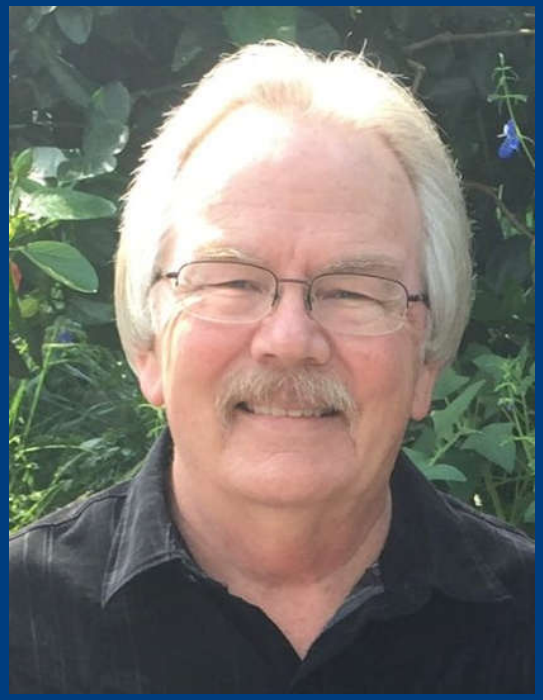

# Chuck Michael, PE

## Regulatory Advisor & US Feasibility Studies Lead

## Hyperloop TT

HYPERLOOP TRANSPORTATION TECHNOLOGIES

HYPERLOOPTT

COLLEGE OF ENGINEERING
THE UNIVERSITY OF TOLEDO

Technology
Takes the Wheel®

OCTOBER 23, 2020

# Hyperloop Transportation Technologies

Technology Takes the Wheel

University of Toledo

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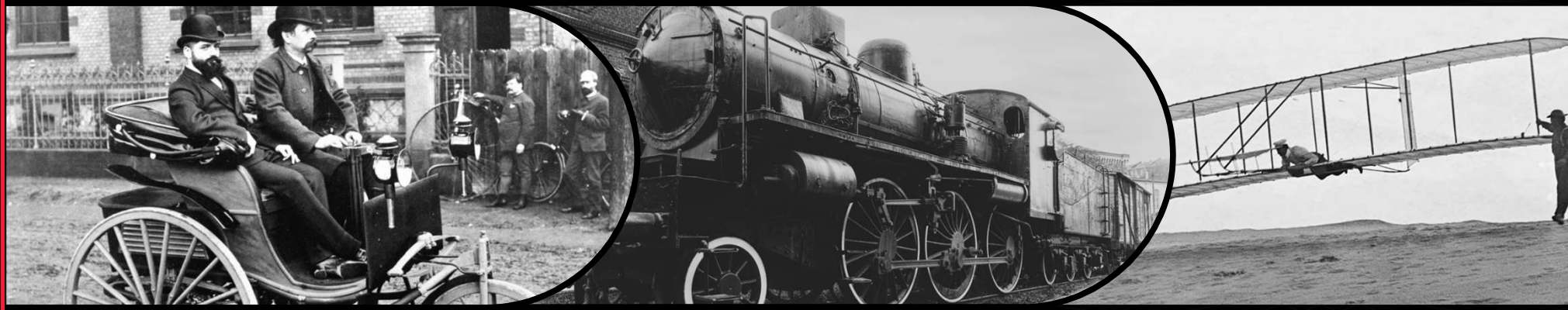
# Transport Evolution.
# Transport Revolution.

**Chuck Michael, P.E.**
Regulatory Advisor & US Feasibility Studies Lead
Hyperloop Transportation Technologies

# What defines
## the next era of human mobility?



1769 1812 1903

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HIGH-SPEED

EFFICIENT

SAFE

SUSTAINABLE

FRICTIONLESS

PROFITABLE

TRANSPORTATION

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# Fully sustainable transportation system

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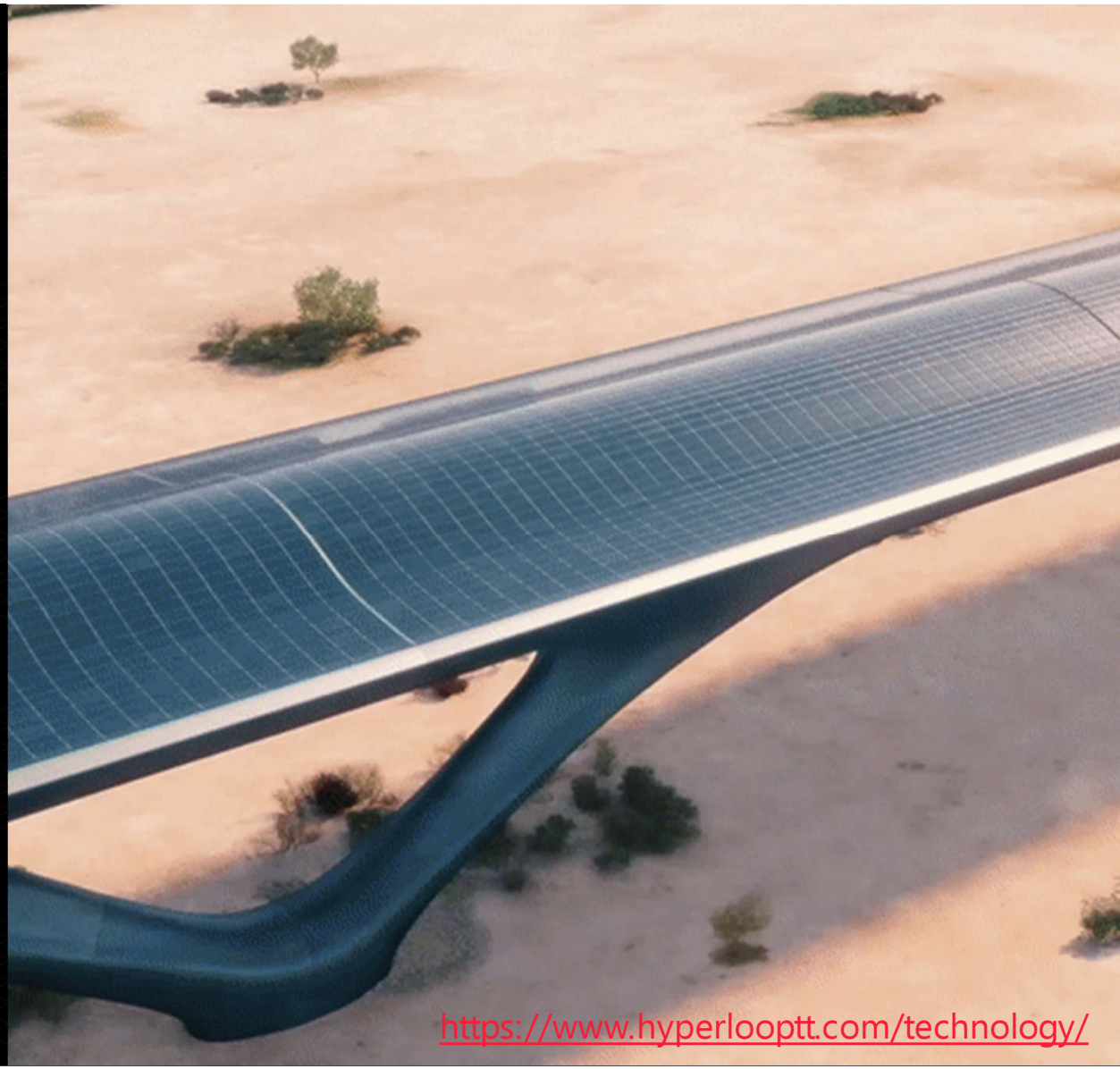
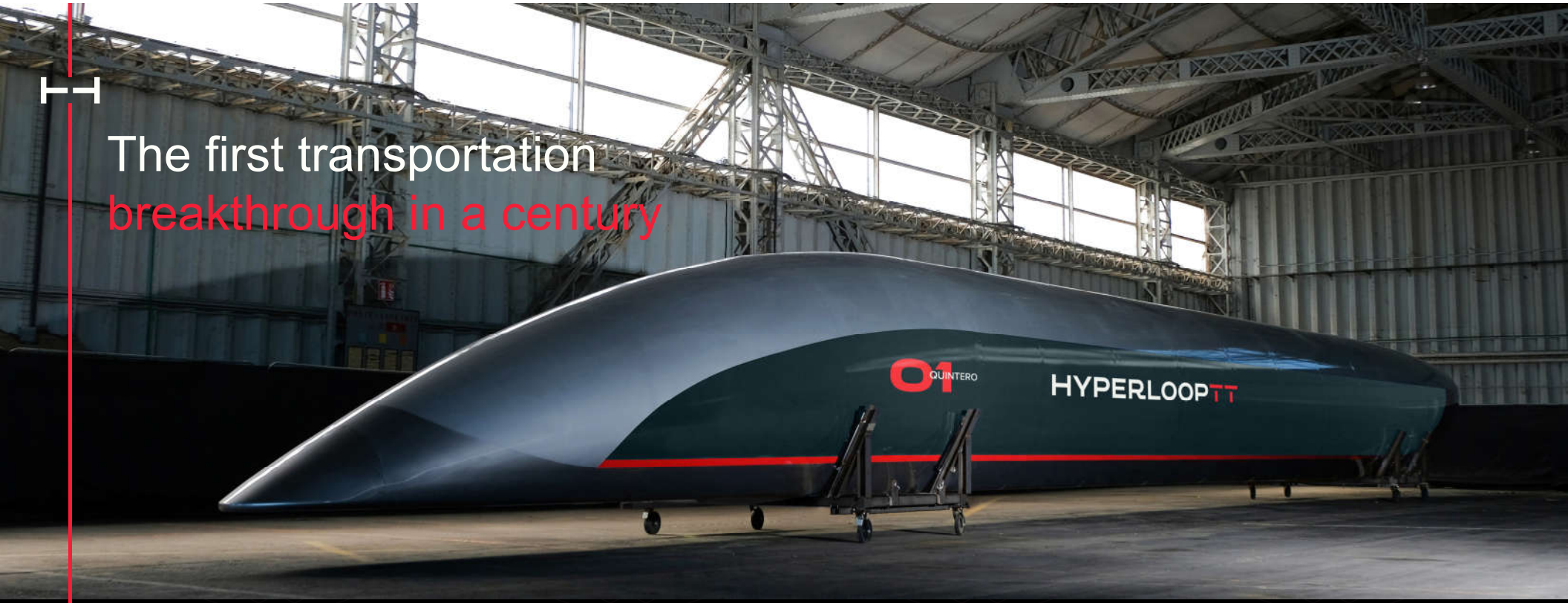


https://www.hyperlooptt.com/technology/

# The first transportation breakthrough in a century




### SUSTAINABILITY

→ Energy efficient

→ Carbon-free operations

### TECHNOLOGY

→ Safe by design

→ High-speed travel

### EXPERIENCE

→ Fully connected

→ Frictionless ecosystem

### ECONOMICS

→ Subsidy free

→ Increased GDP

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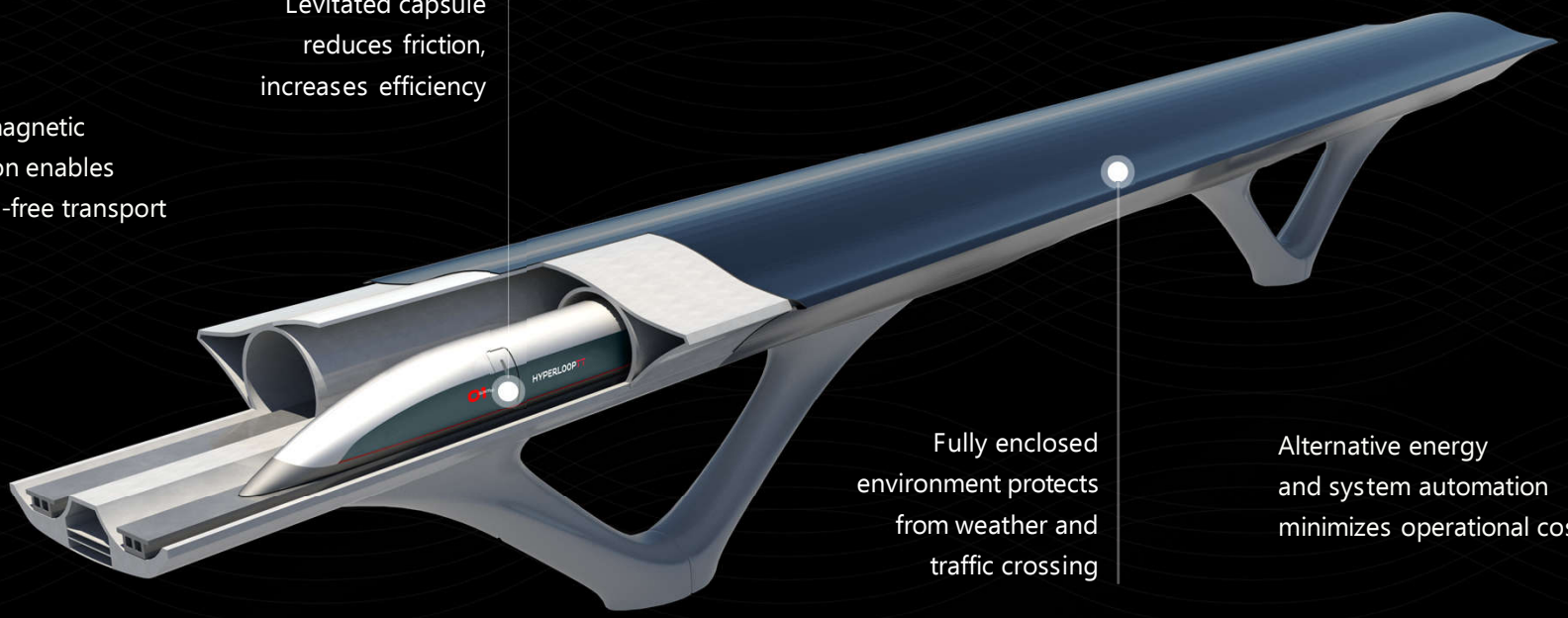
# How it works

Levitated capsule reduces friction, increases efficiency

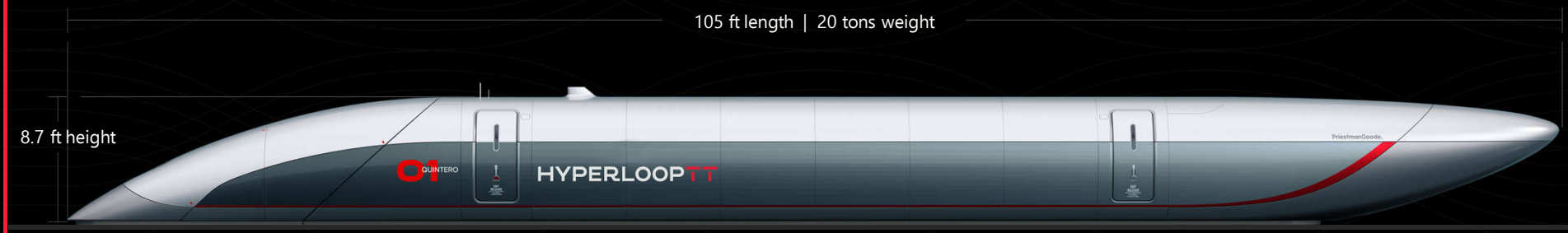
Electromagnetic propulsion enables emission-free transport




Fully enclosed environment protects from weather and traffic crossing

Alternative energy and system automation minimizes operational costs

# Full-scale
# passenger capsule




Passive magnetic levitation

Electromagnetic propulsion

**760** MPH
Maximum speed

**28-50**
Passenger capacity

**160,000** +
Passengers daily

**4,000** +
Cargo loads daily

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# Passive magnetic levitation

ELEVATING TRANSPORT

- Proprietary Inductrack™ passive magnetic levitation
- Capsules levitate over an unpowered, conductive track
- Energy-efficient solution tested and validated on a full-scale passive levitation track

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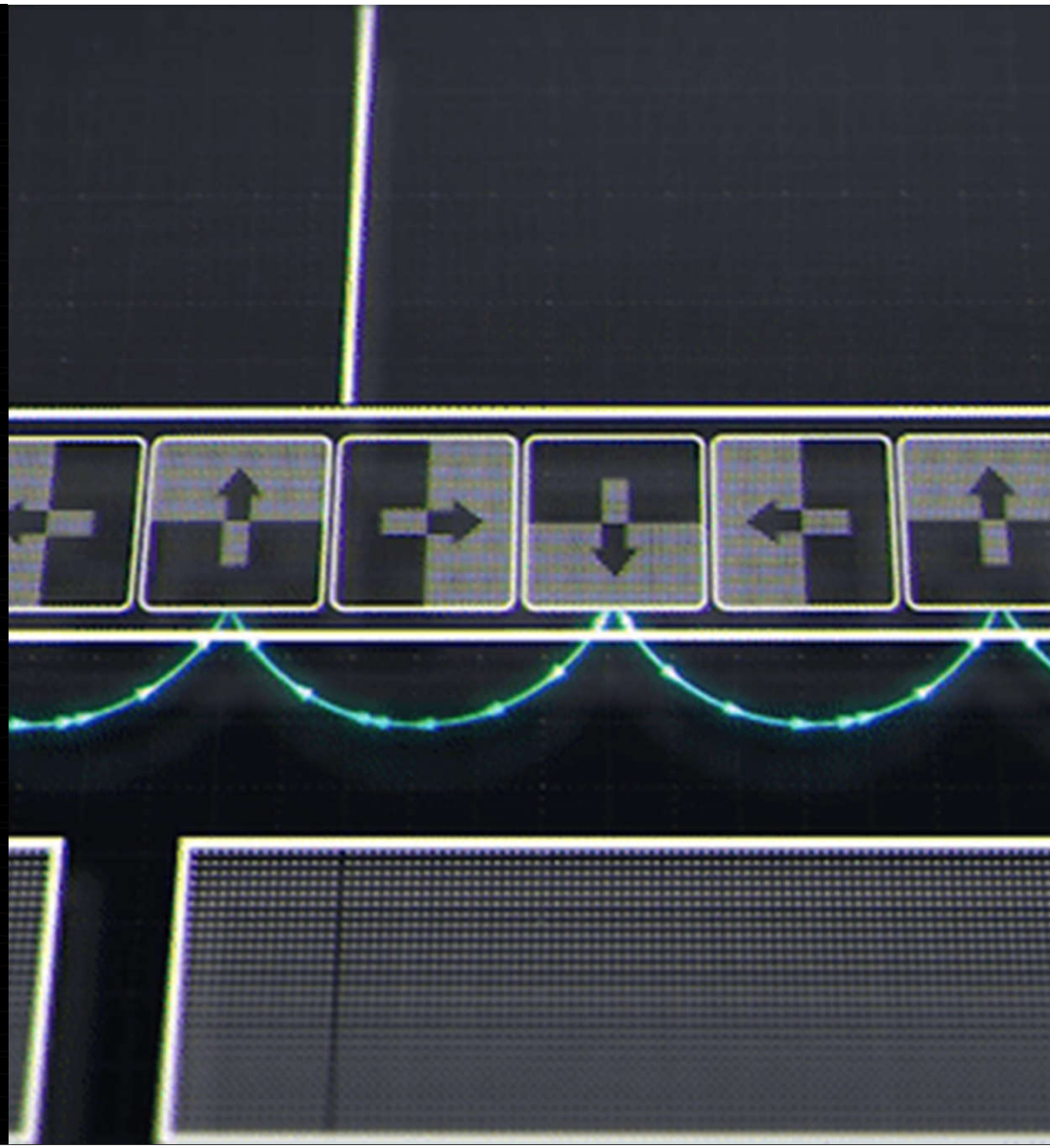
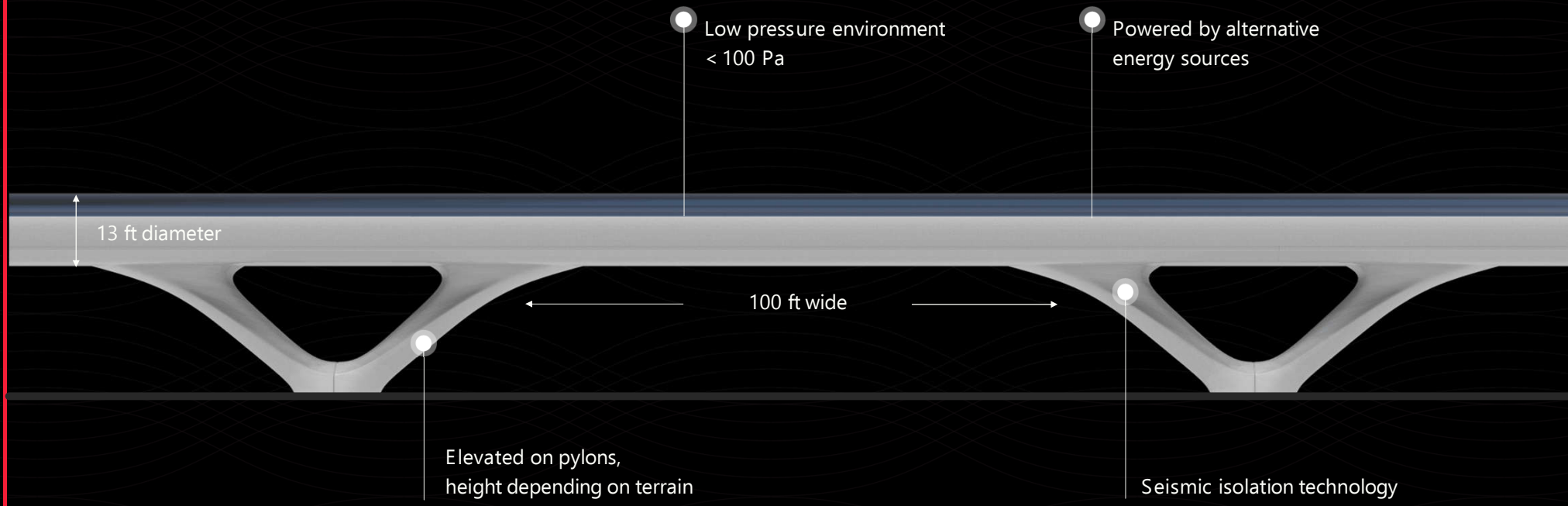


# Elevated system



# Adaptable infrastructure

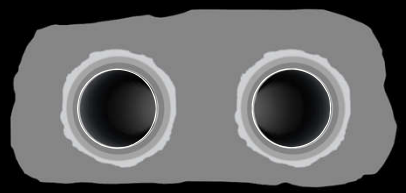
Ground level

Elevated cross section with solar panels

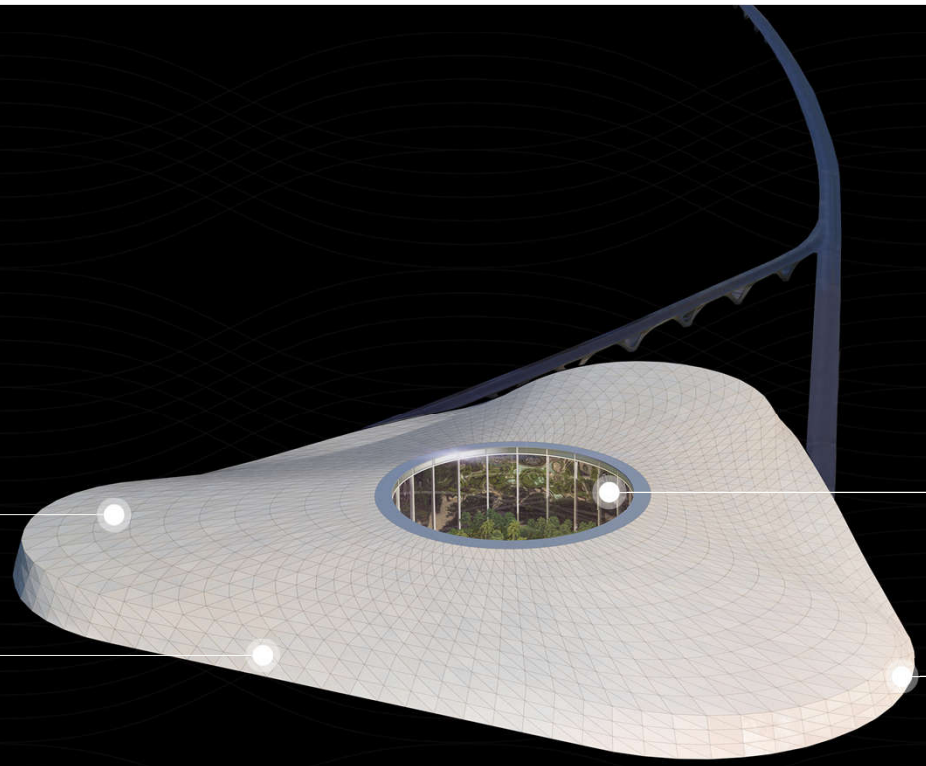
Elevated urban cross section with walkways and solar panels

Cut and cover cross section with 13 ft diameter tubes

Bored tunnel cross section with 16 ft sealed tunnel



# Multi-modal station



Energy net positive

Terminal station

Community & transit hub

On-demand boarding system

**3,600** PAX/H
During peak hours

**40** SEC
Adaptive departure rate

**0.1** G
Acceleration

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# Airplane speed on the ground


| | | |
|---|---|---|
| CLEVELAND → CHICAGO | | 47 min |
| | | 6 h 5 min |
| | | 1 h 8 min |

| | | |
|---|---|---|
| CLEVELAND → PITTSBURGH | | 24 min |
| | | 3 h 11 min |
| | | 3 h 15 min （1 stop） |

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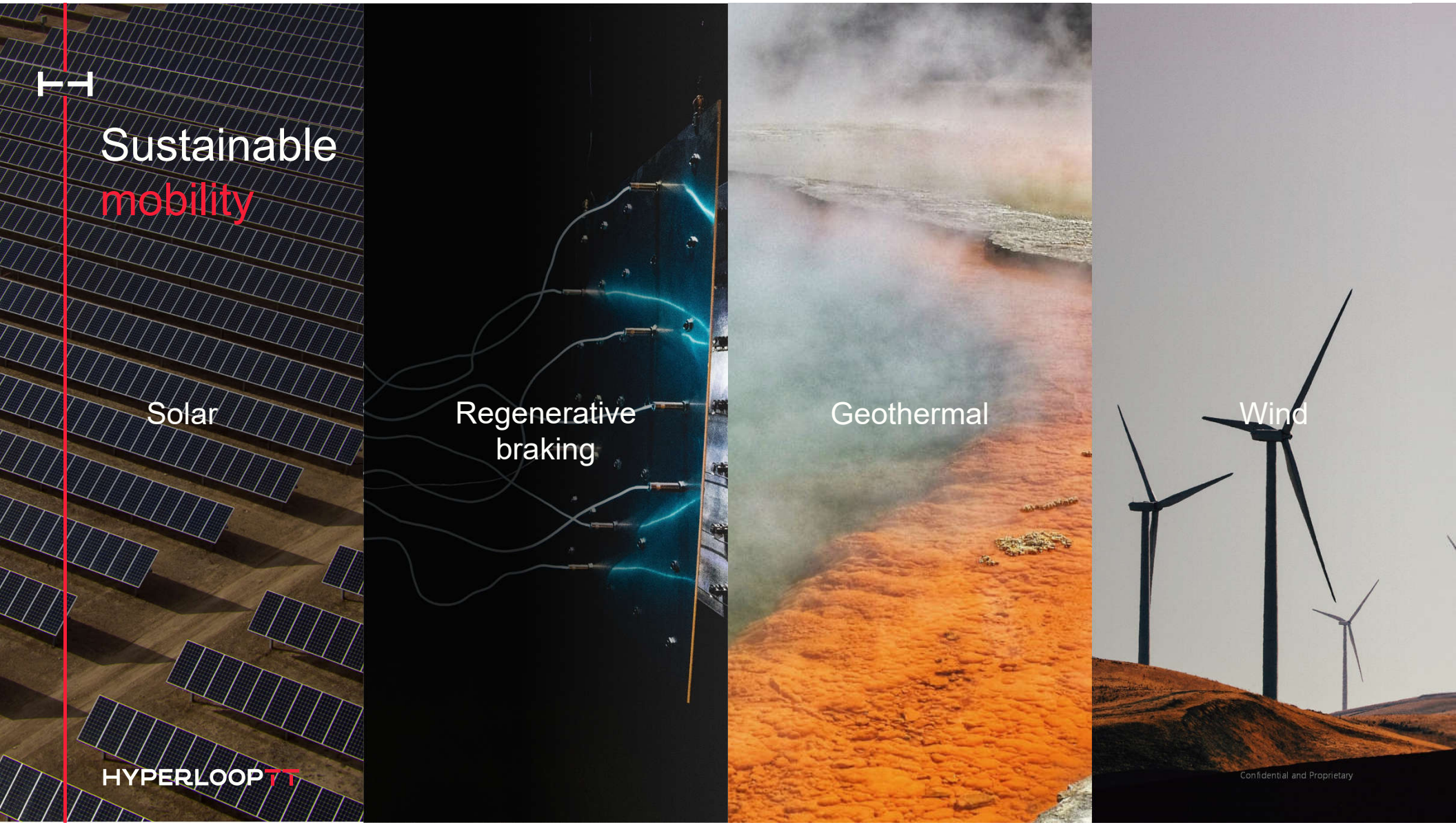
Sustainable
mobility
Solar
Regenerative
braking
Geothermal
Wind
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Confidential and Proprietary

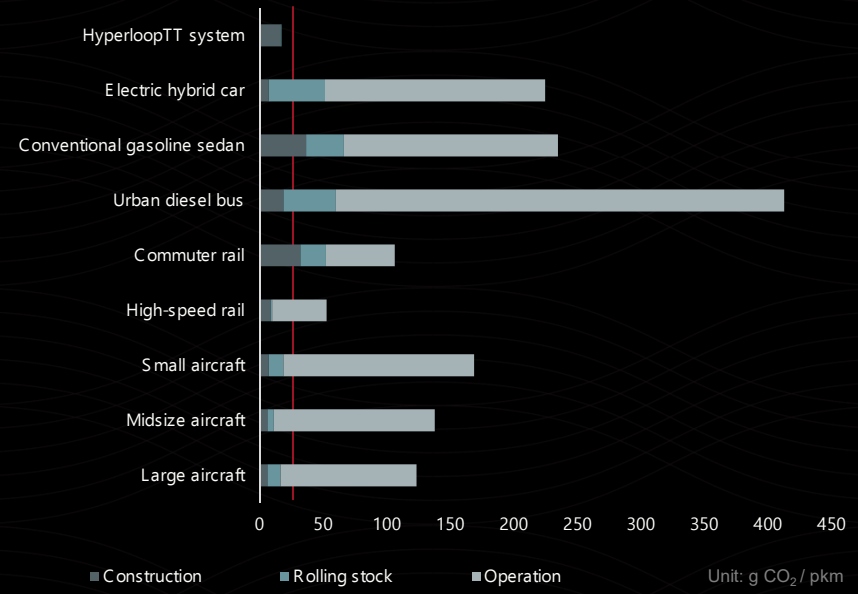
# Low environmental impact
## Net zero carbon operations

The HyperloopTT system is among the lowest emissions transport options available, with under 20 g $CO_2$/pkm[1].

Hyperloop has minimal environmental impact and is net zero operating emissions[2].

Comprehensive factors are being considered from design and manufacturing through construction and operation.

Carbon emission comparison[3] | Multi modes of transport

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[1] HyperloopTT system carbon footprint model based the Great Lakes Hyperloop feasibility study and other high-speed systems globally | [2] Based on operation scope 1 and scope 2 emissions | [3] https://iopscience.iop.org/article/10.1088/1748-9326/7/3/034012 and http://www.transportationlca.org/tlcadb-passenger.php

# Best safety standards and new technologies

First company able to offer an insurable and viable regulatory solution for a commercial system.

01
Enclosed environment

02
Smart sensors in capsules and tubes

03
Immune to weather conditions

04
Passive magnetic levitation

05
No grade crossings with traffic

06
Quiet and clean electric propulsion

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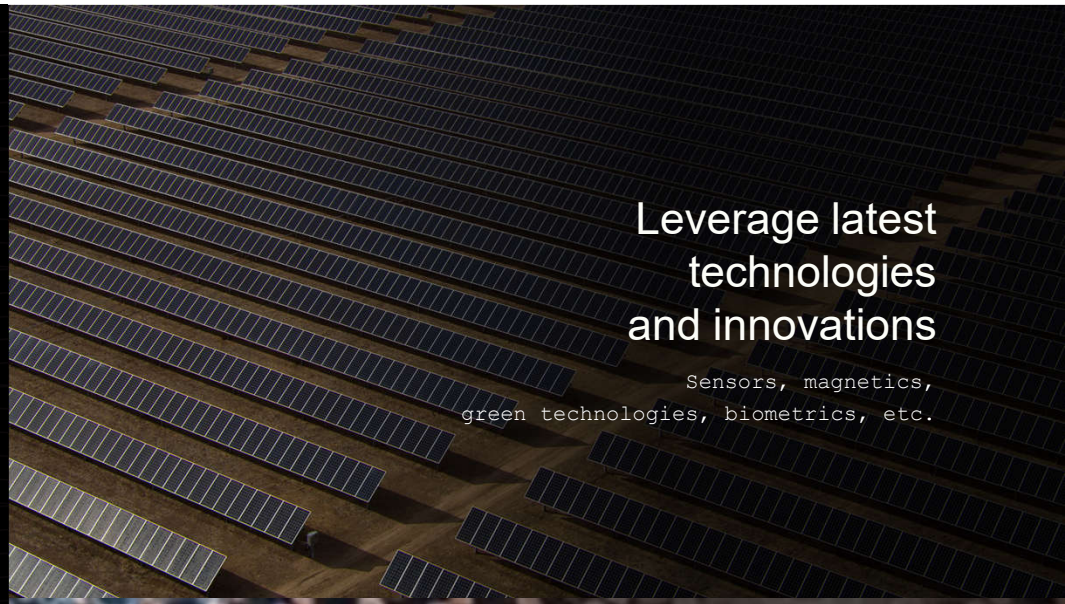
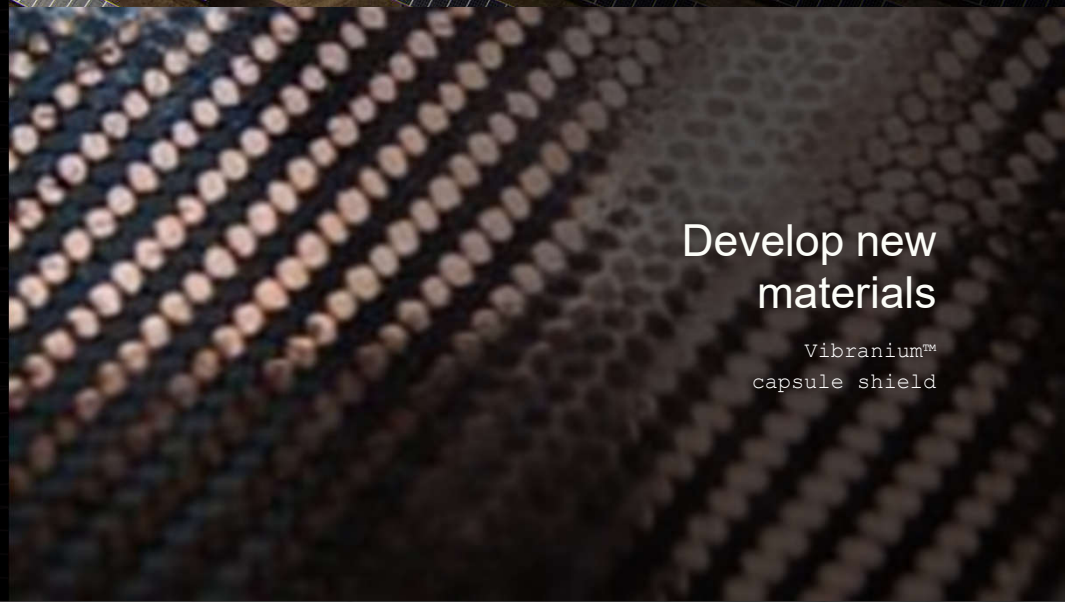


## Leverage latest technologies and innovations

Sensors, magnetics, green technologies, biometrics, etc.



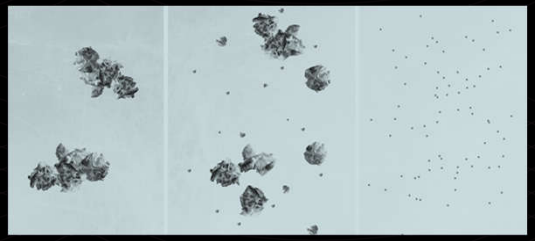
## Develop new materials

Vibranium™ capsule shield

# The journey begins
## with the health of all passengers

Biometric sensors |
Realtime monitoring

Advanced air purification |
Air purifier



Contactless travel |
Automated ticketing & security

Rapid disinfecting cleaning |
UV-C tech

### Minimal passenger to passenger contact

| Mode of transport | Passenger number per unit |
|---|---|
| Personal Vehicle | Up to 7 |
| Hyperloop | 28-50 |
| Bus | 40-80 |
| Train (per vehicle) | 100 |
| Airplane (mid-size) | 150-200 |
| Subway (per vehicle) | >200 |

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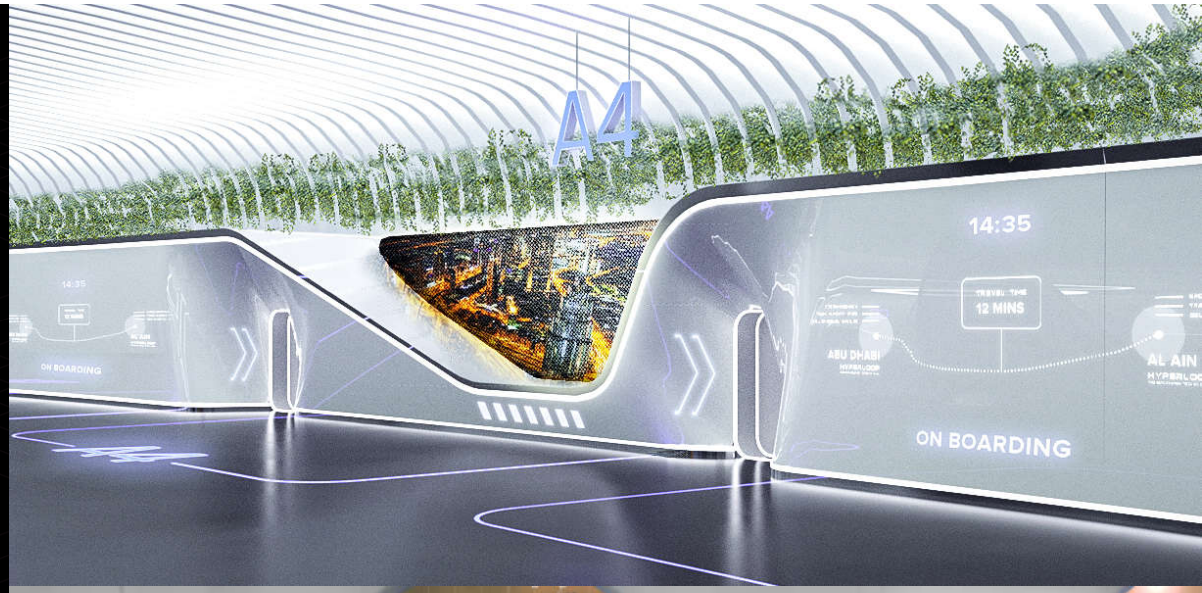
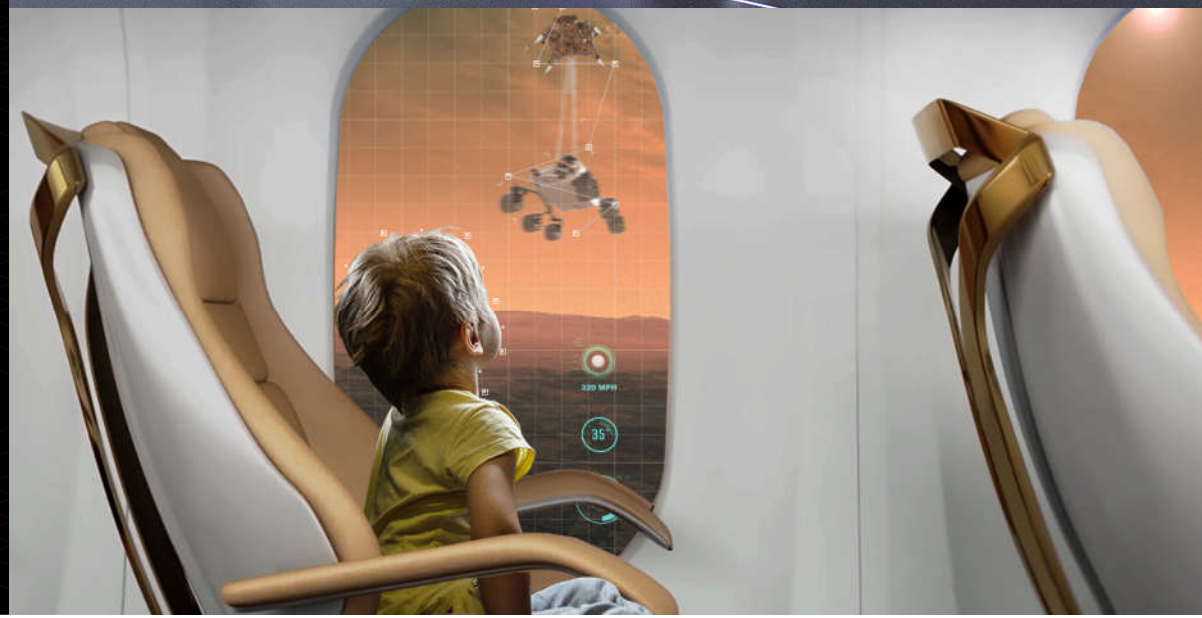
# Reimagined
# passenger experience

- → Human-centric design
- → Immersive environment
- → Access to personalized experiences



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# Profitability from infrastructure, to operation, to economic impact

## Infrastructure

- Low construction cost
- Low operational cost
- Low maintenance cost

## Income

- Dynamic ticket pricing
- On-demand mobility
- High throughput

## Socio-economics

- Positive benefit-cost ratio
- Competitive ROI
- Zero operating subsidies *

* Based on the Great Lakes Hyperloop Feasibility Study

# Development projects


## R&D Center

Toulouse, France

→ Testing & certification
→ Ongoing integration and optimization
→ Co-developed certification guidelines

## Commercial Prototype

Abu Dhabi, UAE

→ Located close to Expo and airport
→ Concept design completed
→ 3-5 km passenger hyperloop

## Cargo Prototype

Port of Hamburg, Germany

→ Joint Venture with HHLA
→ Integrating with port automation
→ Sustainable plug-and-play solution

# Passenger-ready timeline


320 m full-scale infrastructure

320 m full-scale integration

3-5 km commercial prototype

Commercial line

2019 — 2020 — 2021 — 2024

TESTING → IMPLEMENTATION → PASSENGER READY

CERTIFICATION

Continued testing for incremental technology development and certification with strategic partners

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# Industry advancements


Insurance framework


Certification guidelines


Government guidance

# HyperloopTT snapshot

- Full-scale system & passenger capsule
- Insurance & regulatory framework
- Proprietary passive magnetic levitation
- 10+ global agreements
- 800+ experts & 50+ partners
- 45+ patents
  60+ trademarks
- Scalable organizational model
- Asset-light licensing business model
- Commercial readiness

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# The future
# is now boarding

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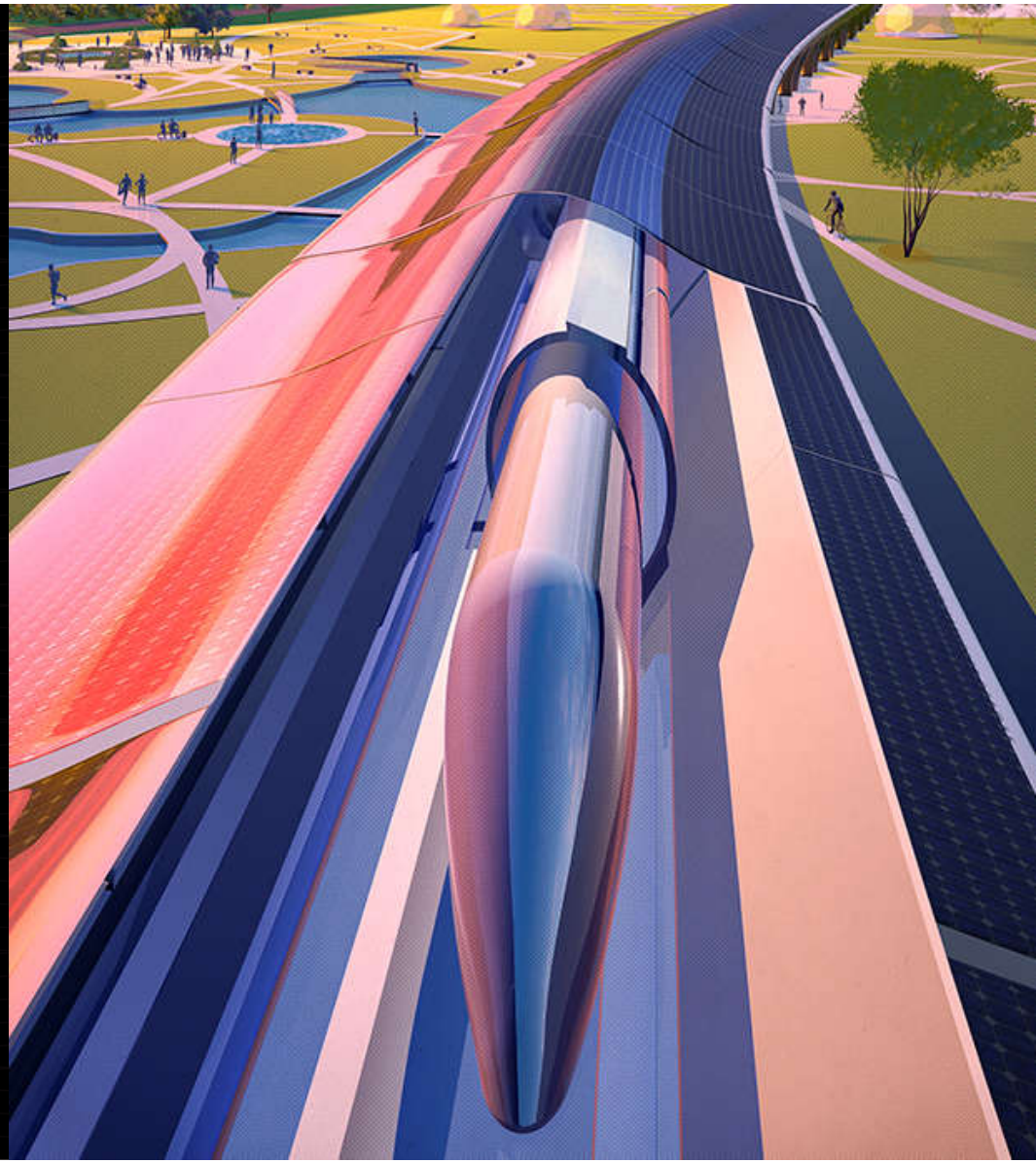

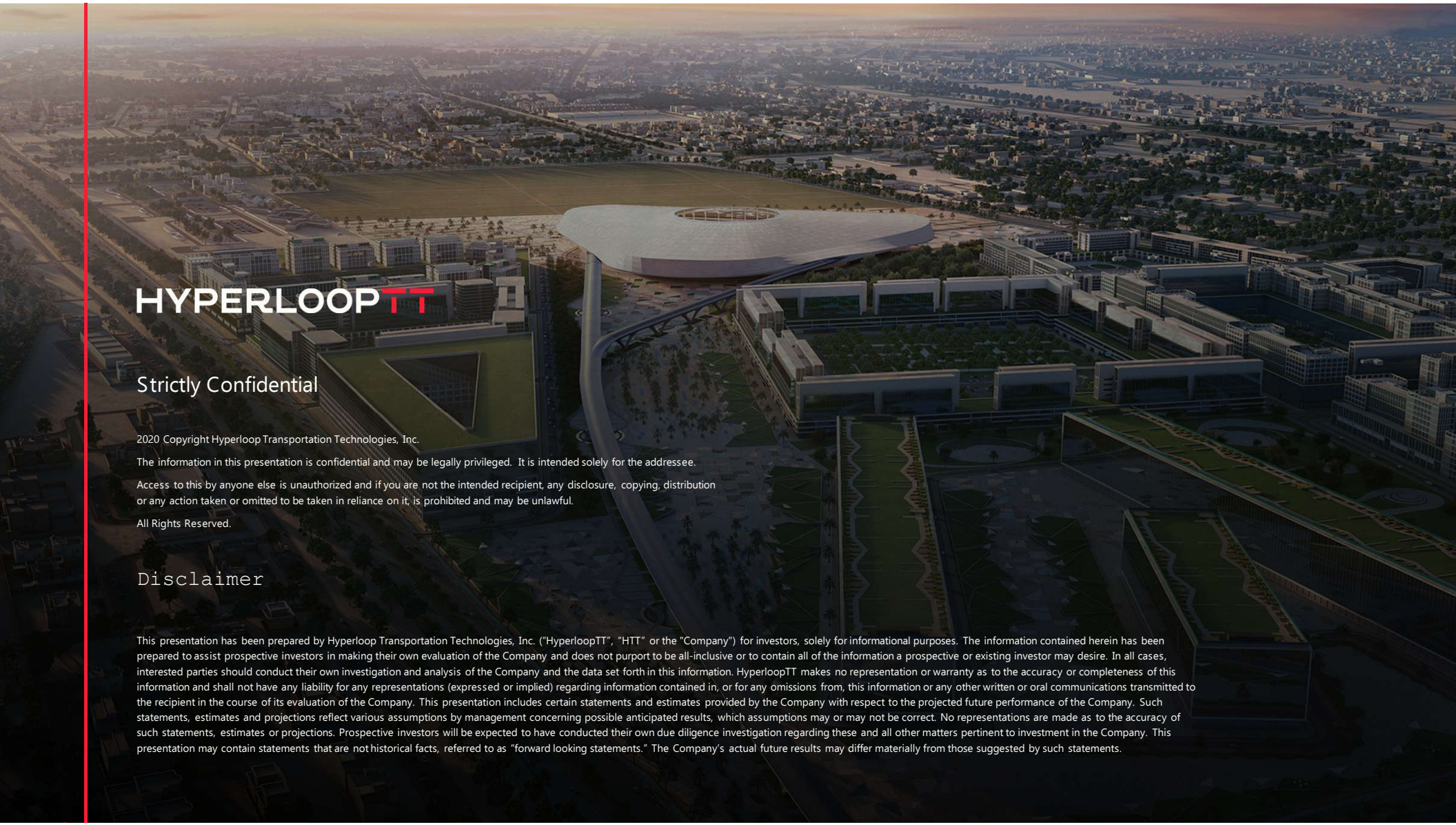

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