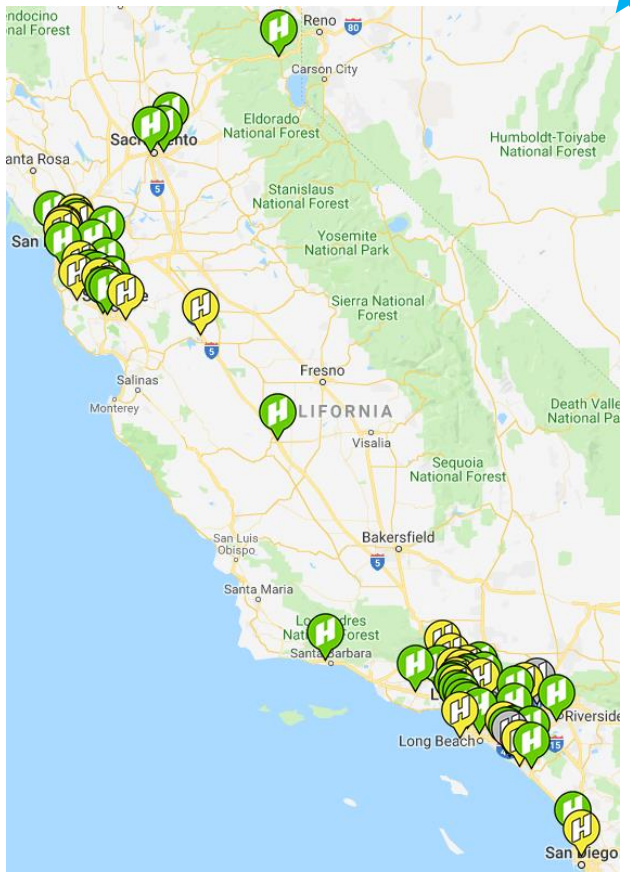
China
Increasing interest in FCEV

TOKYO 2020

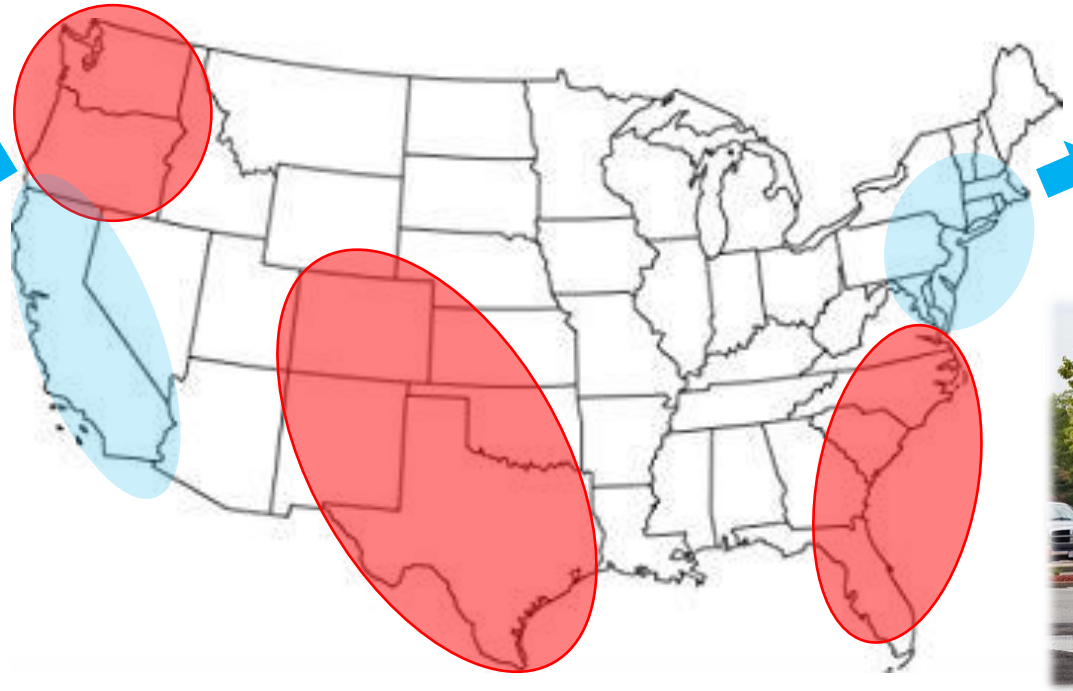
Global FCEV markets continue to expand for many mobility markets

U.S. Market Expansion

California
- 40 Open retail stations
- ~25 additional stations funded
- Over 6,000 FCEVs on the road



Blue: Existing development



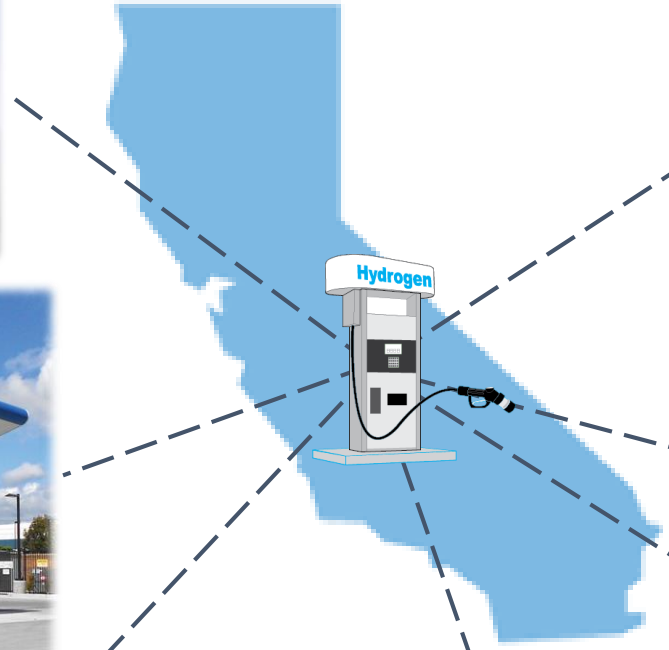
Northeast States
- Infra development underway
- Interest in PORTAL (NY/NJ Ports)

FCEV market expansion continues beyond California

Current CA Station Providers

FEFUEL

Iwatani



StratosFuel

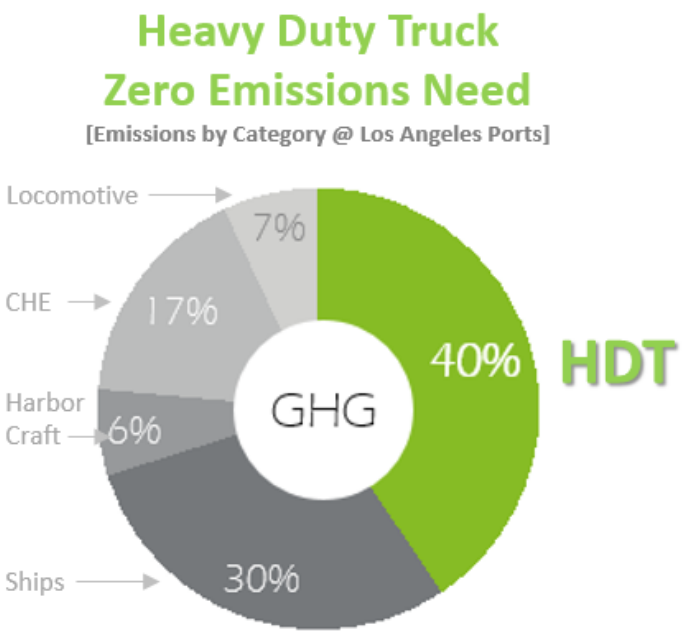
AIR PRODUCTS

Air Liquide

ITM POWER

Toyota provided strong infrastructure development support to multiple station operators

San Pedro Ports Environmental Landscape



Desire to expand while reducing emissions

High impact to disadvantaged communities

Clean Air Action Plan

- 2030: Terminal Trucks ZEV
- 2035: All Trucks ZEV

Requires ZEV solution

CALIFORNIA SUSTAINABLE FREIGHT ACTION PLAN

Ports of LA/LB have established aggressive goals to reduce emissions

Project PORTAL

Blue-chip collaboration leveraging Toyota's FCET development are enabling ZEV freight movement

Key Heavy Duty Projects

ZANZEFF Project

California Environmental Protection Agency AIR RESOURCES BOARD

$41MM Grant

THE PORT OF LOS ANGELES

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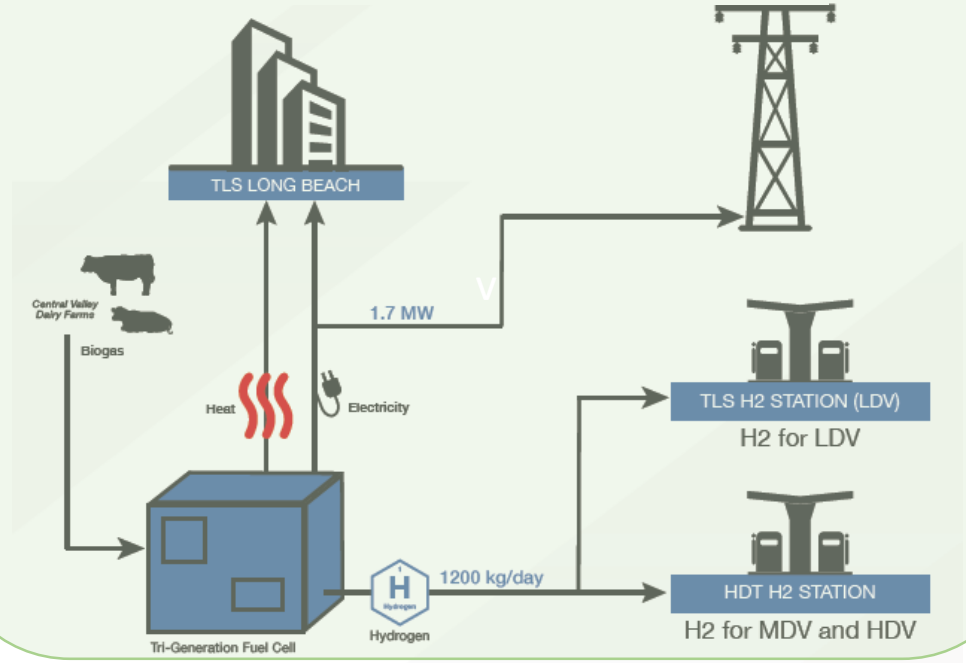
KENWORTH

10 Class 8 FC Trucks
2 H2 stations to support HDTs

Tri-Generation



HD Fueling Development

NIKOLA CORPORATION

Air Liquide

TOYOTA

HYUNDAI

nel

Large demonstration projects support development for trucks, infrastructure, and renewable H2

Light-Duty and Heavy-Duty Synergy

HD Scale → ↑Fuel Demand ↓H2 Cost

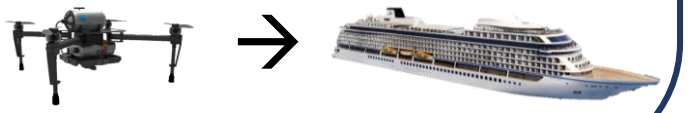
↑FC Volume ↓FC Stack Cost ← LD Scale

↓ ↓

H_2 Society

HD and LD markets grow together synergistically to reduce costs and enable a hydrogen society

Pathway to Scale

	Today		Future Vision
RH2 Supply	Existing SMR 	New, dedicated, large scale RH2 production	100% Renewable 
H2 Distribution	Gaseous tube trailer 	Innovative, reliable, and cost effective distribution	High pressure, LH2, Pipeline, LOHC 
Fueling Infrastructure	Sparse  $$$$	Pathway to affordable and reliable fueling	
Mobile FC Applications		Provide fueling solutions at global scale	

Significant growth, innovation, and scale are needed now to realize the full opportunity of hydrogen


Thank you!
KOBELCO
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H_2Only