Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*					R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	207.768	232.547	197.546	-	197.546	173.232	179.038	181.468	183.558	Continuing	Continuing
623012: *Advanced Propulsion Technology*	-	20.009	23.637	22.304	-	22.304	21.383	23.359	26.020	26.522	Continuing	Continuing
623048: *Combustion and Mechanical Systems*	-	19.717	15.874	13.235	-	13.235	12.491	12.527	12.645	12.886	Continuing	Continuing
623066: *Turbine Engine Technology*	-	70.515	102.188	77.444	-	77.444	52.595	55.965	52.887	52.433	Continuing	Continuing
623145: *Aerospace Power Technology*	-	32.066	30.061	26.587	-	26.587	28.717	29.453	28.127	28.679	Continuing	Continuing
624847: *Rocket Propulsion Technology*	-	59.331	55.293	52.651	-	52.651	52.904	52.570	56.535	57.680	Continuing	Continuing
625330: *Aerospace Fuel Technology*	-	6.130	5.494	5.325	-	5.325	5.142	5.164	5.254	5.358	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has six projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology project develops high-speed air breathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Combustion and Mechanical Systems project evaluates lubricants and combustion concepts and technologies for new and existing engines. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems and develops component technologies for ultra high pressure ratio, substantially improved durability, and adaptive cycle engine architecture to provide optimized performance, fuel efficiency, and life for widely varying mission needs. The Aerospace Power Technology project develops electrical power and thermal management technologies for military applications that are part of energy optimized aircraft development. The Rocket Propulsion Technology project develops advances in rocket propulsion technologies for space access, space maneuver, missiles, the sustainment of strategic systems, and tactical rockets. The Aerospace Fuel Technology project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation, and combined-cycle engines. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Air Force					DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*			R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	207.406	232.547	200.918	-	200.918
Current President's Budget	207.768	232.547	197.546	-	197.546
Total Adjustments	0.362	0.000	-3.372	-	-3.372
• Congressional General Reductions	-	0.000			
• Congressional Directed Reductions	-	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	-	0.000			
• Congressional Directed Transfers	-	0.000			
• Reprogrammings	4.000	0.000			
• SBIR/STTR Transfer	-3.638	0.000			
• Other Adjustments	0.000	0.000	-3.372	-	-3.372

Change Summary Explanation

Decrease in FY14 is due to higher DoD priorities.

Received reprogramming from PE 0601103F University Research Initiative for Adaptive Versatile Engine Technology (ADVENT) effort.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623012: *Advanced Propulsion Technology*	-	20.009	23.637	22.304	-	22.304	21.383	23.359	26.020	26.522	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle air breathing high-speed (up to Mach 4) and hypersonic (Mach 5 to 7) propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft concepts. The primary focus is on hydrocarbon-fueled engines capable of operating over a broad range of flight Mach numbers. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Demonstrate Low Mach Scramjet Technologies	1.650	1.650	0.000
Description: Develop advanced fuel-cooled scramjet engine technologies to support flight demonstration and enable the broad application of hypersonics to meet future warfighter needs. ***FY 2012 Accomplishments:*** Developed and demonstrated advanced engine control systems and flight weight scramjet engine components. Developed and demonstrated closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conducted flight test using sounding rocket launch and successfully demonstrated transition from ramjet to scramjet. ***FY 2013 Plans:*** Complete development and demonstration of advanced engine control systems and flight weight scramjet engine components. Build upon prior ground and flight test data and experience to refine and demonstrate closed loop engine control system with advanced instrumentation to increase scramjet engine operability at low scramjet Mach numbers. Conduct direct connect testing of flight weight scramjet components for cold start systems. ***FY 2014 Plans:*** Advance scramjet engine controls and cold start demonstration development transferred to PE 0603216F Aerospace Propulsion, project 635098 Advanced Aerospace Propulsion.			
Title: Integrated Propulsion Technologies	0.165	0.120	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: Conduct assessments, technology design trades, and simulations to integrate combined cycle engines (CCEs) and air breathing hypersonic propulsion technologies into future systems. ***FY 2012 Accomplishments:*** Conducted trade studies to determine military payoff and establish component technology goals. ***FY 2013 Plans:*** Improve definition of component and engine performance objectives to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. Conduct development roadmapping. ***FY 2014 Plans:*** Effort transitioned to PE 0602203F, Thrust 3, Hypersonic Scramjet Technologies, where component technologies will be integrated into scramjet engine subsystems for hypersonic systems.			
Title: Hypersonic Scramjet Technologies ***Description:*** Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future platforms. ***FY 2012 Accomplishments:*** Developed advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Developed techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Developed low internal drag flame stabilization devices and flight test engine components. Completed preliminary designs of heavy weight scramjet combustor in medium scale (ten times) scramjet engines. ***FY 2013 Plans:*** Continue to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continue to develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Continue to develop low internal drag flame stabilization devices and flight test engine components. Complete critical designs and initiate fabrication of scramjet combustors in medium scale (ten times) scramjet engines. Prepare for direct connect testing of medium scale (ten times) scramjet engines operating at Mach 3.5 to Mach 7 conditions. ***FY 2014 Plans:*** Continue to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continue to develop techniques to decrease scramjet takeover from Mach 4.5 to Mach 3.5 to provide	18.194	21.867	22.304

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623012: *Advanced Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
robust options for CCEs. Continue to develop low drag flame stabilization devices and flight test components. Initiate direct testing of medium scale (ten times) scramjet engines operating at Mach 3.5 to Mach 7 conditions.			
Accomplishments/Planned Programs Subtotals	20.009	23.637	22.304

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623048: *Combustion and Mechanical Systems*	-	19.717	15.874	13.235	-	13.235	12.491	12.527	12.645	12.886	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project evaluates lubricants, mechanical systems, and combustion concepts for advanced turbine engines, pulse detonation engines, and combined cycle engines. This project also develops technologies to increase turbine engine operational reliability, durability, mission flexibility, maintainability, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, and sustained high-speed vehicles. Analytical and experimental areas of emphasis include lubricants, bearings, mechanical systems diagnostics, mechanical systems prognostics, rotor dynamics, oil-less engine technology, optical diagnostics, fundamental combustion, detonations, combustors, and afterburners. Lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, durable, and reduce pollutant emissions. A portion of this project supports adaptive cycle technologies. This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Combustion Technologies	8.367	6.202	5.133
Description: Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulse detonation, and combined cycle engines for missiles, manned and unmanned systems.			
FY 2012 Accomplishments: Evaluated alternative fuels in combustion systems at relevant engine conditions. Tested full-scale compact combustor concept relevant to highly efficient, embedded turbine engine goals. Demonstrated small-scale propulsion system operation using reduced-octane fuels. Employed new physical models in simulation tools. Investigate pressure gain combustion concepts for application to propulsion systems. Continued studies of pulse detonation engine-turbine interactions. Investigated feasibility of rotary detonation engines (RDE) and continuous detonation engines.			
FY 2013 Plans: Develop new models for combustion processes at high pressure conditions. Test combustion system designs that produce low pollutant emissions. Test RDE concepts coupled with conventional turbomachinery. Evaluate alternative fuels and their impact on engine performance and durability. Test novel compact combustion systems at relevant operating conditions.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Implement new technologies to operate small-scale propulsion systems with reduced octane fuels. Continue to develop new RDE concepts.			
Title: Diagnostic Technologies ***Description:*** Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies. ***FY 2012 Accomplishments:*** Applied line-of-sight measurement techniques for temperature and species to combustion systems in a relevant engine environment. Demonstrated simultaneous high-speed planar laser-induced fluorescence and particle-image velocimetry for measurements of species and velocity fields in practical combustion devices. Demonstrated tomographic reconstruction of reacting flowfields in relevant combustion systems. ***FY 2013 Plans:*** Apply advanced laser diagnostics and novel optics configurations to high pressure test cell environment. Demonstrate particle image velocimetry in high pressure combustion test apparatus. Investigate high-speed measurement techniques for combustion temperature and species. ***FY 2014 Plans:*** Develop high-speed laser systems to measure combustion species, temperature, and velocity. Apply new diagnostics to combustion systems at relevant engine conditions. Refine fiber optic methods for high-power laser diagnostics use.	1.311	1.128	0.974
Title: Lubricant Technologies ***Description:*** Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants. ***FY 2012 Accomplishments:*** Demonstrated surface modifiers on full-scale lubrication system components to prevent formation of solid deposits that can cause clogging. Developed engine mechanical system health management control algorithms for active rotor thrust balancing. Developed suite of technologies for intelligent lube system prognostics and health monitoring, such as integrated debris capture devices, real-time oil debris monitoring, and vibration sensing. Developed lubrication system thermal management technologies for reduced heat generation and improved heat dissipation for efficient turbine engines. ***FY 2013 Plans:***	4.966	4.181	3.490

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Demonstrate lube system health management control algorithms with full-scale technology readiness level 5 test rig hardware. Test enhanced ester oils in demonstrator turbine engines. Continue investigating advanced lube system thermal management technologies for fuel efficient turbine engines. Develop new oil traction models and validate experimentally. ***FY 2014 Plans:*** Finalize transition plans of enhanced ester oil to current and future engines. Qualify additional enhanced ester oil candidates for field use. Demonstrate advanced mechanical system health monitoring algorithms on full-scale demonstrator engine. Continue investigating advanced lube system thermal management technologies for fuel efficient engines. Incorporate new traction models into bearing heat generation models.			
Title: Bearing Technologies ***Description:*** Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications. ***FY 2012 Accomplishments:*** Conducted shakedown tests of active thrust balance rig. Developed and demonstrated robust thrust load sensing devices for highly loaded engine thrust bearings. Developed bearing spall debris monitoring model and limits and incorporated into thrust load control algorithm. Demonstrated oil debris monitoring technology fused with vibration sensing on seeded fault bearing rig tests. Developed new bearing heat generation models for engines and validated with full-scale bearing experimental performance data. ***FY 2013 Plans:*** Conduct parametric active thrust control experiments to validate load control algorithms. Conduct seeded fault bearing tests to validate reliable active and autonomous thrust load control. Integrate active thrust control, vibration, and oil debris sensing for complete TRL 5 mechanical system health management system. Coordinate plans for demonstrating active thrust control system in future TRL 6 engine demonstration. ***FY 2014 Plans:*** Conduct full-scale bearing tests in support of adaptive turbine engines. Conduct foil bearing rig tests in support of expendable supersonic turbine engine follow-on development. Develop improved bearing material life model. Mature autonomous active thrust bearing system. Finalize transition plans of hybrid ceramic/metallic bearings into upgrades of current aircraft.	5.073	4.363	3.638
Accomplishments/Planned Programs Subtotals	19.717	15.874	13.235

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623048: *Combustion and Mechanical Systems*

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623066: *Turbine Engine Technology*	-	70.515	102.188	77.444	-	77.444	52.595	55.965	52.887	52.433	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, adaptive cycle technologies, and structural design. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs. This project supports joint Department of Defense, agency, and industry efforts to focus turbine propulsion technology on national needs. The program plan is relevant across capability areas for global responsive strike, tactical and global mobility, responsive space lift, and persistent intelligence, surveillance, and reconnaissance (ISR).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Turbofan/Turbojet Engine Core Technologies	41.133	40.578	35.125
Description: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.			
FY 2012 Accomplishments: Developed modeling and simulation rules and tools for advanced components including advanced interactive cost analysis tools for adaptive core components and unsteady aerodynamics/aeromechanics models. Conducted bench and rig tests to validate unsteady aerodynamics/aeromechanics models. Continued rig testing adaptive cycle features, an efficient compressor, an efficient turbine, and an efficient exhaust system. Developed and applied advanced modeling and simulation rules and tools to initiate definition and design of efficient, very high pressure ratio core component technologies.			
FY 2013 Plans: Continue to develop modeling and simulation tools for advanced components including coupled aerothermal models and turbine durability design. Continue to conduct bench and rig test using surface mapping thin film temperature gauges. Develop high resolution non-contact stress measurement systems for high frequency response measurement. Demonstrate engine efficiency			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
improvements from active clearance and flow control. Conduct rig testing of high-power low-emission combustion. Develop improved compressor aerodynamic design tools to extend engine operability and efficiency. ***FY 2014 Plans:*** Continue developing modeling and simulation tools for advanced components including coupled aerothermal models; highly loaded, low emissions combustion systems; and turbine durability designs. Perform structural assessment research of combustor and turbine components operating in a realistic engine environment. Continue to develop improved compressor aerodynamic design tools to extend engine operability and efficiency. Initiate conceptual design of efficient, very high pressure ratio core component technologies. Decrease in FY 2014 due completion ADVENT.			
Title: Turbofan/Turbojet Engine Fan, Low Pressure Turbine, and Integration Technologies ***Description:*** Develop turbofan/turbojet engine components (i.e., fans, nozzles, etc.) used in engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports. ***FY 2012 Accomplishments:*** Developed modeling and simulation rules and tools for advanced components including: advanced interactive cost analysis tools for adaptive engine components; unsteady aerodynamics and aeromechanics models; augmentor combustion processes; and probability-based cooled turbine airfoil high cycle fatigue prediction methods. Conducted bench and rig tests to validate unsteady aerodynamics/aeromechanics models and probabilistic cooled turbine airfoil high cycle fatigue prediction methods. Developed and validated test protocols and improved augmentor rig test capabilities. Continued rig testing of advanced fan design, advanced low pressure turbine design, and lightweight, simple, low-observable compatible inlet and exhaust systems. ***FY 2013 Plans:*** Develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Demonstrate methods to detect/predict incipient bearing damage to ensure engine operation. ***FY 2014 Plans:*** Continue to develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Develop modeling and simulation tools to predict fan/inlet interaction for both podded and embedded propulsion systems. Develop a probabilistic ignition prediction tool for advanced augmentor design. Develop models to validate function and durability of high temperature electronics for engine control.	14.323	8.672	8.177
Title: Missile and Remotely Piloted Aircraft Engine Technologies ***Description:*** Develop limited life engine components for missile and remotely piloted aircraft (RPA) applications, including long-range supersonic and hypersonic vehicles.	5.400	3.993	3.900

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Developed and applied advanced modeling and simulation rules and tools for ceramic material small turbine blades, variable area turbines, and integration/performance of lubeless bearings. Developed and evaluated components to increase pressure ratio by 50% in this size class with minimum efficiency loss. ***FY 2013 Plans:*** Develop and apply advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Demonstrate advanced designs in rig testing. ***FY 2014 Plans:*** Continue to develop and apply advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Continue to demonstrate advanced designs in rig testing. Develop and validate a test protocol for small engine augmentor designs.			
Title: Turboshaft/Turboprop and Small Turbofan Engine Technologies ***Description:*** Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports. ***FY 2012 Accomplishments:*** Developed and applied advanced modeling and simulation rules and tools for emissions and noise to decrease detection. Developed and evaluated components to increase thrust-to-weight ratio and to decrease specific fuel consumption, production cost, and development cost. ***FY 2013 Plans:*** Develop and apply advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Develop advanced vibration and temperature sensors for use in demonstration of engine durability requirements. ***FY 2014 Plans:*** Continue to develop and apply advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Continue to develop advanced vibration and temperature sensors for use in demonstration of engine durability requirements.	1.659	1.545	1.563
Title: Adaptive Turbine Engine Technologies ***Description:*** Develop high performance, durable components which enable adaptive turbine engine technologies.	8.000	47.400	28.679

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623066: *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Initiated multiple analyses and trade studies required to finalize adaptive engine conceptual designs. The adaptive engine conceptual design goals include 25% reduction in specific fuel consumption and 10% increase in thrust within the weight and unit cost constraints of state-of-the-art fifth generation fighter class engines. ***FY 2013 Plans:*** Complete adapative engine conceptual designs meeting goals to reduce 25% reduction in specific fuel consumption and 10% increase in thrust over fifth generation fighter class engines with comparable weight and unit cost. Initiate preliminary designs addressing extensive performance, operability, maintainability, and prognostic health management requirements. Design and conduct ground rig tests to validate preliminary design technologies and reduce risk for several parts of adaptive engines such as adaptive fans, high pressure compressors, combustors, high and low pressure turbines, mechanical system components, controls and accessories, thermal management subsystems, and three-stream compatible afterburner/exhaust systems. Conduct ground rig testing of at least two unique adaptive fan concepts. Complete the design, procurement, and assembly of hardware for ground rig tests and initiate ground rig tests. ***FY 2014 Plans:*** Complete detailed design of at least two unique adaptive fan concepts and initiate fabrication of components for ground engine testing. Continue to conduct ground rig tests to validate preliminary design technologies and reduce risk for several parts adaptive engines. Transition effort from development to demonstration of parts of adaptive engines.			
Accomplishments/Planned Programs Subtotals	70.515	102.188	77.444

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623145: *Aerospace Power Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
623145: *Aerospace Power Technology*	-	32.066	30.061	26.587	-	26.587	28.717	29.453	28.127	28.679	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops electrical and thermal management technologies for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable future military megawatt level power and thermal management needs. This project supports development of electrical power and thermal management component and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: High Power System Technologies	26.258	29.805	26.587
Description: Develop electrical power and thermal management component and subsystem technologies with low volume displacement for delivery of high power for manned and unmanned systems. ***FY 2012 Accomplishments:*** Performed tip-to-tail modeling and simulation to identify solutions for platform level power and thermal management needs of next generation military air platforms. ***FY 2013 Plans:*** Complete critical design review of Integrated Vehicle Energy Technology (INVENT) effort to develop adaptive power and thermal management subsystems for next generation military air platforms. Initiate platform tip-to-tail modeling and simulation energy optimization for potential INVENT integration into current and future fifth generation fighter class aircraft. ***FY 2014 Plans:*** Initiate testing of adaptive power and thermal management subsystems hardware for next generation air platforms in conjunction with continued platform level tip-to-tail modeling and simulation energy optimization.			
Title: Special Purpose Application Technologies	5.808	0.256	0.000
Description: Develop technologies for special purpose applications, including hybrid electrical power, thermal management systems, and energy conversion/storage components and subsystems.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 623145: *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Developed fully ruggedized hybrid power subsystems and energy harvesting components. Performed flight tests of these subsystems to demonstrate achievement of power and energy density goals for special purpose applications. Explored technology set for development of power systems for micro air vehicles. ***FY 2013 Plans:*** Complete power generation and management advanced technology demonstration to transition to Air Force customer, Air Force Special Operations Command (AFSOC), to provide enhanced capability and endurance for battlefield airmen. This effort completion and transition incorporates and leverages components developed in prior year activities. ***FY 2014 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	32.066	30.061	26.587

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 624847: *Rocket Propulsion Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
624847: *Rocket Propulsion Technology*	-	59.331	55.293	52.651	-	52.651	52.904	52.570	56.535	57.680	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project develops rocket propulsion technologies for space access, space maneuver, the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts), and tactical missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, technology for sustainment of strategic systems, and innovative space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire DoD. Technologies developed under this program enable capabilities of interest to both DoD and NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests. Aging and surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50%, enabling motor replacement for cause.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Fuel Technologies	4.943	7.035	7.156
Description: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.			
FY 2012 Accomplishments: Analyzed and tested potential hydrocarbon fuel additives to improve performance of kerosene. Evaluated scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Explored and developed advanced ionic liquids including synthesis and characterization. Evaluated suitability for ionic liquid propellants for missile defense interceptor and spacecraft propulsion demonstrations.			
FY 2013 Plans: Analyze and test new candidates for potential hydrocarbon fuel additives to improve performance of kerosene. Continue synthesis and downselect process and scale-up of promising high energy-density materials candidates. Continue to develop methods and additives to reduce fuel coking in rocket engine environments. Evaluate candidate propellants in advanced			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
combustion devices. Develop and characterize next generation ionic liquids for use in spacecraft and missile defense applications. Develop scale-up capability for advanced solid propellant ingredients. ***FY 2014 Plans:*** Evaluate methods for removing components from fuels that adversely affect fuel coking in rocket engine environments. Evaluate scaled-up propellants in advanced combustion devices to determine materials compatibility and performance to include supporting large-scale motor tests. Continue development and characterization of next generation ionic liquid propellants for use in spacecraft and missile defense applications. Complete scale-up capability for advanced solid propellant ingredients. Evaluate and modify polymeric systems for use in rocket applications.			
Title: Liquid Engine Combustion Technologies ***Description:*** Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles. ***FY 2012 Accomplishments:*** Evaluated injector performance to ensure chamber/injector compatibility and prevent damage to engines using sub-scale ground engine demo. Validated study results in more realistic rocket-chamber conditions and transitioned predictive tools to industry. Started modification of test cell to allow hot-firing of combustion stability characterizing rig. Characterized differences between different kerosone rocket fuel batches which impact their coking behavior in a rocket engine. Evaluated novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. ***FY 2013 Plans:*** Begin efforts looking at multi-injector designs and control effectors. Feed advanced combustion device technology into a hydrocarbon boost demo and to various contractor designs and continue additional analysis on changing designs and concepts. Develop improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conduct validation and verification of advanced modeling and simulation capabilities. Develop understanding of kerosene production to determine what components affect fuel coking and should be removed from the fuel during the production process. Complete modification of test cell and conduct first hot-fire tests of combustion stability rig. ***FY 2014 Plans:*** Begin evaluation of injector concepts in hot fire conditions. Continue efforts looking at multi-injector designs and control effectors. Complete transition of candidate injector technologies to contractor for use in Hydrocarbon Boost (HCB), a rocket engine ground demonstration. Continue hot fire tests in combustion stability rig and feed data to HCB to influence supporting design efforts.	5.387	7.174	8.709

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Continue characterization of novel cooling channels and transfer info to HCB to influence rocket engine thrust chamber design. Continue developing understanding of kerosene production, what components affect fuel coking and should be removed from the fuel during the production process. Continue to evaluate and develop advanced material solutions for high temperature components in rocket engines.			
Title: Advanced Material Applications ***Description:*** Develop advanced material applications for lightweight components and material property enhancements for current and future rocket propulsion systems. ***FY 2012 Accomplishments:*** Developed new material formulations that better address the challenges inside solid rockets. Continued to characterize and finalize processing parameters of new reinforced high temperature polymers and scale-up processing of carbon-carbon materials. Refined formulations of polymers for use in various liquid rocket engine components. Continued to characterize and understand the mechanisms behind a new class of hydrophobic and oleophobic materials exploring various transition opportunities. ***FY 2013 Plans:*** Support transition efforts of advanced polymers to operational missile systems. Down select to single method of material deposition, characterize and document for follow-on development and future potential acquisition programs. Finish nano-material activities and document. ***FY 2014 Plans:*** N/A.	5.722	1.000	0.000
Title: Advanced Liquid Engine Technologies ***Description:*** Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles. ***FY 2012 Accomplishments:*** Completed development of engine health monitoring technologies supporting the hydrocarbon boost technology development effort. Completed development of advanced hydrocarbon engine technologies using fuels other than kerosene, including Methane. ***FY 2013 Plans:*** Develop enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies. Develop and demonstrate in-house, moderate scale liquid rocket component	16.300	10.872	10.623

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
testing capability. Complete gas phase and super critical phase testing capability and begin experiments, which is also work supporting risk reduction in hydrocarbon boost. Develop high performance compact liquid rocket engine technologies. ***FY 2014 Plans:*** Continue to develop enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies (subscale turbopump assembly, thrust chamber assembly. Continue to develop and demonstrate in-house, moderate scale liquid rocket component testing capability-complete hot fire capability to support risk reduction in hydrocarbon boost technology. Continue to develop high performance compact liquid rocket engine technologies.			
Title: On-Orbit Propulsion Technologies ***Description:*** Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations. ***FY 2012 Accomplishments:*** Characterized advanced plasma thrusters for microsatellite propulsion systems. Conducted scale-up of advanced monopropellants and evaluated advanced ignition schemes and chamber concepts. Assessed advanced chemical propulsion technology developments for satellite thrusters and development components. Developed advanced multi-mode chemical-electric propulsion concepts for satellites and continued component developments. Developed next generation high power electric spacecraft propulsion. Performed advanced modeling and simulation tool development to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. ***FY 2013 Plans:*** Conduct scale-up of advanced monopropellants and evaluate advanced ignition schemes and chamber concepts. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. Begin development of new bi-propellant thruster technologies to take advantage of new non-toxic liquid propellants. ***FY 2014 Plans:*** Conduct scale-up of advanced monopropellants and evaluate advanced ignition schemes and chamber concepts. Continue development of next generation high power electric spacecraft propulsion. Continue advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies, incorporating multi-scale/multi-physics. Conduct experiments to understand the physics behind the wide range of spacecraft propulsion	6.651	8.330	9.409

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
concepts/technologies and accurately model the physics. Begin transition of new thruster modeling framework to spacecraft industry for use in future designs. Explore and develop new generation of chemical spacecraft thruster technologies.			
Title: Space Access and Strike Applications ***Description:*** Develop missile propulsion and boost technologies for space access and strike applications. ***FY 2012 Accomplishments:*** Tested components as part of risk reduction efforts for future missile propulsion demonstration. Developed advanced tactical propulsion technologies. Continued development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. ***FY 2013 Plans:*** Develop advanced tactical propulsion technologies. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. Develop advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. ***FY 2014 Plans:*** Continue to develop advanced tactical propulsion. Continue development and evaluation of next generation of updated, physics-based modeling, simulation, and analysis tools for missile propulsion components and applications. Continue to develop advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. Complete propellant development efforts.	14.884	11.476	6.739
Title: Ballistic Missile Technologies ***Description:*** Develop missile propulsion technologies and aging and surveillance technologies for ballistic missiles. ***FY 2012 Accomplishments:*** Conducted sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrated advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Applied next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. ***FY 2013 Plans:*** Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Integrate advanced aging and surveillance technologies into	5.444	9.406	10.015

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Continue to apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. ***FY 2014 Plans:*** Conduct sub-scale testing of existing and advanced sensors to be attached to solid rocket motors and tools that can integrate sensor data into existing aging and surveillance tool suite. Continue integration of advanced aging and surveillance technologies into demonstrations to validate and verify efforts to reduce uncertainties and accurately model motor behavior. Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. Complete data management system used to track and correlate aging and surveillance data for individual missiles.			
Accomplishments/Planned Programs Subtotals	59.331	55.293	52.651

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2014 Air Force			DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602203F: *Aerospace Propulsion*	PROJECT 625330: *Aerospace Fuel Technology*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
625330: *Aerospace Fuel Technology*	-	6.130	5.494	5.325	-	5.325	5.142	5.164	5.254	5.358	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project evaluates hydrocarbon-based fuels for legacy and advanced turbine engines, scramjets, pulse detonation and combined cycle engines. This project also considers fuel related concepts that can increase turbine engine operational reliability, durability, mission flexibility, energy efficiency, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include evaluations of fuel properties and characteristics of alternative fuels developed from unconventional sources (such as coal, natural gas, biomass, and combinations thereof), unique/alternate fuels and components used in integrated thermal and energy management systems including high heat sink fuel capability, fuels logistics and associated vulnerabilities, and combustion diagnostics and engine emissions measurements.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Alternative Fuels	3.042	2.500	2.372
Description: Conduct evaluations and perform technical assessments of alternative hydrocarbon fuels derived from coal, natural gas, and biomass for use in legacy and advanced aerospace systems.			
FY 2012 Accomplishments: Developed link between fully-synthetic fuel composition and basic physical properties and rig test performance.			
FY 2013 Plans: Continue evaluation of industry-submitted alternative fuel samples. Tri-service coordinated efforts focus on hydrocarbon composition, jet-in-diesel performance, bulk modulus, and stability during long-term military storage/handling.			
FY 2014 Plans: Continue evaluation of cellulosic aviation biofuels, focusing on potential fuels capable of being used at a 100% pure state rather than blends.			
Title: Integrated Thermal and Energy Management	1.088	1.100	1.045
Description: Develop and demonstrate advanced components and conduct performance assessments of advanced aircraft integrated thermal and energy management systems for engines and aircraft.			
FY 2012 Accomplishments:			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Assessed advanced catalyst approaches to enhancing heat sink in hydrocarbon-based endothermic fuels. ***FY 2013 Plans:*** Evaluate alternative fuel compositions to increase life and heat sink in hydrocarbon-based endothermic fuels, using reduced-scale rigs to simulate engine-scale fuel system conditions. ***FY 2014 Plans:*** Develop advanced producible endothermic fuel composition with enhanced heat sink and life to support medium-scale scramjet engine demonstrations.			
Title: Fuel Logistics ***Description:*** Study and evaluate low-cost approaches to reduce fuel logistics footprint to reduce cost. Study fuel logistics vulnerabilities and develop detection and mitigation technologies. ***FY 2012 Accomplishments:*** Developed biological growth mitigation approaches for commercial jet fuels in support of Air Force effort to implement commercial off-the-shelf jet fuels. Evaluated approaches for portable hydrogen generation to support emergency field power generation. ***FY 2013 Plans:*** Assess impact of conversion to commercial jet fuel (without military jet fuel additives) on biological growth in base fuel systems. Evaluate cross-section of Jet A fuels using advanced instrumentation to develop chemical composition information to link to fuel properties and performance to support Jet A conversion. ***FY 2014 Plans:*** Develop composition-to-performance link and models for Jet A fuels for physical properties.	1.000	1.000	0.958
Title: Emissions ***Description:*** Develop and test advanced emissions diagnostic techniques for airbreathing propulsion systems. Conduct evaluations of the combustion and emissions characteristics of aviation fuels. ***FY 2012 Accomplishments:*** Implemented advanced particulate diagnostics in high-pressure combustor test rig. Assessed emissions from fully-synthetic fuels relative to JP-8 and JP-8/synthetic blends. ***FY 2013 Plans:*** Develop methodology to assess operability of fuels in high pressure combustor rig. ***FY 2014 Plans:***	1.000	0.894	0.950

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Evaluate combustor operability of narrow-boiling and high/low cetane alternative fuels as well as fully-synthetic fuels.			
Accomplishments/Planned Programs Subtotals	6.130	5.494	5.325

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.