Attachment A - ARMD's Strategic R&D Thrusts

ARMD's global trends analysis led to the identification of the following three overarching drivers, referred to as Mega-Drivers, which will in large part shape the needs of aeronautical research in the coming years:

- Mega-Driver 1: Global Growth in Demand for High Speed Mobility, reflects rapid growth in traditional measures of global demand for mobility.
- Mega-Driver 2: Global Climate Change, Sustainability, and Energy Use, presents severe challenges in maintaining affordability and sustainability.
- Mega-Driver 3: Technology Convergence, points to revolutions in automation, information, and communication technologies, which will combine to transform aeronautical capabilities.

ARMD identified 6 Strategic Thrusts in response to these 3 Mega-Drivers:

- Strategic Thrust 1: Safe, Efficient Growth in Global Operations
- Strategic Thrust 2: Innovation in Commercial Supersonic Aircraft
- **Strategic Thrust 3: Ultra-Efficient Commercial Vehicles**
    - Large leaps in aircraft efficiency, coupled with reductions in noise and harmful emissions, are critical to the aviation community's roadmap for greatly-improved environmental sustainability. ARMD will develop critical technologies to enable future generations of subsonic fixed wing and vertical lift commercial aircraft that demonstrate the needed improvements in environmental impacts
        - **Research Theme 1: Advanced Ultra-Efficient Airframes**: Research and development of tools and technologies to enable new airframe configurations with *high levels of aerodynamic performance, lower structural weight, and innovative approaches to noise reduction*
        - **Research Theme 2: Advanced Ultra-Efficient Propulsion**: Research and development of tools and technologies to *reduce turbofan thrust specific fuel consumption, propulsion noise, and emissions*
        - **Research Theme 3: Advanced Airframe-Engine Integration**: Research and development of innovative approaches and the supporting tools and technologies *to reduce perceived noise and aircraft fuel burn through integrated airframe-engine concepts*
- Strategic Thrust 4: Transition to Low-Carbon Propulsion
- Strategic Thrust 5:Real-Time System-Wide Safety Assurance
- Strategic Thrust 6:Assured Autonomy for Aviation Transformation

Attachment B - NASA's Subsonic Transport Goals

v2013.1

TECHNOLOGY BENEFITS*	TECHNOLOGY GENERATIONS (Technology Readiness Level = 4-6)		
	N+1 (2015)	N+2 (2020**)	N+3 (2025)
Noise (cum margin rel. to Stage 4)	-32 dB	-42 dB	-52 dB
LTO NOx Emissions (rel. to CAEP 6)	-60%	-75%	-80%
Cruise NOx Emissions (rel. to 2005 best in class)	-55%	-70%	-80%
Aircraft Fuel/Energy Consumption‡ (rel. to 2005 best in class)	-33%	-50%	-60%

* Projected benefits once technologies are matured and implemented by industry. Benefits vary by vehicle size and mission. N+1 and N+3 values are referenced to a 737-800 with CFM56-7B engines, N+2 values are referenced to a 777-200 with GE90 engines

** ERA's time-phased approach includes advancing "long-pole" technologies to TRL 6 by 2015

‡ CO2 emission benefits dependent on life-cycle CO2e per MJ for fuel and/or energy source used

Thrust 3 – Ultra-Efficient Commercial Vehicles Summary Description - XYZ Demonstration

Ultra Efficient Airframes	Ultra Efficient Propulsion	Airframe Engine Integration

- **Needs**:
- **Goals/Objectives**:

- **Deliverables**:
- **Impact to Outcome**:
- **Benefit to Community**:

Technical Approach

Partnerships, Workforce & Facilities

- **Partners:**
- **Workforce**:
- **Facilities**:

Attachment C

Resource Summary - Demonstration XYZ
*Provide Non-binding ROM only

Milestones

FY15	FY16	FY17	FY18	FY19
	PDR Complete	CDR Complete	Fab & Integration Complete	Flight/Ground Test Complete

Resources	FY15	FY16	FY17	FY18	FY19	Total
Total Resources Required (Gov't + Partner)						
Proposed Cost Share						

Assumptions and Notes:

A.
B.
C.
D.
Etc.