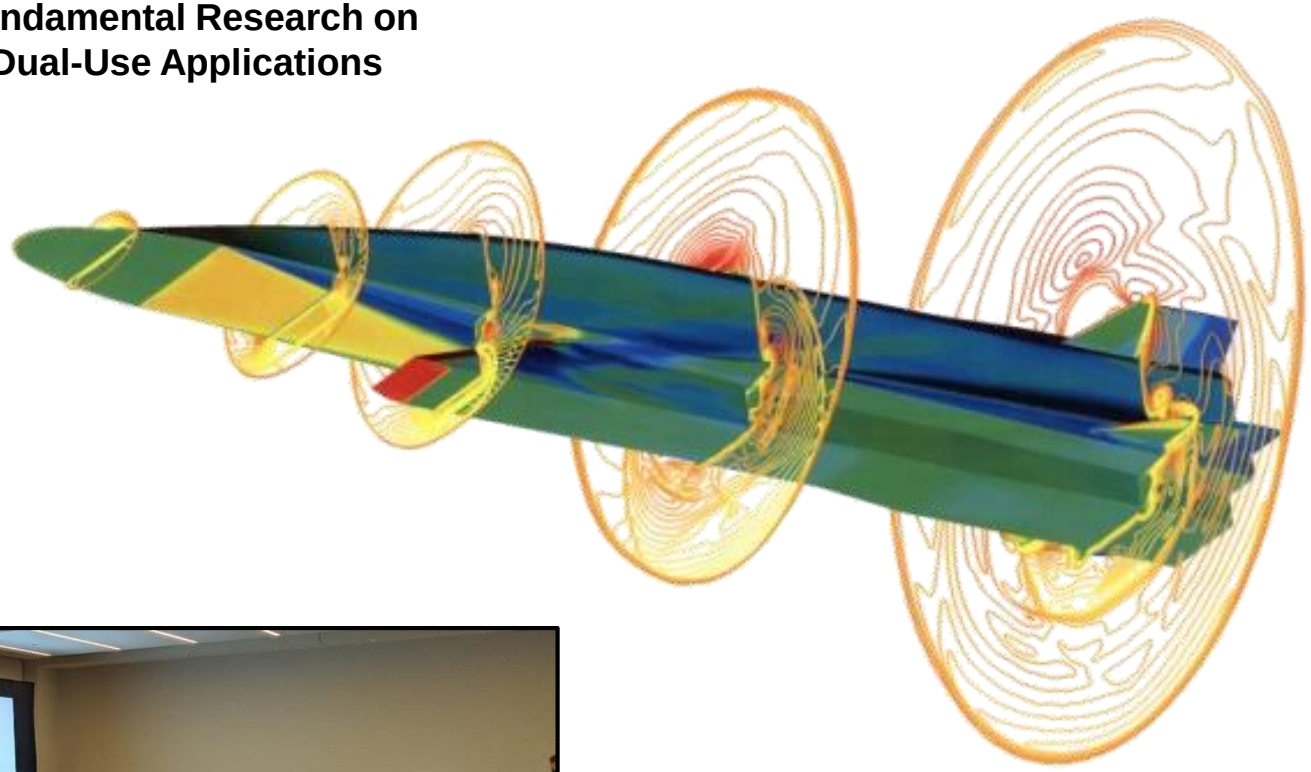
NASA Hypersonics Overview

Jimmy Kenyon
Director, Advanced Air Vehicles Program

December 2020

Hypersonic Technology Project

Fundamental Research on Dual-Use Applications



Industry Engagement on Future Commercial Hypersonic Vision

Strong DoD Partnership

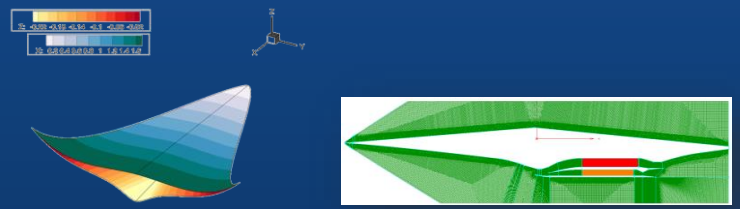
HTP Portfolio Aligned with Mission

Systems Level Design, Analysis, and Validation

Uncertainty Quantification Method Development & Validation

Integrated Design & Analysis Environment Enhancements

Multi-Cycle Propulsion Design and Analysis

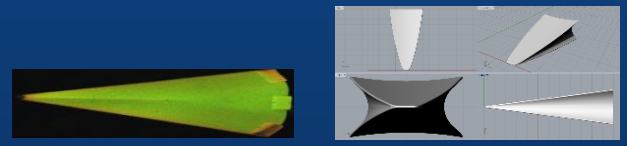


Vehicle Technologies

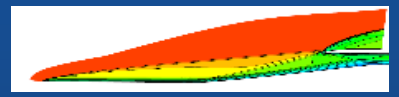
Next Generation Phosphor Thermography

Boundary Layer Transition

Shock Interactions



hypersonic technology project



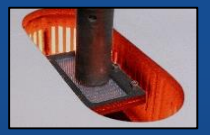
Propulsion Technologies

Integrated Turbine-Based Combined Cycle Propulsion System

Enhanced Fuel Injection and Mixing Concept

VULCAN Code Enhancements for Hypersonic Propulsion Analysis

Advanced Sensors for Adaptive Controls & Health Monitoring



High Temperature, Durable Materials

Ceramic Matrix Composite Heat Exchanger

High Temperature Seals & Preload Devices

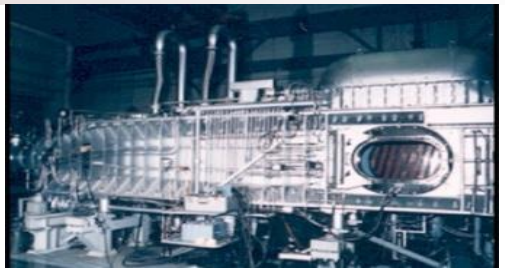
Carbon/Carbon Hot Structures

Additive Manufacturing for Hypersonic Engines

High Temperature Fiber Optic Sensors

Facilities in Use for Hypersonic Testing

- LaRC 8’ HTT
- LaRC LaL
- LaRC UPWT
- LaRC Direct Connect Scramjet
- LaRC Arc-Heated Scramjet
- GRC 10x10
- GRC PSL
- GRC Seals Test Rigs
- AFRC Flight Loads Lab



LaRC Aerothermodynamics Laboratory
Exploration Workhorse

LaRC 8’ High Temperature Tunnel
Large-scale Hypersonics & Propulsion

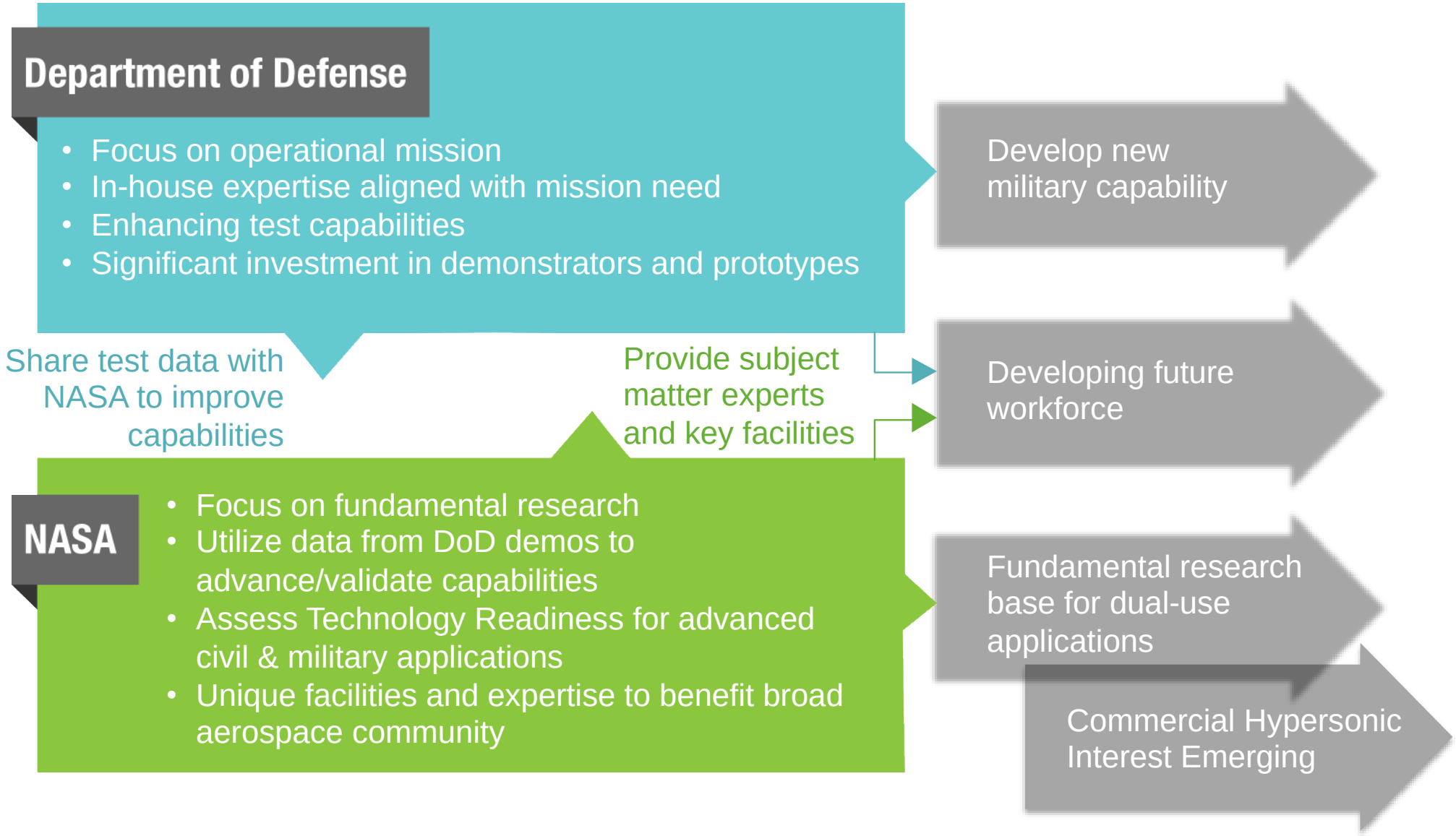
LaRC Unitary Plan Wind Tunnel
Supersonic Speed Range

GRC 10’x10’ Supersonic Wind Tunnel
Large-scale Supersonics & Propulsion

GRC Propulsion Systems Laboratory
Engine (and Icing) Simulation at Altitude

High demand for NASA high-speed test facilities

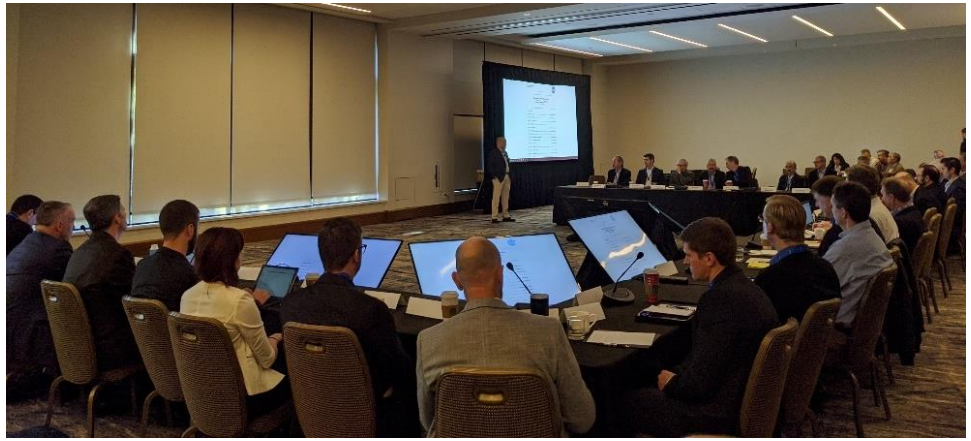
NASA/DoD Partnership for Hypersonics



Hypersonic Strategy Assessment

Enabling routine, reusable, airbreathing hypersonic flight

- Industry announcements reveal interest in commercial applications
- Workshop held to understand interest and identify needs
  - Independent market study
  - Regulatory and data protection concerns
  - Hypersonic ground and flight test capability
  - Technology development
- Assessing strategy in light of growing industry interest

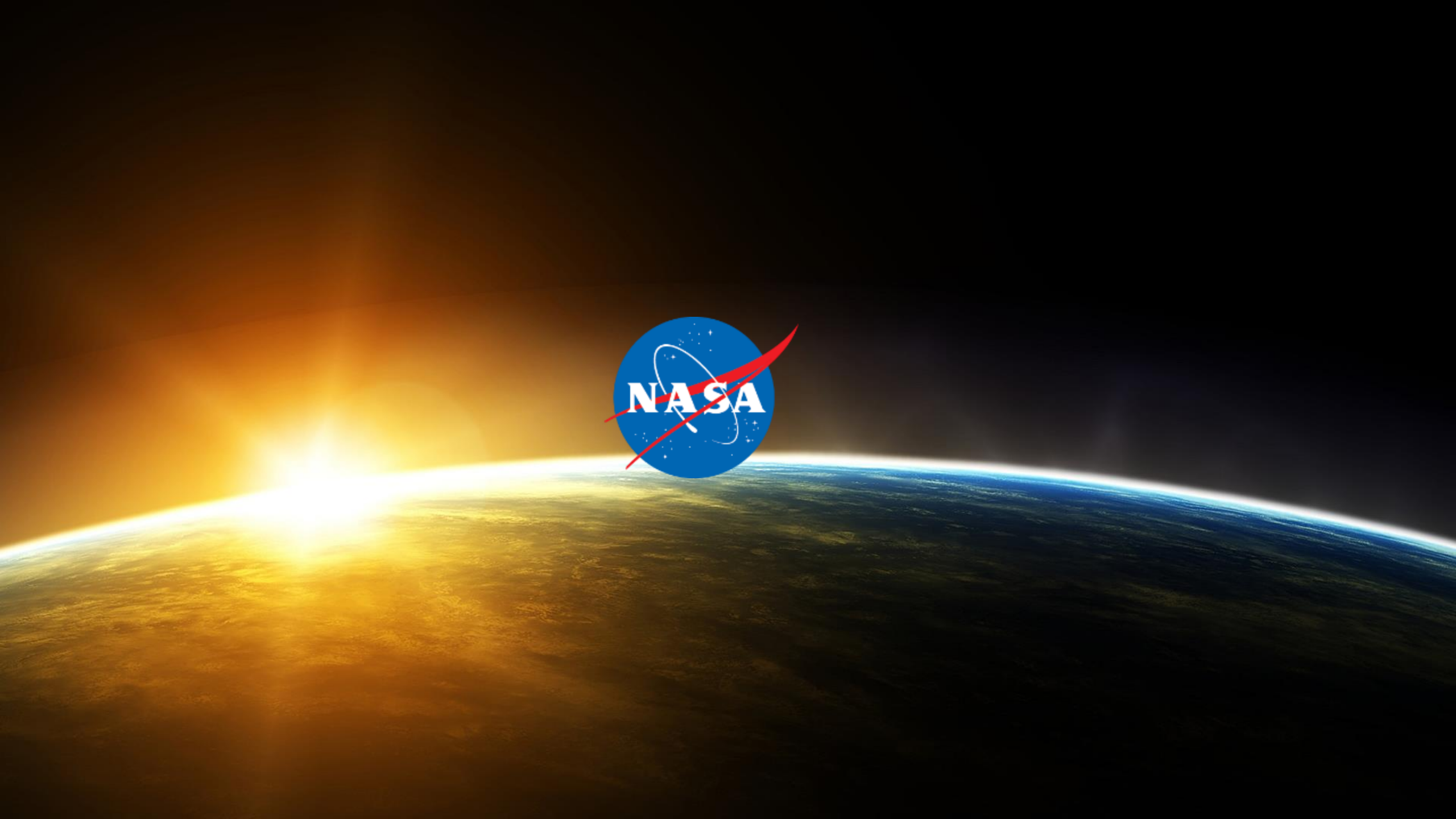


Emerging industry vision for potential future commercial hypersonic market

Year of Due Diligence

- Conducting multiple studies to provide insight on key questions
  - Market viability
  - Technology needs
- Engaging industry partners on aircraft concepts
  - Industry leverages NASA tools
  - NASA gets insight into industry concepts
  - Multiple SAAs in place or in work
- Insights will help inform NASA hypersonic strategy

OBJECTIVES:	STUDIES:				
	Independent Market Assessment	Internal Market Assessment	External Design Study	Gov't Baseline Vehicle	High-Mach TRJ Study
Is there a Business Case that makes developing a vehicle economically viable?					
Is there a Market for a fleet of these vehicles?					
What are the Enabling Technologies?					
What are the predicted performance requirements?					
What does the design space look like multiple vehicle designs?					


NASA