STRATEGIC INSIGHT

NASA/CR-1998-206490

HRST Final Briefing

Integrated Technology Analysis & Technology Sequencing

Strategic Insight
November 7, 1997

FINAL
7N-61-CR
OCIT

Discussion Topics

- Statement of Work
- Analysis Strategy
- Technical Results
- Evaluation by Integrated Technology Index (ITI) and Subsystem Sequencing
- Summary

Statement of Work

- **Conduct integrated analyses for HRST in two areas:**
  - Integrated analysis of high-interest system concepts
  - Technology sequencing analysis for predicting timetables for research & development

Analysis Strategy

- Collect data from TIMs, working group meetings
- Identify high-interest subsystems
- Perform technology comparisons across several perspectives
- Sum up technology sequences to attain TRL-6
- Match with desirable operational characteristics

Elements of the Analysis

- HRST system hierarchy applied in a spread sheet structure
- Estimates of subsystem technologies' TRLs, ΔTRL steps, RD3 levels, technology need values
- Integrated technology assessment in the form of an "index"
- Consideration of limitations

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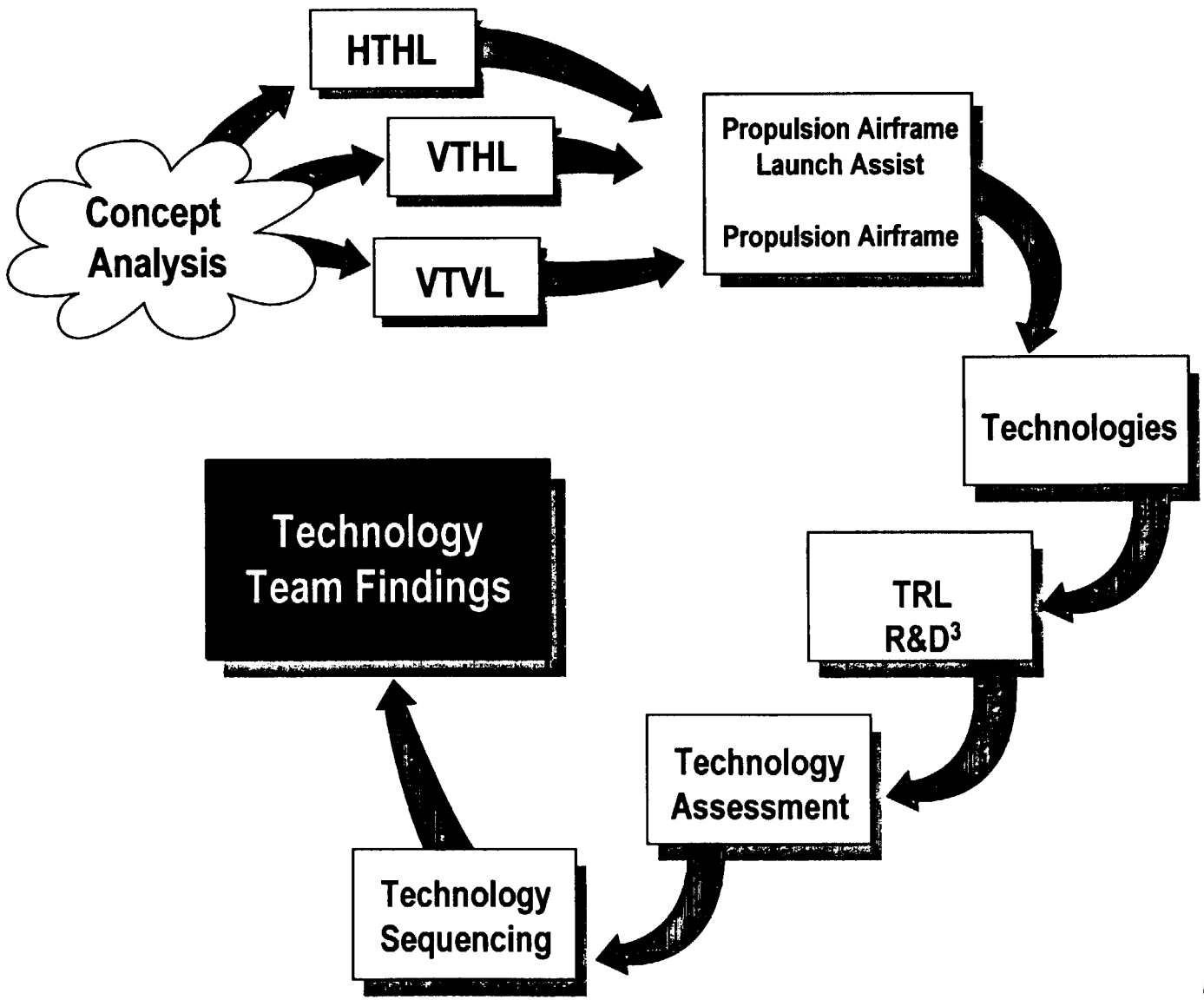
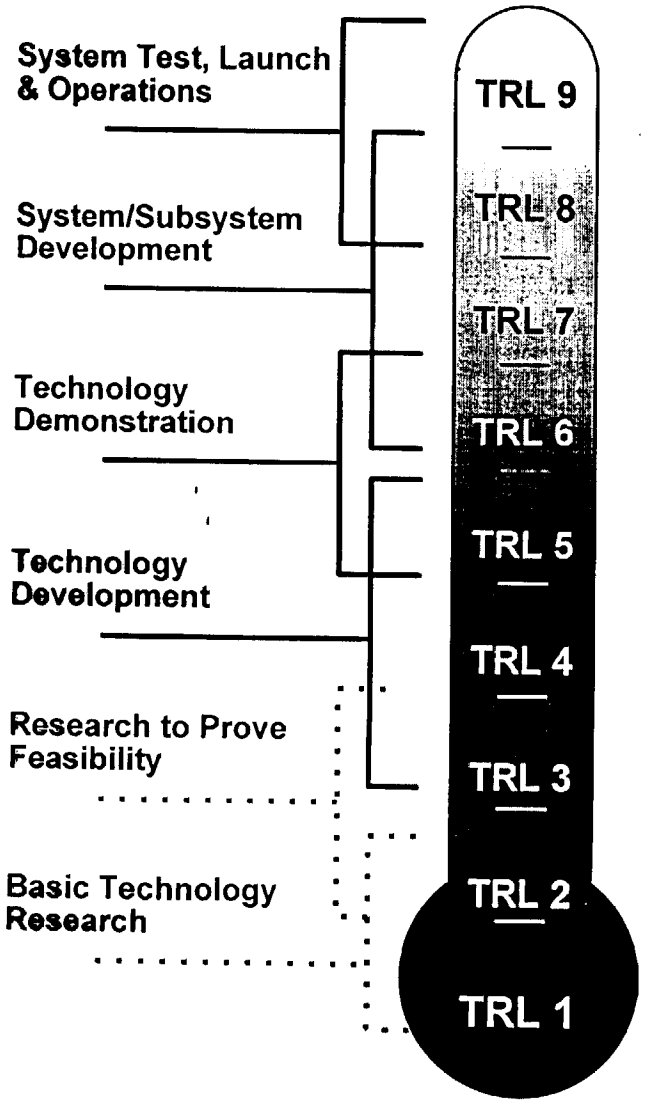
Structure for Technology Roadmaps



REFERENCE

HIGHLY REUSABLE SPACE TRANSPORTATION

VEHICLE SYSTEM / TECH. WORKSHEET – TECHNOLOGY READINESS LEVELS



TRL 9	Actual system "flight proven" through successful mission operations
TRL 8	Actual system completed and "flight qualified" through test and demonstration (Ground or Flight)
TRL 7	System prototype demonstration in a space environment
TRL 6	System/subsystem model or prototype demonstration in a relevant environment (Ground or Space)
TRL 5	Component and/or breadboard validation in relevant environment
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept
TRL 2	Technology concept and/or application formulated
TRL 1	Basic principles observed and reported

R&D Difficulty

- **DDR&D Description:**
  - #1: Very low degree of difficulty in achieving R&D goals for this technology subsystem
  - #2: Moderate degree of difficulty
  - #3: High degree of difficulty
  - #4: Very high degree of difficulty

Technical Need

- **Defined for this analysis as:**
  - #1: Enhancing
  - #2: Significantly enhancing
  - #3: Concept-enabling

Integrated Technology Index

- $$ITI = \frac{\Delta TRL \times RD3 \times \text{Tech. need}}{\text{\# of subsystem technologies}}$$

ITI collects several measures from individual concepts for comparison across the HRST spectrum

Operational Effectiveness

- **Includes features/characteristics that relate to concept performance in the HRST mission, including:**
  - payload capacity
  - operating margin
  - flight characteristics
- **When used as denominator in conjunction with ITI, operational effectiveness leads to scoring/ranking of concepts**

Limitations of the Analysis

- **Focus on technology items can be entertaining, but it must not overshadow such issues as impacts on operations and the interplay of cost and risk in the research & development process**

The Issue of Operations

- Technology and system designs do not exist in a vacuum—their effects must be measured with respect to cost and fabrication complexity as well as operations impacts
- Operations impacts rule the HRST equation for success
- Operations cannot be ignored

The Dilemma of R&D

- Increased risk typically means increased cost in the R&D process
- Costs amortized over life cycle affect cost per payload pound
- Question: Is the risk worth the cost?
- Conversely, are costs and risks required to meet given recurring cost thresholds?

The Matrix

Matrix/Spreadsheet

- Based mostly on compilation of "known" technologies from TIMs
- Spreadsheet sent out for comment & review in late September
- In-house evaluation conducted on all concepts
- Raw data: almost 1,000 items to evaluate in 19 system concepts

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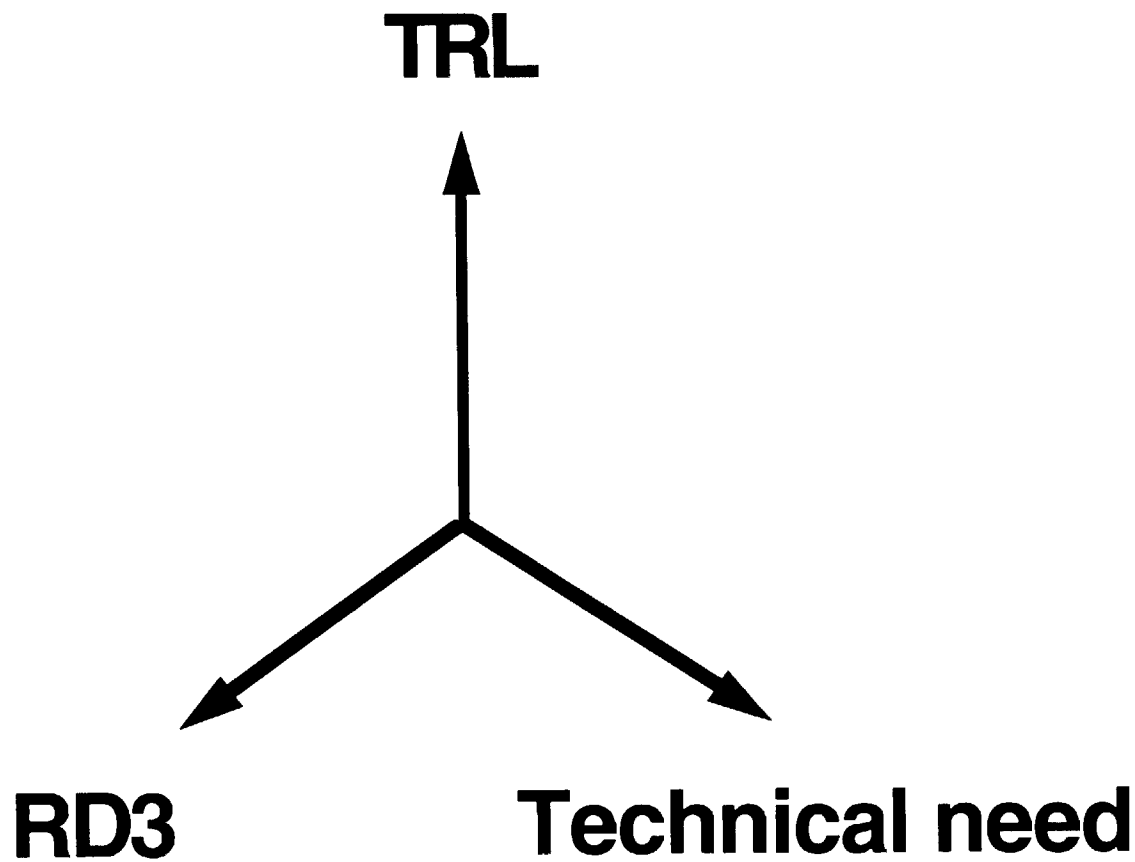
Axes of the Analysis



Technology Downselect

- **Concepts were divided into time frames of anticipated availability**
  - long term options evaluated separately
- **Subsystem technologies were then:**
  - assessed by concept
  - segmented by ITI
  - categorized by use in other concepts
  - categorized by time frames
- **TRLs >6 considered mature**

Technology Choices

- **Conduct Technology Cost/Benefit to Force a Systems View Into Launch & Landing Concepts**
  - Evaluate How a Certain Technology Can Be Integrated Into—and Provide Value Added to—a Launch/Landing Concept
  - Corollary: Use Some Other Technology to Strengthen Technology Concept
- **Technologies Should Naturally Group Themselves**

Timeline Estimation Methodology

Basic Technology Type	Given TRL=3, time to go to: 3-4	4-5	5-6
Information Systems/Software	1 yr.	1 yr.	2 yrs.
Power Machinery/Propulsion	1 yr.	2 yrs.	3 yrs.
Materials Manufacturing	1 yr.	2 yrs.	3 yrs.
Mechanisms/actuators/studies	1 yr.	1 yr.	2 yrs.

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An Example: R&D "Time Constant" for TRL=3

Information Systems/Software	=	4 yrs. to attain TRL6
Power Machinery/Propulsion	=	6 yrs. to attain TRL6
Materials, Manufacturing	=	6 yrs. to attain TRL6
Mechanisms, Actuators, Studies	=	4 yrs. to attain TRL6

Technology Readiness Level (TRL) Analysis

REFERENCE

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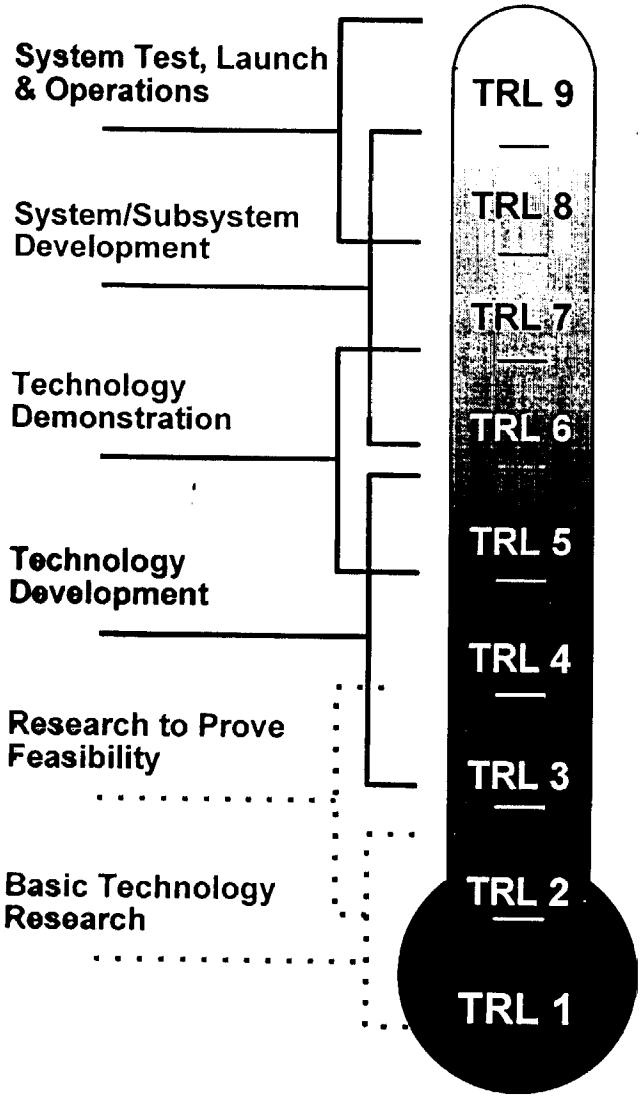
VEHICLE SYSTEM / TECH. WORKSHEET – TECHNOLOGY READINESS LEVELS



Actual system "flight proven" through successful mission operations

Actual system completed and "flight qualified" through test and demonstration (Ground or Flight)

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Component and/or breadboard validation in laboratory environment

Analytical and experimental critical function and/or characteristic proof-of-concept

Technology concept and/or application formulated

Basic principles observed and reported

TRL Evaluation Criteria

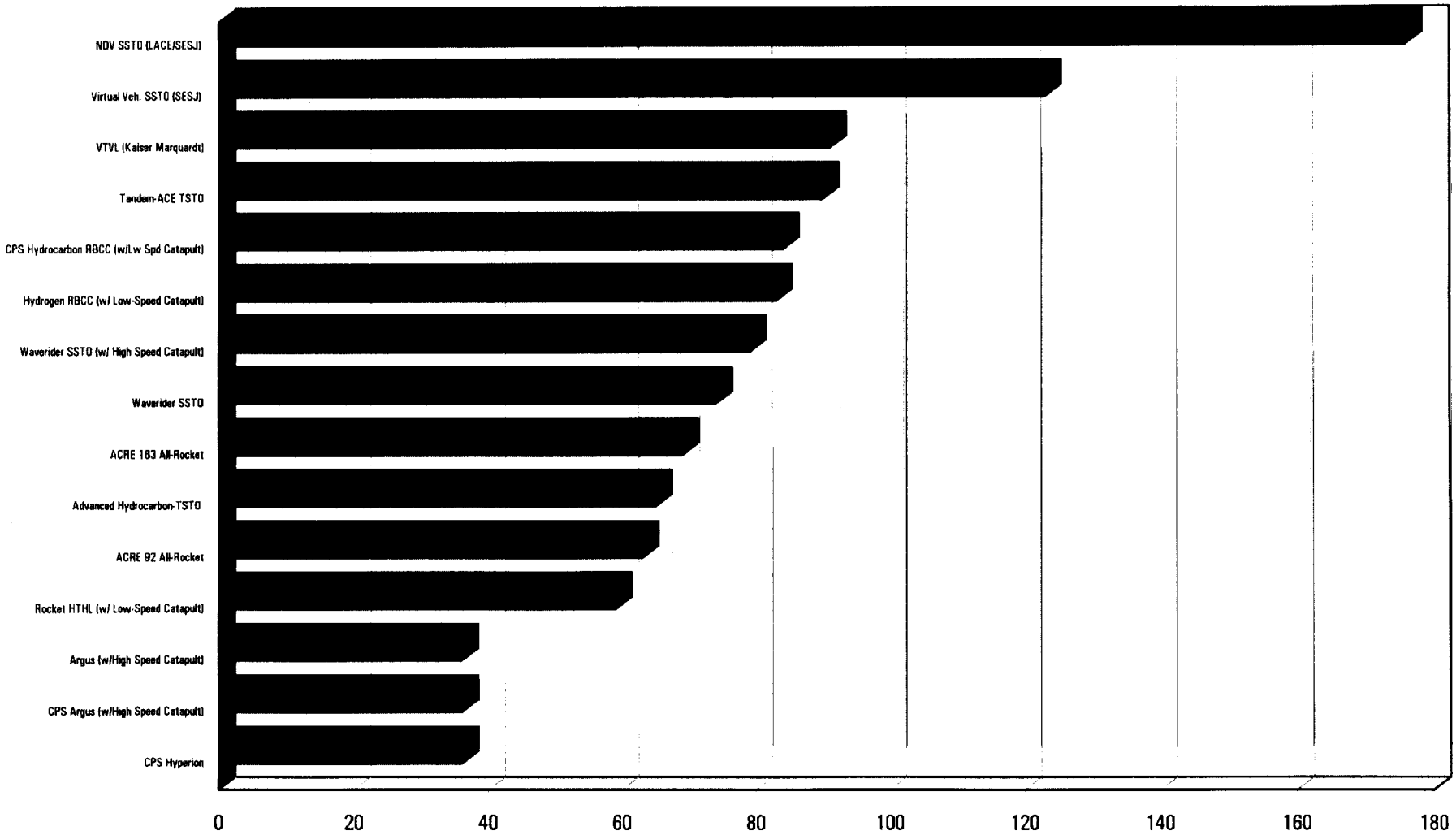
- TRL values broken down by major subsystem
- Average TRL computed by concept
- ΔTRL computed by concept

What is ΔTRL?

- **Measurement of the number of steps per subsystem technology to attain TRL 6**
- **Each step denotes another level of developmental maturity**
  - more steps = more risk over equal time
- **TRL represents one axis of the trade space**

Number of TRL Steps

Sorted By System Concept



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Degree of Difficulty in Research & Development (RD3) Analysis

R&D Difficulty

- **DDR&D Description:**
  - #1: Very low degree of difficulty in achieving R&D goals for this technology subsystem
  - #2: Moderate degree of difficulty
  - #3: High degree of difficulty
  - #4: Very high degree of difficulty

Technical Need Analysis

Technical Need

- **Defined for this analysis as:**
  - #1: Nice to have
  - #2: Significantly enhancing
  - #3: Concept-enabling

Technology Roadmap

Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	ITI	ΔTRL	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame
Main Propulsion System	Engine Systems	Nozzle	2	4	3	48	4	1	1	2	3	7	28	2028
Main Propulsion System	Engine Systems	Engine Integrated Performance & Mode Transition	3	4	3	36	3	0	1	2	3	6	24	2024
Main Propulsion System	Engine Systems	Chemical Heat Regeneration	2	3	3	36	4	1	1	2	3	7	21	2021
Main Propulsion System	Engine Systems	Scramjet (M = 12 to 20)	4	4	3	24	2	0	0	2	3	5	20	2020
Main Propulsion System	Engine Systems	Scramjet (M = 8 to 12)	4	4	3	24	2	0	0	2	3	5	20	2020
Main Propulsion System	Engine Systems	Ramjet (M = 3 to 5)	4	4	3	24	2	0	0	2	3	5	20	2020
Main Propulsion System	Engine Systems	Low Speed System: Low Speed Ejector	4	4	3	24	2	0	0	2	3	5	20	2020
Main Propulsion System	Engine Systems	Two-Dimensional Variable Geometry Inlet	3	3	3	27	3	0	1	2	3	6	18	2018
Main Propulsion System	LACE	Liquid Air Collection & Enrichment System	3	3	3	27	3	0	1	2	3	6	18	2018
Main Propulsion System	Engine Systems	Overall ESJ Integrated Performance & Mode Transition	3	3	3	27	3	0	1	2	3	6	18	2018

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Technology Roadmap

Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	ITI	ΔTRL	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame
Main Propulsion System	Engine Systems	Si3N4 Components	3	3	3	27	3	0	1	2	3	6	18	2018
Main Propulsion System	Engine Systems	Scramjet Mode (M=12 to 15)	3	3	3	27	3	0	1	2	3	6	18	2018
Main Propulsion System	Engine Systems	Scramjet w/LOX augmentation	2	2	3	24	4	1	1	2	3	7	14	2014
Main Propulsion System	Engine Systems	Low Speed System: Low Speed Ejector	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Engine Systems	Low Speed System: External Burning	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Propellant Transfer Systems	Flight-Operable Liquid Air Pumping System (w/ Interconnects)	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Engine Systems	Active Cooling (Combustor)	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Engine Systems	Multi-Engine Integrated Performance & Mode Transition	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Engine Systems	Retracting Supercharging Fan	3	2	3	18	3	0	1	2	3	6	12	2012
Main Propulsion System	Engine Systems	Ramjet/Scramjet (M=5 to 8)	4	2	3	12	2	0	0	2	3	5	10	0
Main Propulsion System	Engine Systems	Ramjet/Scramjet Mode (M=5 to 8)	4	2	3	12	2	0	0	2	3	5	10	0

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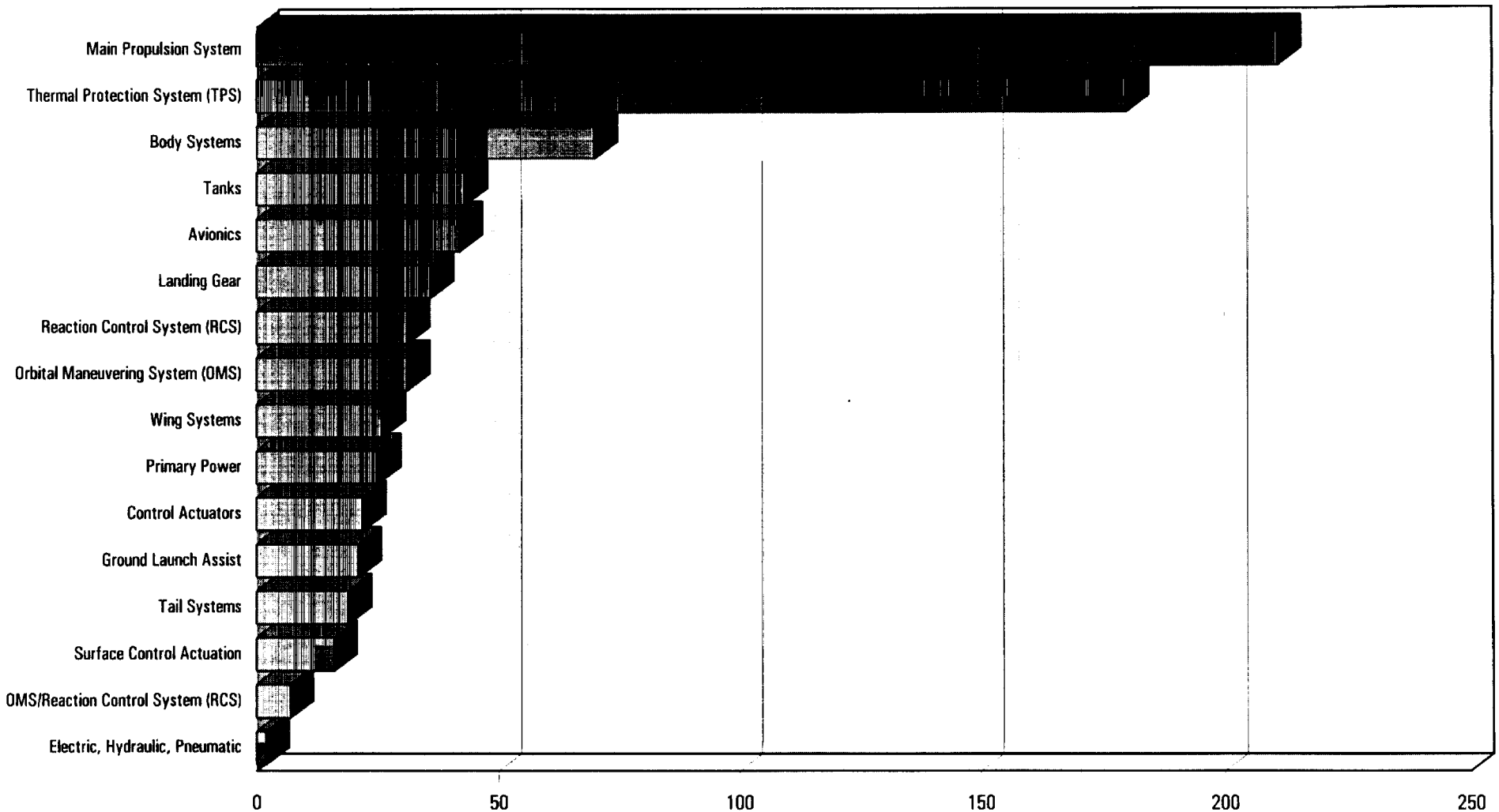
Major System Technology Group

Referenced By System Concept Developers



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Major System Technologies

- Based on Frequency of use and importance to system concepts:

- Thermal Protection System (TPS)
- Main Propulsion System
- Airframe Structures

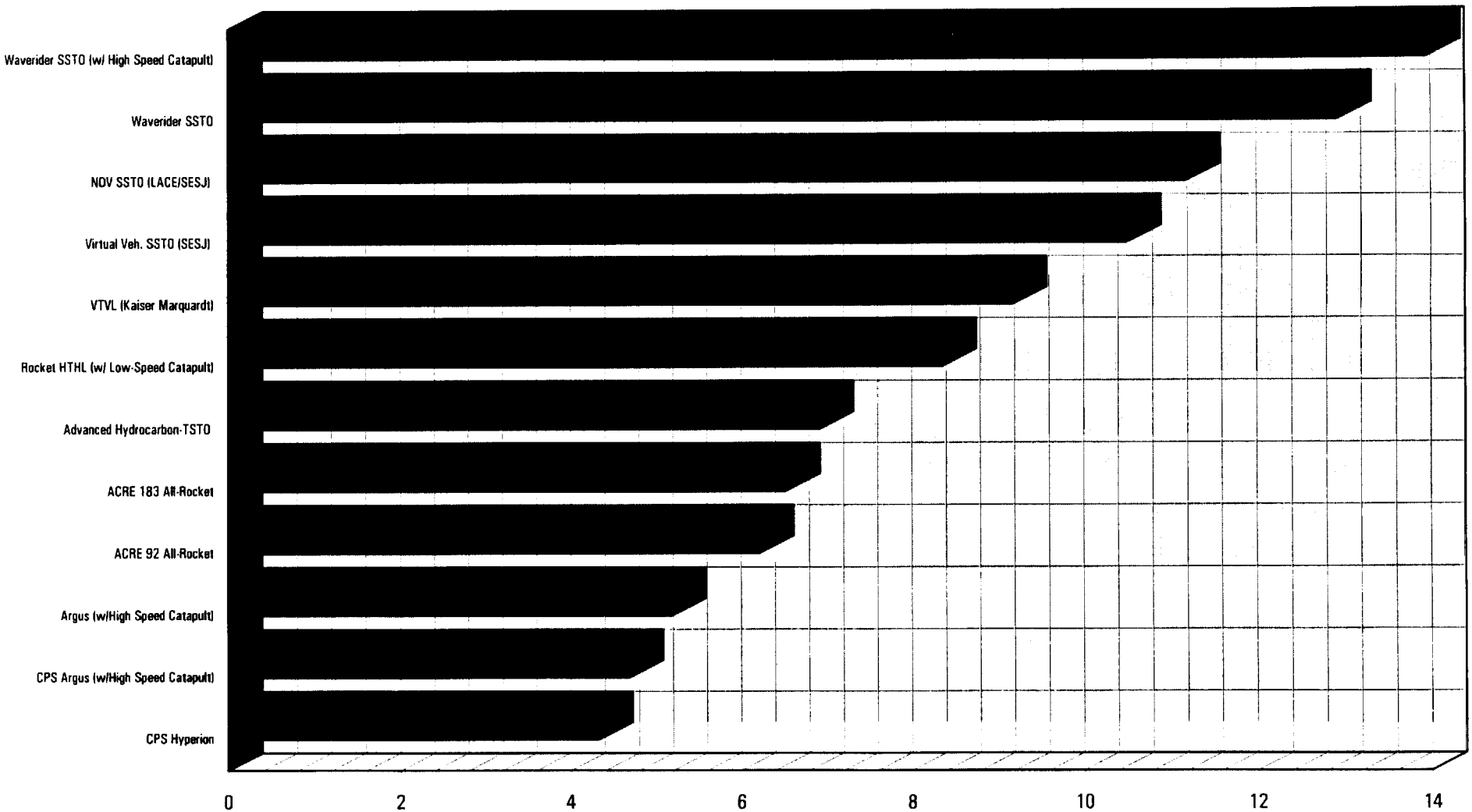
- Control Actuators
- Tanks
- Avionics
- Orbital Maneuvering System (OMS)
- Landing Gear

- Prime Power
- Ground Launch Assist
- Reaction Control System (RCS)

- OMS/Reaction Control System (RCS)
- Electric, Hydraulic, Pneumatic

Integrated Technology Index

Sorted By System Concept



Integrated Technology Index: Summary

- Top 12 concepts ranked according to the product of TRL steps-RD3-Technology need & divided by number of subsystem technologies:

1st Tier

- Waverider SSTO (w/High Speed Catapult)
- Waverider SSTO
- Virtual Veh. SSTO (SESJ)
- NDV SSTO (Lace/SESJ)

2nd Tier

- VTVL (Kaiser Marquardt)
- Rocket HTHL (w/Low-Speed Catapult)
- Advanced Hydrocarbon-TSTO
- ACRE 183 All-Rocket
- ACRE 92 All-Rocket

3rd Tier

- Argus (w/High Speed Catapult)
- CPS Hyperion
- CPS Argus (W/High Speed Catapult)

Operational Effectiveness

- **Includes features/characteristics that relate to concept performance in the HRST mission, including:**
  - payload capacity
  - operating margin
  - flight characteristics
- **When used as denominator in conjunction with ITI, operational effectiveness leads to scoring/ranking of concepts**

Operational Effectiveness

	DV SSTO (ACCESS)	Rocket RTOL w/Low-Speed	CPS Argus (w/High-Speed	CP Argus (w/High-Speed	CPS Hypersonic	Waverider SSTO	Waverider SSTO (w/High-Speed	Tricone Vehicle (SESJ/	ACRE 92 All Rocket	ACRE 183 All Rocket	LAV/POSGO/HYPOCAT/BOR	LAV/
Payload Capacity > 20,000 lbs	1	1	1	1	1	1	1	1	1	1	1	1
Payload Capacity > 40,000 lbs	1	1				1	1	1	1	1		1
Operating Margin > 15%		1	1	1	1	1	1		1	1	1	1
Dry Mass Fraction > 10%	1	1	1	1	1	1	1					1
Self Ferry	1		1	1	1	1	1	1				1
Loiter	1		1	1	1	1	1	1				1
Powered Landing	1		1	1	1	1	1	1				1
Return to Launch Site Abort	1		1	1	1							1
Score	7	4	7	7	7	7	7	5	3	3	2	8

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Concepts vs. Operational Effectiveness

First Tier

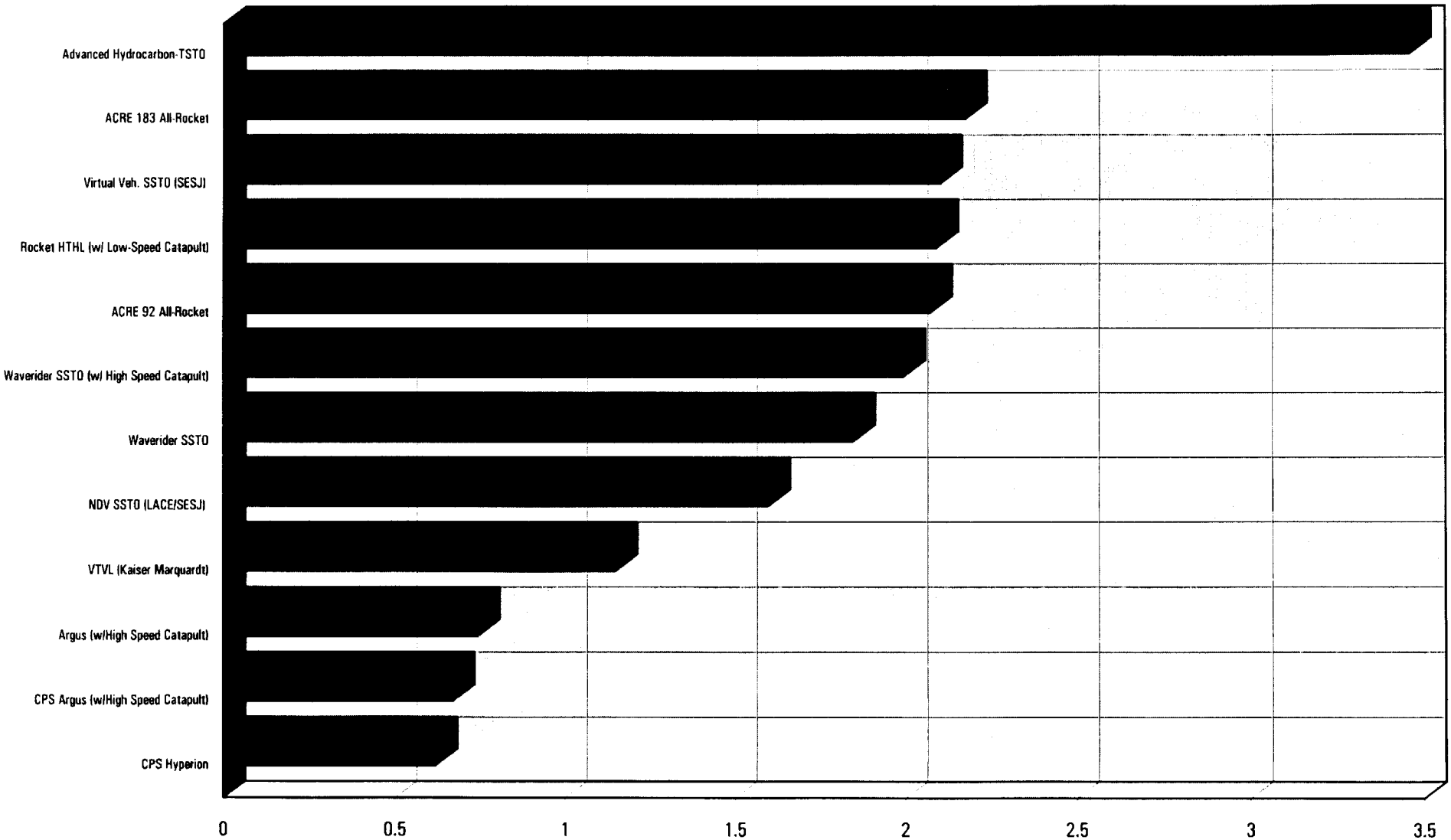
- VTVL Airbreather (Kaiser Marquardt)
- NDV SSTO (Lace/SESJ)
- CPS Argus w. Launch Assist
- Waverider SSTO
- Waverider SSTO w. Launch Assist
- CPS Hyperion

Second Tier

- Virtual Vehicle (SESJ)
- Rocket HTHL w. Launch Assist
- ACRE 92/ACRE 103
- Advanced Hydrocarbon VTVL TSTO

Integrated Technology List/Operational Effectiveness

Sorted By System Concept



ITI Operations: Summary

- Dividing ITI by the operational effectiveness ranking gives a relative sense of payoff for several concepts:

1st Tier

Adv. Hydrocarbon TSTO
ACRE 92 / 183
Virtual Vehicle SSTO
Rocket HTHL w. L. A.

2nd Tier

Waverider SSTO w. L. A.
NOV SSTO
VTVC (KM)

3rd Tier

Argus w. L. A.
CPS Argus W. L. A.
Hyperion

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Technology Categorization By Time

- **Very Long Term**
  - 2030 and beyond
- **Long Term**
  - 2020 and beyond
- **Mid Term**
  - 2015 at the earliest
- **Short Term**
  - 2010 at the earliest
-

Technical Assessment: Sorted by System Concept

HRST TECHNOLOGIES ASSESSMENT

Sorted By System Concept

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=12 to 15)	3	3	3	27	3	1	47	0	1	2	3	6	18	2018
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Combustor	3	2	3	18	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Multi-Engine Integrated Performance & Mode Transition	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Retracting Supercharging Fan	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Inlet EMAs	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode w/LOX Aug. (Mach 14-18)	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Hydraulic Actuators	2	2	2	16	4	15	29	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Rocket Nozzle	Variable Geometry Exit Nozzle	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Extension Nozzle	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Forebody Ramp	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	VTVL Gear System	Extremely Reliable Mechanical Systems	4	2	3	12	2	1	1	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet Mode (M=5 to 8)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=8 to 12)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010

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HRST TECHNOLOGIES ASSESSMENT

Sorted By System Concept

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Supercharged Ejector Mode (M=3 to 5)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Distribution & Pressurization	Stoichometric	4	2	2	8	2	1	2	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Tail Systems	Tail	TMC SiC/β21) Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Wing Systems	Wing	TMC SiC/β21) Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Internal Inlet	5	2	2	4	1	5	47	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	47	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	2	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	2	2	4	1	30	18	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Body Flap	Advanced Composite Structures	3	2	2	12	3	6	15	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	O2 Turbopump	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Advanced Composite Structures	3	2	2	12	3	6	17	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Intertank	Advanced Composite Structures	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Advanced Composite Structures	4	2	2	8	2	6	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Thrust Structure	Advanced Composite Structures	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Combustor	4	2	2	8	2	4	4	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C (Orbiter)	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C (Orbiter), None on Booster	4	2	2	8	2	1	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Graphite Polymide w/TABI	4	2	2	8	2	7	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Advanced Composite Structures	4	2	2	8	2	6	45	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Control Actuators	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	5	2	2	4	1	10	2	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ROS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Ox Rich Pre-Burner	5	2	2	4	1	1	4	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Main Engine Control System Actuators	EMAs	5	2	2	4	1	54	1	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Propellant Supply	Distribution & Pressurization	5	2	2	4	1	2	1	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Radiation Cooled Nozzle- C/SiC	7	2	2	-	0	1	4	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Fusion Engine	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	2	12	3	3	9	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IRDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tanks	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IPD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	No New Technology	6	2	2	-	0	1	5	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	2	16	2	7	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid Thrusters	3	2	2	12	3	1	28	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	2	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	EHP Conversion & Dist.	EMAs	5	2	2	4	1	54	5	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Actively-Cooled Nozzle	6	2	2	-	0	13	2	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IOD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Si3N4 Components	3	2	3	18	3	1	9	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Cu-8Co-4Nb for MCC Liner	3	2	2	12	3	1	9	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Nanophase Al Components	3	2	2	12	3	2	5	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010

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ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Turbopumps	4	2	2	8	2	4	1	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Gas/Gas Injection	5	2	2	4	1	2	5	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0

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ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Ox Rich Operation	5	1	2	2	1	2	5	0	0	0	3	3	3	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Actively-Cooled Nozzle	6	2	2	-	0	13	5	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Nanophase Al Components	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012

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ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Sensors. Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	6	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0

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ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Gas/Gas Injection	5	2	2	4	1	2	6	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Ox Rich Operation	5	1	2	2	1	2	6	0	0	0	3	3	3	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Actively-Cooled Nozzle	6	2	2	-	0	13	6	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	AEBTB/TUFI-C	3	2	2	12	3	3	26	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	AEBTB/TUFI-C	3	2	2	12	3	3	45	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Combuster	4	2	2	8	2	1	2	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Primary Power	Power Supply	APU	4	2	2	8	2	1	23	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	AEBTB/TUFI-C	4	2	2	8	2	3	12	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Hot Structure	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0

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Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	4	1	2	4	2	10	2	0	0	2	3	5	5	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	1	2	4	2	10	19	0	0	2	3	5	5	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Nozzle	6	2	2	-	0	3	2	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	In-Flight Propellant Transfer	High Speed LOX Pumping System	6	2	2	-	0	1	1	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Main Propulsion System	ACE	Air Collection and Enrichment	1	4	1	20	5	1	1	0	0	0	0	0	0	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Propellant Transfer Systems	Flight-Operable Liquid Air Pumping System (w/ Interconnects)	3	2	3	18	3	1	1	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Inlet Hydraulic Actuators	2	2	2	16	4	1	15	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	ATREX Engines	3	2	2	12	3	1	15	0	1	2	3	6	12	2012

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Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	3	2	2	12	3	6	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	3	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Primary Power	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 6)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Combustor Film Cooling	4	2	2	8	2	6	3	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IPD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Hot Structures	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Low-Maintenance Turbomachinery and Combustion Systems	5	2	2	4	1	7	3	0	0	0	3	3	6	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-Fed Thrusters	5	2	2	4	1	1	28	0	0	0	3	3	6	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Ionizer	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Chemical Heat Regeneration	Chemical Heat Regeneration	2	3	2	24	4	2	2	1	1	2	3	7	21	2021
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	2	3	24	4	3	47	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	3	18	3	3	9	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	Centralized Hydraulic System (8000 psi)	2	2	2	16	4	1	5	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Advanced C-C	3	2	2	12	3	26	15	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSIC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System	3	2	2	12	3	1	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	2	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Inlets	Actively-Cooled	3	2	2	12	3	30	3	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Engine Systems	Ramjet (M=3 to 5)	4	2	2	8	2	6	9	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	47	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	External Rocket System (ERS) Engine	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: External Burning	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	2	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	4	2	2	8	2	30	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Control Surfaces	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ROI (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	2	2	4	1	3	47	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Internal Inlet	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	19	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020

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Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Overall ESJ Integrated Performance & Mode Transition	3	3	3	27	3	1	1	0	1	2	3	6	18	2018
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Forebody Centerline	Actively-Cooled Film	3	3	3	27	3	1	1	0	1	2	3	6	18	2018

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	IT	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp Edge)	4	2	3	12	2	2	20	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Hot Structure	4	2	3	12	2	4	45	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Wing	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	6	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Intertank	Ti-Al/Hot Structure	5	2	3	6	1	4	19	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Tail System	Tail	Ti-Al/Hot Structure	5	2	3	6	1	4	17	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure & Overshell	Ti-Al/Hot Structure	5	2	2	4	1	4	1	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Rocket Ejectors	5	2	2	4	1	3	6	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Non-Integral Graphite Epoxy/PEEK Honeycomb w/ metal liners	5	2	2	4	1	1	19	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	External Cryogenic Insulation	Rohacell	5	2	2	4	1	1	1	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	GG for Ducted Fans	3	1	1	3	3	1	4	0	1	2	3	6	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LOX Tank	Non-Integral GP/Epoxy.	5	1	2	2	1	1	19	0	0	0	3	3	3	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0

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CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	VHM/BIT/BITE	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	6	2	2	-	0	8	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Control Actuators	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Internal Inlet	9	2	2	-	0	5	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Nozzle	9	2	2	-	0	13	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	TP Ducted Fans (Props)	6	1	1	-	0	1	4	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	OMS/Reaction Control System (RCS)	Feed Lines & Valves (for Cryogenic OMS/RCS)		6	2	2	-	0	0	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX/LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	Thrusters	Pressure-Fed Cryo Gaseous	6	2	2	-	0	1	28	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Pump-Fed Cryo Engine	6	2	2	-	0	1	5	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Inconel Metallic Tiles	6	2	2	-	0	1	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Ti-Al Hot Structure	6	2	2	-	0	3	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Sharp TPS	6	2	3	-	0	3	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Inlet	Sharp TPS	6	2	3	-	0	3	2	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Sharp TPS	6	2	3	-	0	3	20	0	0	0	0	0	0	0

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CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp Edge)	6	2	3	-	0	2	19	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	9	2	2	-	0	1	11	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	9	1	2	15	0	0	0	3	3	9	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0

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Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0

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Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	9	1	2	15	0	0	0	3	3	9	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0

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CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Actively-Cooled Nozzle	9	1	2	-	0	13	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	6	2	2	-	0	7	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0

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CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC(Over Ti-Al)	6	2	2	-	0	1	45	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	1	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	4	0	1	2	3	6	12	2012

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Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Control Surfaces	Advanced Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	4	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	4	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tail Systems	Tail	Advanced Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010

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Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Wing Systems	Wing	Advanced Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	Internal Inlet and Nozzle	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	4	0	0	0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	3	2	2	12	3	13	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	3	2	2	12	3	7	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Combuster	3	2	2	12	3	1	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Combustor Film Cooling	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Ramjet (M=3 to 6)	4	2	2	8	2	2	7	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	1	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Internal Inlet	5	2	2	4	1	5	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	13	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Pneumatic Actuators	6	2	2	-	0	9	45	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	FI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	4	2	2	8	2	13	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	4	2	2	8	2	12	26	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Wing	Advanced C-C	4	2	2	8	2	26	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0

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Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-2	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled Advanced Materials	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	3	3	9	1	30	3	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	3	3	9	1	30	20	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-10	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	3	3	9	1	30	18	0	0	0	3	3	9	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	DRAG REDUCTION	Cold Plasma	2	4	3	48	4	1	3	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ELECTRO MAGNETIC REFRIGERATOR	LIQUID HELIUM COOLER	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FLOW CONDUCTIVITY CONTROL	ION BEAM GENERATOR	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	5-10 TESLA SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD RAMJET	MACH 5.6-12.0	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Nose	DRAG REDUCTION	MICROWAVE	2	4	3	48	4	2	3	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Drag Reduction	Microwave	2	4	3	48	4	2	3	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 0-2.8	4	3	3	18	2	1	6	0	0	2	3	5	15	2015
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	SCRAMJET	MACH 4.0-9.0	4	3	3	18	2	1	1	0	0	2	3	5	15	2015
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	EMAs	3	2	3	18	3	54	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 9.0-11.8	3	2	3	18	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Leading Edge	C/SIC AND CC,	3	2	3	18	3	3	4	0	1	2	3	6	12	2012

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Nose Cap	C/SIC AND CC,	3	2	3	18	3	3	19	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Wing	C/SIC AND CC,	3	2	3	18	3	3	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Filters	2	2	2	16	4	2	6	1	1	2	3	7	14	2014
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	MHD RAM ROCKET	INTEGRATED PROPELLANT MANAGEMENT SYSTEM	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	BIT FOR ENGINE, AND STRUCTURES, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	ENGINE, STRUCTURE, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Nozzle	3	2	2	12	3	13	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	HIGH PERFORMANCE INJECTORS	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Composite Propellant Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	EMAs	3	2	2	12	3	54	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	SERVO VALVES	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Composite Feed Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	EMAs	3	2	2	12	3	54	2	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Insulation	Rigid Polymide Foam	3	2	2	12	3	1	2	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	AEROJET STRUTJET	INTEGRATED PROPELLANT CONTROLS	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	COWL	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	Leading Edge	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	Centralized Hydraulic System	3	2	2	12	3	1	45	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	Body Flap	Graphite Epoxy	4	2	3	12	2	17	15	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	INSULATION	Integral Graphite Epoxy	4	2	3	12	2	12	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Intertank	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	19	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	LH2 TANK (NO SLUSH)	Advanced Composite Materials Tanks	4	2	3	12	2	6	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LH2 TANK (NO SLUSH),	Integral Graphite Epoxy	4	2	3	12	2	12	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LOX Tank (NO DENSIFIED)	Advanced Composite Materials Tanks	4	2	3	12	2	6	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Non-Tank Primary Structure	TMC (SIC/B21),	4	2	3	12	2	1	18	0	0	2	3	5	10	2010

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Sorted By System Concept

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Wing	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	Hydraulic Actuators (High Pressure)	3	1	3	9	3	1	29	0	1	2	3	6	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Body Flap	EMAs	4	2	2	8	2	54	15	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Brakes	HIGH TEMPERATURE	4	2	2	8	2	1	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	APU (GAS EXPANDER)	4	2	2	8	2	2	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	POWER SYSTEMS	APU (GAS EXPANDER)	4	2	2	8	2	2	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	BOOST PUMPS	4	2	2	8	2	2	6	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TMC (SIC/B21) HOT STRUCTURE	4	2	2	8	2	7	12	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	FULL WING ACTIVATION SYSTEM	4	2	2	8	2	1	45	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	COWL	Actively-Cooled	5	2	3	6	1	30	1	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET INJECTOR	MACH 0-2.0,	4	1	3	6	2	1	1	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	LEADING EDGE	Actively-Cooled	5	2	3	6	1	30	4	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	THRUSTERS	Actively-Cooled	5	2	3	6	1	30	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	HIGH TEMP	4	2	1	4	2	1	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	TIRES	HIGH SPEED	4	2	1	4	2	1	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	4	1	2	4	2	54	29	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	MORE HOT STRUCTURE	5	2	2	4	1	1	2	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Filters	4	1	2	4	2	2	6	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	EMAs	4	1	2	4	2	54	45	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	TMC	5	1	3	3	1	5	18	0	0	0	3	3	3	
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 11.8-CUTOFF	5	1	3	3	1	1	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	BOOST PUMPS	5	1	2	2	1	2	6	0	0	0	3	3	3	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need7(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	EMAs	5	1	2	2	1	54	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	SERVO VALVES	5	1	2	2	1	2	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Turbopumps	5	1	2	2	1	4	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank (NO DENSIFIED)	PRESSURE-FED GH/GO	5	2	1	2	1	3	2	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	TMC AERO SURFACES	5	1	2	2	1	1	45	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Intertank	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	19	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Primary Structure	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	1	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	TMC	6	1	2	-	0	5	18	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.0-5.6	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.8-4.0	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 12.0-CUTOFF	6	1	2	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MLI	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MULTI-LAYER	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC (SIC/B21) HOT STRUCTURE	6	2	2	-	0	7	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC HOT STRUCTURE	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edge	NB,	6	1	2	-	0	3	4	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	TMC	6	1	2	-	0	5	19	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	TAIL	NB,	6	1	2	-	0	3	17	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	WING	NB,	6	1	2	-	0	3	18	0	0	0	0	0	0	0

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Technical Assessment: Sorted by Major System Technology Group

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Sorted By Major System-Technology Group

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	BD3 (1-4)	Tech Need? (1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	MHD RAM ROCKET	INTEGRATED PROPELLANT MANAGEMENT SYSTEM	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	BIT FOR ENGINE, AND STRUCTURES, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	ENGINE, STRUCTURE, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010

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Sorted By Major System-Technology Group

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	BD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	VHM/BIT/BITE	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	6	2	2	-	0	8	1	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	DRAG REDUCTION	Cold Plasma	2	4	3	48	4	1	3	1	1	2	3	7	28	2028
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Body Flap	Advanced Composite Structures	3	2	2	12	3	6	15	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ROS (1-4)	Tech Need?(1-3)	TT	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Advanced C-C	3	2	2	12	3	26	15	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	Body Flap	Graphite Epoxy	4	2	3	12	2	17	15	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Intertank	Advanced Composite Structures	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Advanced Composite Structures	4	2	2	8	2	6	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Thrust Structure	Advanced Composite Structures	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IOS (1-4)	Tech Need? (1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Control Surfaces	Advanced Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Body Flap	EMAs	4	2	2	8	2	54	15	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Intertank	Ti-Al/Hot Structure	5	2	3	6	1	4	19	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure & Overshell	Ti-Al/Hot Structure	5	2	2	4	1	4	1	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	TMC	6	1	2	-	0	5	18	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Control Actuators	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Control Actuators	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Pneumatic Actuators	6	2	2	-	0	9	45	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	Centralized Hydraulic System (8000 psi)	2	2	2	16	4	1	5	1	1	2	3	7	14	2014

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need? (1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	No New Technology	6	2	2	-	0	1	5	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020

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Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	2	16	2	7	21	0	0	2	3	5	20	2020
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	EMAs	3	2	3	18	3	54	18	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	VTVL Gear System	Extremely Reliable Mechanical Systems	4	2	3	12	2	1	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	Hydraulic Actuators (High Pressure)	3	1	3	9	3	1	29	0	1	2	3	6	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Brakes	HIGH TEMPERATURE	4	2	2	8	2	1	1	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0

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Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	EHP Conversion & Dist.	EMAs	5	2	2	4	1	54	5	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	HIGH TEMP	4	2	1	4	2	1	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	TIRES	HIGH SPEED	4	2	1	4	2	1	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	4	1	2	4	2	54	29	0	0	2	3	5	5	0

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	TMC	5	1	3	3	1	5	18	0	0	0	3	3	3	
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Fusion Engine	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Ionizer	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ELECTRO MAGNETIC REFRIGERATOR	LIQUID HELIUM COOLER	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FLOW CONDUCTIVITY CONTROL	ION BEAM GENERATOR	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	5-10 TESLA SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD RAMJET	MACH 5.6-12.0	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=12 to 15)	3	3	3	27	3	1	47	0	1	2	3	6	18	2018
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Overall ESJ Integrated Performance & Mode Transition	3	3	3	27	3	1	1	0	1	2	3	6	18	2018
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Chemical Heat Regeneration	Chemical Heat Regeneration	2	3	2	24	4	2	2	1	1	2	3	7	21	2021

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Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	2	3	24	4	3	47	1	1	2	3	7	14	2014
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Main Propulsion System	ACE	Air Collection and Enrichment	1	4	1	20	5	1	1	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Combustor	3	2	3	18	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Multi-Engine Integrated Performance & Mode Transition	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Retracting Supercharging Fan	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Si3N4 Components	3	2	3	18	3	1	9	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Propellant Transfer Systems	Flight-Operable Liquid Air Pumping System (w/ Interconnects)	3	2	3	18	3	1	1	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	3	18	3	3	9	0	1	2	3	6	12	2012

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 0-2.8	4	3	3	18	2	1	6	0	0	2	3	5	15	2015
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	SCRAMJET	MACH 4.0-9.0	4	3	3	18	2	1	1	0	0	2	3	5	15	2015
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 9.0-11.8	3	2	3	18	3	1	6	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Inlet EMAs	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode w/LOX Aug. (Mach 14-18)	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Inlet Hydraulic Actuators	2	2	2	16	4	1	15	1	1	2	3	7	14	2014
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Filters	2	2	2	16	4	2	6	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Rocket Nozzle	Variable Geometry Exit Nozzle	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Extension Nozzle	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Forebody Ramp	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet Mode (M=5 to 8)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=8 to 12)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Supercharged Ejector Mode (M=3 to 5)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	O2 Turbopump	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	2	12	3	3	9	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Cu-8Co-4Nb for MCC Liner	3	2	2	12	3	1	9	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Nanophase Al Components	3	2	2	12	3	2	5	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Nanophase Al Components	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	ATREX Engines	3	2	2	12	3	1	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	3	2	2	12	3	6	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	3	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System	3	2	2	12	3	1	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	2	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ID3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	4	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	3	2	2	12	3	13	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	3	2	2	12	3	7	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Combuster	3	2	2	12	3	1	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Nozzle	3	2	2	12	3	13	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	HIGH PERFORMANCE INJECTORS	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Composite Propellant Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	EMAs	3	2	2	12	3	54	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	SERVO VALVES	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Composite Feed Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	9	1	2	15	0	0	0	3	3	9	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	9	1	2	15	0	0	0	3	3	9	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Combustor	4	2	2	8	2	4	4	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	2	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Turbopumps	4	2	2	8	2	4	1	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	6	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Combuster	4	2	2	8	2	1	2	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	IM	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 6)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Combustor Film Cooling	4	2	2	8	2	6	3	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Engine Systems	Ramjet (M=3 to 5)	4	2	2	8	2	6	9	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	External Rocket System (ERS) Engine	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: External Burning	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	2	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	6	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	4	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	4	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Combustor Film Cooling	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Ramjet (M=3 to 6)	4	2	2	8	2	2	7	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	4	2	2	8	2	13	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	APU (GAS EXPANDER)	4	2	2	8	2	2	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	POWER SYSTEMS	APU (GAS EXPANDER)	4	2	2	8	2	2	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	BOOST PUMPS	4	2	2	8	2	2	6	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	COWL	Actively-Cooled	5	2	3	6	1	30	1	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET INJECTOR	MACH 0-2.0,	4	1	3	6	2	1	1	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	LEADING EDGE	Actively-Cooled	5	2	3	6	1	30	4	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Internal Inlet	5	2	2	4	1	5	47	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	47	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	R&D (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	5	2	2	4	1	10	2	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Ox Rich Pre-Burner	5	2	2	4	1	1	4	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Main Engine Control System Actuators	EMAs	5	2	2	4	1	54	1	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Gas/Gas Injection	5	2	2	4	1	2	5	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Gas/Gas Injection	5	2	2	4	1	2	6	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	4	1	2	4	2	10	2	0	0	2	3	5	5	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	1	2	4	2	10	19	0	0	2	3	5	5	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Low-Maintenance Turbomachinery and Combustion Systems	5	2	2	4	1	7	3	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	2	2	4	1	3	47	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Rocket Ejectors	5	2	2	4	1	3	6	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Non-Integral Graphite Epoxy/PEEK Honeycomb w/ metal liners	5	2	2	4	1	1	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	Internal Inlet and Nozzle	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	4	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	1	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Internal Inlet	5	2	2	4	1	5	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	13	7	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	MORE HOT STRUCTURE	5	2	2	4	1	1	2	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Filters	4	1	2	4	2	2	6	0	0	2	3	5	5	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	GG for Ducted Fans	3	1	1	3	3	1	4	0	1	2	3	6	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 11.8-CUTOFF	5	1	3	3	1	1	2	0	0	0	3	3	3	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Ox Rich Operation	5	1	2	2	1	2	5	0	0	0	3	3	3	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Ox Rich Operation	5	1	2	2	1	2	6	0	0	0	3	3	3	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LOX Tank	Non-Integral GP/Epoxy.	5	1	2	2	1	1	19	0	0	0	3	3	3	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	BOOST PUMPS	5	1	2	2	1	2	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	EMAs	5	1	2	2	1	54	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	SERVO VALVES	5	1	2	2	1	2	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Turbopumps	5	1	2	2	1	4	6	0	0	0	3	3	3	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	R03 (1-4)	Tech Need7(1-3)	IT	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Radiation Cooled Nozzle- C/SiC	7	2	2	-	0	1	4	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Actively-Cooled Nozzle	6	2	2	-	0	13	2	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Actively-Cooled Nozzle	6	2	2	-	0	13	5	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Actively-Cooled Nozzle	6	2	2	-	0	13	6	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Nozzle	6	2	2	-	0	3	2	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	In-Flight Propellant Transfer	High Speed LOX Pumping System	6	2	2	-	0	1	1	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IRD3 (1-4)	Tech Need?(1-3)	IM	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Internal Inlet	9	2	2	-	0	5	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Nozzle	9	2	2	-	0	13	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	TP Ducted Fans (Props)	6	1	1	-	0	1	4	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Actively-Cooled Nozzle	9	1	2	-	0	13	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	6	2	2	-	0	7	2	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.0-5.6	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.8-4.0	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 12.0-CUTOFF	6	1	2	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Nose	DRAG REDUCTION	MICROWAVE	2	4	3	48	4	2	3	1	1	2	3	7	28	2028

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	IRD3 (1-4)	Tech Need?(1-3)	TI	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	OMS/Reaction Control System (RCS)	Feed Lines & Valves (for Cryogenic OMS/RCS)		6	2	2	-	0	0	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX/LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	Thrusters	Pressure-Fed Cryo Gaseous	6	2	2	-	0	1	28	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid Thrusters	3	2	2	12	3	1	28	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010

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Sorted By Major System-Technology Group

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-Fed Thrusters	5	2	2	4	1	1	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Pump-Fed Cryo Engine	6	2	2	-	0	1	5	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Primary Power	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Distribution & Pressurization	Stoichometric	4	2	2	8	2	1	2	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Primary Power	Power Supply	APU	4	2	2	8	2	1	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ROS (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Propellant Supply	Distribution & Pressurization	5	2	2	4	1	2	1	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank (NO DENSIFIED)	PRESSURE-FED GH/GO	5	2	1	2	1	3	2	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Hydraulic Actuators	2	2	2	16	4	15	29	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ID3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Tail System	Tail	Ti-Al/Hot Structure	5	2	3	6	1	4	17	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Advanced Composite Structures	3	2	2	12	3	6	17	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	EMAs	3	2	2	12	3	54	2	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Tail Systems	Tail	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tail Systems	Tail	Advanced Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MLI	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MULTI-LAYER	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Leading Edge	C/SIC AND CC.	3	2	3	18	3	3	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Nose Cap	C/SIC AND CC.	3	2	3	18	3	3	19	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Wing	C/SIC AND CC.	3	2	3	18	3	3	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Insulation	Rigid Polymide Foam	3	2	2	12	3	1	2	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	INSULATION	Integral Graphite Epoxy	4	2	3	12	2	12	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Intertank	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	19	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	LH2 TANK (NO SLUSH)	Advanced Composite Materials Tanks	4	2	3	12	2	6	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LH2 TANK (NO SLUSH).	Integral Graphite Epoxy	4	2	3	12	2	12	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LOX Tank (NO DENSIFIED)	Advanced Composite Materials Tanks	4	2	3	12	2	6	2	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tanks	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Forebody Centerline	Actively-Cooled Film	3	3	3	27	3	1	1	0	1	2	3	6	18	2018
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket Plane (w/ In-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	AEBTB/TUFI-C	3	2	2	12	3	3	26	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	AEBTB/TUFI-C	3	2	2	12	3	3	45	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Inlets	Actively-Cooled	3	2	2	12	3	30	3	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp Edge)	4	2	3	12	2	2	20	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	AEROJET STRUTJET	INTEGRATED PROPELLANT CONTROLS	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	COWL	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	Leading Edge	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	KD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Non-Tank Primary Structure	TMC (SiC/B21),	4	2	3	12	2	1	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	3	3	9	1	30	3	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	3	3	9	1	30	20	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-10	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	3	3	9	1	30	18	0	0	0	3	3	9	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C (Orbiter)	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C (Orbiter), None on Booster	4	2	2	8	2	1	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Graphite Polymide w/TABI	4	2	2	8	2	7	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010

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Sorted By Major System-Technology Group

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	AEBTB/TUFI-C	4	2	2	8	2	3	12	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Hot Structure	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	4	2	2	8	2	30	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	4	2	2	8	2	12	26	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Wing	Advanced C-C	4	2	2	8	2	26	18	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
NDV SSTO (LACE/SESJ)	HTHL-SSTO-2	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled Advanced Materials	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TMC (SIC/B21) HOT STRUCTURE	4	2	2	8	2	7	12	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	THRUSTERS	Actively-Cooled	5	2	3	6	1	30	28	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	2	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	2	2	4	1	30	18	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Internal Inlet	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	19	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	External Cryogenic Insulation	Rohacell	5	2	2	4	1	1	1	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Advanced Hydrocarbon-	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Inconel Metallic Tiles	6	2	2	-	0	1	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Ti-Al Hot Structure	6	2	2	-	0	3	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Sharp TPS	6	2	3	-	0	3	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Inlet	Sharp TPS	6	2	3	-	0	3	2	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Sharp TPS	6	2	3	-	0	3	20	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp Edge)	6	2	3	-	0	2	19	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	9	2	2	-	0	1	11	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC(Over Ti-Al)	6	2	2	-	0	1	45	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	1	0	0	0	0	0	0	0

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Sorted By Major System-Technology Group

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC (SIC/B21) HOT STRUCTURE	6	2	2	-	0	7	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC HOT STRUCTURE	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edge	NB.	6	1	2	-	0	3	4	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	TMC	6	1	2	-	0	5	19	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	TAIL	NB.	6	1	2	-	0	3	17	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	WING	NB.	6	1	2	-	0	3	18	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Drag Reduction	Microwave	2	4	3	48	4	2	3	1	1	2	3	7	28	2028
Advanced Hydrocarbon-	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Hot Structure	4	2	3	12	2	4	45	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Wing	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	18	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	Centralized Hydraulic System	3	2	2	12	3	1	45	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Wing	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Wing Systems	Wing	TMC SIC/B21) Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Advanced Composite Structures	4	2	2	8	2	6	45	0	0	2	3	5	10	2010

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Rocket SSTO (w/ 55 degree	VTHL-SSTO-6	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-	HTHL-TSTO-2	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Hot Structures	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Control Surfaces	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Wing Systems	Wing	Advanced Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	FULL WING ACTIVATION SYSTEM	4	2	2	8	2	1	45	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	EMAs	4	1	2	4	2	54	45	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	TMC AERO SURFACES	5	1	2	2	1	1	45	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Intertank	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	19	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Primary Structure	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	1	0	0	0	3	3	3	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Fusion Engine	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Ionizer	MHD	2	4	3	48	4	2	1	1	1	2	3	7	28	2028
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	4	3	48	4	3	47	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	DRAG REDUCTION	Cold Plasma	2	4	3	48	4	1	3	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ELECTRO MAGNETIC REFRIGERATOR	LIQUID HELIUM COOLER	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FLOW CONDUCTIVITY CONTROL	ION BEAM GENERATOR	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	5-10 TESLA SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD GENERATOR	SUPERCONDUCTING MAGNETIC	2	4	3	48	4	1	2	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	MHD RAMJET	MACH 5.6-12.0	2	4	3	48	4	1	1	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Nose	DRAG REDUCTION	MICROWAVE	2	4	3	48	4	2	3	1	1	2	3	7	28	2028
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Drag Reduction	Microwave	2	4	3	48	4	2	3	1	1	2	3	7	28	2028
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	4	3	36	3	8	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Extension Nozzle	3	4	3	36	3	3	47	0	1	2	3	6	24	2024
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Forebody Ramp	3	4	3	36	3	3	47	0	1	2	3	6	24	2024

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Chemical Heat Regeneration	Chemical Heat Regeneration	2	3	2	24	4	2	2	1	1	2	3	7	21	2021
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	2	16	2	7	21	0	0	2	3	5	20	2020
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet (M=3 to 5)	4	4	3	24	2	6	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	4	3	24	2	3	47	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020

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Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	4	4	3	24	2	8	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	GigaJoule Energy Storage System	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Launch Support	Ground Launch Assist	Electromagnetic Catapult	Superconducting EM Levitation, Propulsion & Guidance	4	4	3	24	2	7	21	0	0	2	3	5	20	2020
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=12 to 15)	3	3	3	27	3	1	47	0	1	2	3	6	18	2018
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Health Monitoring	Integrated, Adaptive, Predictive Health Monitoring System	3	3	3	27	3	2	4	0	1	2	3	6	18	2018
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Overall ESJ Integrated Performance & Mode Transition	3	3	3	27	3	1	1	0	1	2	3	6	18	2018

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CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Forebody Centerline	Actively-Cooled Film	3	3	3	27	3	1	1	0	1	2	3	6	18	2018
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 0-2.8	4	3	3	18	2	1	6	0	0	2	3	5	15	2015
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	SCRAMJET	MACH 4.0-9.0	4	3	3	18	2	1	1	0	0	2	3	5	15	2015
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Inlet EMAs	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode w/LOX Aug. (Mach 14-18)	2	2	2	16	4	1	47	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Hydraulic Actuators	2	2	2	16	4	15	29	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Inlet Hydraulic Actuators	2	2	2	16	4	1	15	1	1	2	3	7	14	2014
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	Centralized Hydraulic System (8000 psi)	2	2	2	16	4	1	5	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet w/LOX augmentation	2	2	3	24	4	3	47	1	1	2	3	7	14	2014
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Surface Control Actuation	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014

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Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Body Systems	Doors	Hydraulic Actuators	2	2	2	16	4	15	18	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Hydraulic Actuators	2	2	2	16	4	15	45	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Inlets	Hydraulic Actuators	2	2	2	16	4	15	3	1	1	2	3	7	14	2014
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Control Actuators	Hydraulic Actuators	2	2	2	16	4	15	22	1	1	2	3	7	14	2014
NDV SST0 (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Filters	2	2	2	16	4	2	6	1	1	2	3	7	14	2014
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Rocket Nozzle	Variable Geometry Exit Nozzle	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Combustor	3	2	3	18	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Extension Nozzle	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Forebody Ramp	3	2	2	12	3	3	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Multi-Engine Integrated Performance & Mode Transition	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Retracting Supercharging Fan	3	2	3	18	3	1	47	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Body Flap	Advanced Composite Structures	3	2	2	12	3	6	15	0	1	2	3	6	12	2012

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Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	O2 Turbopump	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Advanced Composite Structures	3	2	2	12	3	6	17	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	2	12	3	3	9	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012

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Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid Thrusters	3	2	2	12	3	1	28	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Cu-8Co-4Nb for MCC Liner	3	2	2	12	3	1	9	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Si3N4 Components	3	2	3	18	3	1	9	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Nanophase Al Components	3	2	2	12	3	2	5	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012

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ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Nanophase Al Components	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	Tanks	Insulation — Rigid Polymide Foam on Tanks	3	2	2	12	3	4	43	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Propellant Supply Systems	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Pi Foam	3	2	2	12	3	12	26	0	1	2	3	6	12	2012
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Liquid	3	2	2	12	3	3	28	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	AEBTB/TUFI-C	3	2	2	12	3	3	26	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	AEBTB/TUFI-C	3	2	2	12	3	3	45	0	1	2	3	6	12	2012
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data: Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSIC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Propellant Transfer Systems	Flight-Operable Liquid Air Pumping System (w/ Interconnects)	3	2	3	18	3	1	1	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	ATREX Engines	3	2	2	12	3	1	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	3	2	2	12	3	6	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	3	0	1	2	3	6	12	2012

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Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Primary Power	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	6	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Advanced C-C	3	2	2	12	3	26	15	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Main Propulsion System	Engine Systems	Nozzle	3	2	3	18	3	3	9	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System	3	2	2	12	3	1	47	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	2	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Inlets	Actively-Cooled	3	2	2	12	3	30	3	0	1	2	3	6	12	2012
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012

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Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Body Systems	Body Flap	Composite Materials	3	2	2	12	3	14	15	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	On-Board System: spray bars, jet mixers, boost pumps	3	2	2	12	3	3	4	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	4	3	12	1	3	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	3	2	2	12	3	14	45	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Advanced Insulation on Tanks	3	2	2	12	3	2	26	0	1	2	3	6	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Internal Inlet	5	4	3	12	1	5	47	0	0	0	3	3	12	2012
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Thermal Protection System (TPS)	SESJ RBCC	Actively-Cooled Nozzle	5	4	3	12	1	13	47	0	0	0	3	3	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012

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Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Engine Control	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	1	6	3	8	6	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Combustor	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	3	2	2	12	3	54	29	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSIC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	4	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous Thrusters	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Extension Nozzle	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Thermal Protection System (TPS)	Forebody Ramp	Actively-Cooled	3	2	2	12	3	30	2	0	1	2	3	6	12	2012
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	TVC	Integrated Prop/Controls (Air Data; Fuel /Cowl Control, Cowl)	3	2	2	12	3	8	9	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Body Flap	Refractory Composite	3	2	2	12	3	4	15	0	1	2	3	6	12	2012

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CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	CSiC Feed Lines	3	2	2	12	3	5	18	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	3	2	2	12	3	13	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	3	2	2	12	3	7	5	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Combuster	3	2	2	12	3	1	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Engine Integrated Performance & Mode Transition	3	2	2	12	3	8	7	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Passive)	Main Propulsion System	Tanks	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	43	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pressure-fed Gaseous	3	2	2	12	3	2	28	0	1	2	3	6	12	2012
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	C/SiC and CC	3	2	2	12	3	5	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Body Flap	Adv. C-C Hot Structure	3	2	2	12	3	10	15	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	High Power Density Fuel Cells	3	2	2	12	3	6	23	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Tail Systems	Tail	Adv. C-C Hot Structure	3	2	2	12	3	10	17	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	Graphite Polymide w/TABI	3	2	2	12	3	7	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	TABI	3	2	2	12	3	6	45	0	1	2	3	6	12	2012
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Thermal Protection System (TPS)	Internal Insulation	Rigid Polymide Foam on Tanks	3	2	2	12	3	9	26	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	MHD RAM ROCKET	INTEGRATED PROPELLANT MANAGEMENT SYSTEM	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	BIT FOR ENGINE, AND STRUCTURES, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Health Monitoring	ENGINE, STRUCTURE, SUBSYSTEMS	3	2	2	12	3	1	4	0	1	2	3	6	12	2012

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	EMAs	3	2	3	18	3	54	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Combustor	3	2	2	12	3	3	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	Actively-Cooled Nozzle	3	2	2	12	3	13	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	HIGH PERFORMANCE INJECTORS	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET	MACH 9.0-11.8	3	2	3	18	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Composite Propellant Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	EMAs	3	2	2	12	3	54	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	SERVO VALVES	3	2	2	12	3	2	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Composite Feed Lines	3	2	2	12	3	1	6	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	EMAs	3	2	2	12	3	54	2	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Insulation	Rigid Polymide Foam	3	2	2	12	3	1	2	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Leading Edge	C/SIC AND CC,	3	2	3	18	3	3	4	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Nose Cap	C/SIC AND CC,	3	2	3	18	3	3	19	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Wing	C/SIC AND CC,	3	2	3	18	3	3	18	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	AEROJET STRUTJET	INTEGRATED PROPELLANT CONTROLS	3	2	2	12	3	1	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	COWL	Actively-Cooled	3	2	2	12	3	30	1	0	1	2	3	6	12	2012
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	Leading Edge	Actively-Cooled	3	2	2	12	3	30	4	0	1	2	3	6	12	2012

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	Centralized Hydraulic System	3	2	2	12	3	1	45	0	1	2	3	6	12	2012
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	VTVL Gear System	Extremely Reliable Mechanical Systems	4	2	3	12	2	1	1	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet Mode (M=5 to 8)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet Mode (M=8 to 12)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Supercharged Ejector Mode (M=3 to 5)	4	2	3	12	2	1	47	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Distribution & Pressurization	Stoichometric	4	2	2	8	2	1	2	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Tail Systems	Tail	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010

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VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Wing Systems	Wing	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Intertank	Advanced Composite Structures	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Advanced Composite Structures	4	2	2	8	2	6	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Body Systems	Thrust Structure	Advanced Composite Structures	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Combustor	4	2	2	8	2	4	4	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C (Orbiter)	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C (Orbiter), None on Booster	4	2	2	8	2	1	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Graphite Polymide w/TABI	4	2	2	8	2	7	19	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Advanced Composite Structures	4	2	2	8	2	6	45	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010

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Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Body Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Tanks	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	2	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010

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Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Turbopumps	4	2	2	8	2	4	1	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	1	4	2	10	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010

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ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	6	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Pi Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Combuster	4	2	2	8	2	1	2	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010

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Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Primary Power	Power Supply	APU	4	2	2	8	2	1	23	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	AEBTB/TUFI-C	4	2	2	8	2	3	12	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Hot Structure	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Wing Systems	Wing	Graphite Polymide	4	2	2	8	2	11	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 6)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Combustor Film Cooling	4	2	2	8	2	6	3	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010

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Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Orbiter)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap (Booster)	Advanced C-C	4	2	2	8	2	26	1	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Control Surfaces	Hot Structures	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Engine Systems	Ramjet (M=3 to 5)	4	2	2	8	2	6	9	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	External Rocket System (ERS) Engine	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: External Burning	4	2	2	8	2	1	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Low Speed System: Low Speed Ejector	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=12 to 20)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Scramjet (M=8 to 12)	4	2	2	8	2	3	47	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	Slush H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	2	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010

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Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tail Systems	Tail	Hot Structure	4	2	2	8	2	4	17	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	4	2	2	8	2	30	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Control Surfaces	TMC SiC/B21) Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Wing Systems	Wing	Hot Structures	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010

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Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Main Propulsion System	Densified H2 System	Production, Delivery & On-Board Maintenance	4	2	2	8	2	3	4	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LH2 Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank	Advanced Composite Materials Tanks	4	2	2	8	2	6	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tail Systems	Tail	Composite Materials	4	2	2	8	2	14	17	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Tanks	Intertank	Composite Materials	4	2	2	8	2	14	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	12	0	0	2	3	5	10	2010

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Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Advanced Materials TPS over Composite Structures	4	2	2	8	2	4	26	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Control Surfaces	Composite Materials	4	2	2	8	2	14	45	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	4	2	2	8	2	5	11	0	0	2	3	5	10	2010
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Wing Systems	Wing	Composite Materials	4	2	2	8	2	14	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	6	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp Edge)	4	2	3	12	2	2	20	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Hot Structure	4	2	3	12	2	4	45	0	0	2	3	5	10	2010
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Wing Systems	Wing	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	18	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharging Fan (Windmilling/Cooling)	4	2	2	8	2	2	15	0	0	2	3	5	10	2010
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Wing Systems	Control Surfaces	Ti-Al/Si-C Hot Structure	4	2	3	12	2	3	45	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010

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Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Control Surfaces	Advanced Hot Structure	4	2	2	8	2	3	45	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Combustor Film Cooling	4	2	2	8	2	6	4	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Ramjet (M=3 to 5)	4	2	2	8	2	6	4	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tail Systems	Tail	Advanced Hot Structure	4	2	2	8	2	3	17	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Tanks	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Wing Systems	Wing	Advanced Hot Structure	4	2	2	8	2	3	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Intertank	Graphite Epoxy	4	2	2	8	2	17	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010

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CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Combustor Film Cooling	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Ramjet (M=3 to 6)	4	2	2	8	2	2	7	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Primary Power	Power Supply	Fuel Cells	4	2	2	8	2	9	23	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Reaction Control System (RCS)	LOX Tank	Non-Integral Al Li	4	2	2	8	2	4	19	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over Rohacell	4	2	2	8	2	7	26	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Graphite Epoxy	4	2	2	8	2	17	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Body Systems	Thrust Structure	Al Li/Graphite Epoxy	4	2	2	8	2	6	7	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Actively-Cooled Nozzle	4	2	2	8	2	13	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Active)	Main Propulsion System	Adv. LOX-H2 Cryogen Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	4	2	2	8	2	7	5	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	EMA Actuation for Valves	4	2	2	8	2	5	18	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy	4	2	2	8	2	12	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	2	2	8	2	10	19	0	0	2	3	5	10	2010

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Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	4	2	2	8	2	11	28	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Primary Power	Power Supply	Dual-Mode APU (Gas Generator/Expander)	4	2	2	8	2	5	23	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Reaction Control System (RCS)	Intertank	Graphite Polymide	4	2	2	8	2	11	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over PI Foam	4	2	2	8	2	12	12	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TABI over PI Foam	4	2	2	8	2	12	26	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Advanced C-C	4	2	2	8	2	26	20	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Advanced C-C	4	2	2	8	2	26	19	0	0	2	3	5	10	2010
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Wing	Advanced C-C	4	2	2	8	2	26	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-2	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled Advanced Materials	4	2	2	8	2	1	20	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	Sensors, Data Process., Comm., GN&C	Fault-tolerant/quad redundant Architecture	4	2	2	8	2	18	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Body Flap	EMAs	4	2	2	8	2	54	15	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Body Systems	Body Flap	Graphite Epoxy	4	2	3	12	2	17	15	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Brakes	HIGH TEMPERATURE	4	2	2	8	2	1	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	HIGH TEMP	4	2	1	4	2	1	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	TIRES	HIGH SPEED	4	2	1	4	2	1	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	APU (GAS EXPANDER)	4	2	2	8	2	2	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	POWER SYSTEMS	APU (GAS EXPANDER)	4	2	2	8	2	2	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	BOOST PUMPS	4	2	2	8	2	2	6	0	0	2	3	5	10	2010

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NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAM, SCRAM	Turbopumps	4	2	2	8	2	4	6	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	INSULATION	Integral Graphite Epoxy	4	2	3	12	2	12	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tanks	Intertank	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	19	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Tanks	LH2 TANK (NO SLUSH)	Advanced Composite Materials Tanks	4	2	3	12	2	6	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LH2 TANK (NO SLUSH),	Integral Graphite Epoxy	4	2	3	12	2	12	1	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Tanks	LOX Tank (NO DENSIFIED)	Advanced Composite Materials Tanks	4	2	3	12	2	6	2	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TMC (SIC/B21) HOT STRUCTURE	4	2	2	8	2	7	12	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Body-Windward Surface	FRCI-12 over Rohacell	4	2	2	8	2	6	26	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Non-Tank Primary Structure	TMC (SIC/B21),	4	2	3	12	2	1	18	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	FULL WING ACTIVATION SYSTEM	4	2	2	8	2	1	45	0	0	2	3	5	10	2010
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Wing	TMC (SIC/B21) HOT STRUCTURE	4	2	3	12	2	7	18	0	0	2	3	5	10	2010
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Internal Inlet	5	2	2	4	1	5	47	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	47	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0

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VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	2	0	0	0	3	3	6	0
VTVL (Kaiser Marquardt)	VTVL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	2	2	4	1	30	18	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Control Actuators	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	5	2	2	4	1	10	2	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Ox Rich Pre-Burner	5	2	2	4	1	1	4	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Light Hydrocarbon -LOX Rocket Engine	Radiation Cooled Nozzle- C/SiC	7	2	2	-	0	1	4	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	Main Engine Control System Actuators	EMAs	5	2	2	4	1	54	1	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Propulsion (Active)	Reaction Control System (RCS)	Propellant Supply	Distribution & Pressurization	5	2	2	4	1	2	1	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Advanced Hydrocarbon-TSTO	VTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RDS (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Electric, Hydraulic, Pneumatic	EHP Conversion & Dist.	No New Technology	6	2	2	-	0	1	5	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
Electric Fusion SSTO Rocket	VTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Landing Gear	EHP Conversion & Dist.	EMAs	5	2	2	4	1	54	5	0	0	0	3	3	6	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Active)	Main Propulsion System	Advanced SSME-Class Turbopump Engine	Actively-Cooled Nozzle	6	2	2	-	0	13	2	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Rocket SSTO (w/ 55 degree Catapult)	VTHL-SSTO-6	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Actively-Cooled Nozzle	6	2	2	-	0	13	5	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Gas/Gas Injection	5	2	2	4	1	2	5	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=183	Ox Rich Operation	5	1	2	2	1	2	5	0	0	0	3	3	3	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 183 All-Rocket	VTHL-SSTO-5	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Control Actuators	Pneumatic Actuators	6	2	2	-	0	9	22	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Landing Gear	Power Supply	EHP Conversion & Dist.	5	2	2	4	1	5	23	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	Full Flow Staged Combustion Power Cycle	4	1	3	6	2	2	9	0	0	2	3	5	5	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	Engine Systems	O2 Dissociation Laser Ignitors	5	1	2	2	1	2	9	0	0	0	3	3	3	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LH2 Tank	Aluminum/Inconel	6	2	2	-	0	15	19	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Main Propulsion System	LOX Tank(s)	Aluminum/Inconel	6	2	2	-	0	15	2	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Actively-Cooled Nozzle	6	2	2	-	0	13	6	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Gas/Gas Injection	5	2	2	4	1	2	6	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Main Propulsion System	SSME-Class Turbopump Engine @ T/W=92	Ox Rich Operation	5	1	2	2	1	2	6	0	0	0	3	3	3	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	ID3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Orbital Maneuvering System (OMS)	Tanks	Propellant Distribution & Pressurization	5	2	2	4	1	2	43	0	0	0	3	3	6	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Feed Lines & Valves	Al & Steel Feed Lines	6	2	2	-	0	3	18	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
ACRE 92 All-Rocket	VTHL-SSTO-4	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Ducting, EMA Vent Door Activators	6	2	2	-	0	3	11	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Active)	Landing Gear	Control Actuators	EMAs	5	2	2	4	1	54	22	0	0	0	3	3	6	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	Highly-Reliable LOX-RP Rocket Engine	Nozzle	6	2	2	-	0	3	2	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Hydrocarbon Propellant Tank	Integral Al Li	4	1	2	4	2	10	2	0	0	2	3	5	5	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Main Propulsion System	In-Flight Propellant Transfer	High Speed LOX Pumping System	6	2	2	-	0	1	1	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	LOX Tank	Integral Al Li	4	1	2	4	2	10	19	0	0	2	3	5	5	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Passive)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-fed Liquid Thrusters	6	2	2	-	0	11	28	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Propulsion (Active)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket Plane (w/ in-flight prop. X-fer)	HTHL-TSTO-2	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Active)	Main Propulsion System	ACE	Air Collection and Enrichment	1	4	1	20	5	1	1	0	0	0	0	0	0	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Main Propulsion System	SSME-Class Cryogenic Propulsion System	Low-Maintenance Turbomachinery and Combustion Systems	5	2	2	4	1	7	3	0	0	0	3	3	6	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	Pump-Fed Thrusters	5	2	2	4	1	1	28	0	0	0	3	3	6	0
Tandem-ACE TSTO	HTHL-TSTO-1	Propulsion (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Tandem-ACE TSTO	HTHL-TSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Propulsion (Active)	Main Propulsion System	SESJ RBCC	Ramjet/Scramjet (M=5 to 8)	5	2	2	4	1	3	47	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Internal Inlet	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Nose Cap	Actively-Cooled	5	2	2	4	1	30	19	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-9	Vehicle (Active)	Thermal Protection System (TPS)	Rocket Nozzle	Actively-Cooled	5	2	2	4	1	30	4	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
Waverider SSTO (w/ High Speed Catapult)	HTHL-SSTO-8b - LA	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need? (1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Control Actuators	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Propulsion (Passive)	Main Propulsion System	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	EMAs	6	2	2	-	0	54	29	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	2	2	4	1	30	3	0	0	0	3	3	6	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Passive)	Thermal Protection System (TPS)	External Insulation	Foam	9	2	2	-	0	2	2	0	0	0	0	0	0	0
Waverider SSTO	HTHL-SSTO-8a	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	2	2	4	1	30	20	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Avionics	VHM/BIT/BITE	Fault-Tolerant/Highly-Reliable Vehicle Interface/Release	6	2	2	-	0	8	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Intertank	Ti-Al/Hot Structure	5	2	3	6	1	4	19	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure & Overshell	Ti-Al/Hot Structure	5	2	2	4	1	4	1	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Control Actuators	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Internal Inlet	9	2	2	-	0	5	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Actively-Cooled Nozzle	9	2	2	-	0	13	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	6	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	ESJ RBCC	Rocket Ejectors	5	2	2	4	1	3	6	0	0	0	3	3	6	0

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Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjusted
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	GG for Ducted Fans	3	1	1	3	3	1	4	0	1	2	3	6	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Main Propulsion System	Fan Subsystems	TP Ducted Fans (Props)	6	1	1	-	0	1	4	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Non-Integral Graphite Epoxy/PEEK Honeycomb w/	5	2	2	4	1	1	19	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	Main Propulsion System	LOX Tank	Non-Integral GP/Epoxy.	5	1	2	2	1	1	19	0	0	0	3	3	3	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	OMS/Reaction Control System (RCS)	Feed Lines & Valves (for Cryogenic OMS/RCS)		6	2	2	-	0	0	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX/LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Passive)	OMS/Reaction Control System (RCS)	Thrusters	Pressure-Fed Cryo Gaseous	6	2	2	-	0	1	28	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Pump-Fed Cryo Engine	6	2	2	-	0	1	5	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Tail System	Tail	Ti-Al/Hot Structure	5	2	3	6	1	4	17	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Inconel Metallic Tiles	6	2	2	-	0	1	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Ti-Al Hot Structure	6	2	2	-	0	3	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Sharp TPS	6	2	3	-	0	3	1	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Engine Inlet	Sharp TPS	6	2	3	-	0	3	2	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	External Cryogenic Insulation	Rohacell	5	2	2	4	1	1	1	0	0	0	3	3	6	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Sharp TPS	6	2	3	-	0	3	20	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp Edge)	6	2	3	-	0	2	19	0	0	0	0	0	0	0
CPS Hyperion	HTHL-SSTO-7	Vehicle (Active)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization/ Repressurization & Cavity Purge	9	2	2	-	0	1	11	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0

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Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	- 9	1	2	15	0	0	0	3	3	9	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC (over Ti-Al)	6	2	2	-	0	2	45	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	2	0	0	0	0	0	0	0
Argus (w/High Speed Catapult)	HTHL-SSTO-6 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Avionics	GNC	Autonomous Landing	7	2	3	-	0	3	3	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	1	2	-	0	54	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Intertank	Ti-Al	5	2	2	4	1	4	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	Ti-Al	5	2	2	4	1	4	18	0	0	0	3	3	6	0

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CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	Fan Subsystems	Gas Generator	3	1	3	9	3	2	4	0	1	2	3	6	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Main Propulsion System	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	1	2	-	0	5	18	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LH2 Tank	Integral Graphite Epoxy/ Honeycomb w/ metal liners	5	2	2	4	1	2	19	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Main Propulsion System	LOX Tank	Graphite Epoxy Non-Integral	5	1	2	2	1	2	19	0	0	0	3	3	3	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	EMAs Inlet Actuators	6	1	2	-	0	4	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Internal Inlet and Nozzle Active Cooling	9	2	2	-	0	2	15	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Rocket Ejectors	5	2	2	4	1	3	15	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Supercharged Ejector Ramjet (M=3 to 6)	5	3	3	9	1	2	15	0	0	0	3	3	9	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Actively-Cooled Nozzle	9	1	2	-	0	13	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Main Propulsion System	SSME-Class LOX/H2 Rocket Engine	Low-Maintenance Turbomachinery and Combustion Systems	6	2	2	-	0	7	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LH2 Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	OMS/Reaction Control System (RCS)	LOX Tank	Non-Integral Al 2219	9	1	2	-	0	5	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Engines	Cryogenic	6	2	2	-	0	2	5	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Feed & Pressurization	Cryogenic Systems	6	2	2	-	0	2	2	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Active)	Reaction Control System (RCS)	Thrusters	Engines	6	2	2	-	0	5	28	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Tail Systems	Tail	Ti-Al Hot Structure	5	2	3	6	1	3	17	0	0	0	3	3	6	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Tanks	External Insulation (Cryo)	Rohacell Foam on Tanks	5	2	2	4	1	2	2	0	0	0	3	3	6	0

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CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Leeward Surface	TABI over Rohacell	6	2	2	-	0	7	12	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	Metallic Inconel over Rohacell	6	2	2	-	0	2	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Control Surfaces	ACC(Over Ti-Al)	6	2	2	-	0	1	45	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Propulsion (Passive)	Thermal Protection System (TPS)	Engine Inlet	Ultra-High Temperature Ceramics	6	2	3	-	0	2	1	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	1	2	-	0	15	26	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Leading Edges	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	20	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	Ultra-High Temperature Ceramics (Sharp-Point)	6	2	3	-	0	4	19	0	0	0	0	0	0	0
CPS Argus (w/ High Speed Catapult)	HTHL-SSTO-5 - LA	Vehicle (Passive)	Thermal Protection System (TPS)	Purge/Vent/Drain	Tank Pressurization	9	2	2	-	0	2	11	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	Internal Inlet and Nozzle	Actively-Cooled	5	2	2	4	1	30	1	0	0	0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC	Actively-Cooled Nozzle	5	2	2	4	1	13	4	0	0	.0	3	3	6	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Primary Power	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Hydrogen RBCC (w/ Low-Speed Catapult)	HTHL-SSTO-4-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Active)	Control Actuators	Control Surfaces	Pneumatic Actuators	6	2	2	-	0	9	45	0	0	0	0	0	0	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	1	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Internal Inlet	5	2	2	4	1	5	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Main Propulsion System	SERJ RBCC (Hydrocarbon)	Actively-Cooled Nozzle	5	2	2	4	1	13	7	0	0	0	3	3	6	0
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Propulsion (Active)	Orbital Maneuvering System (OMS)	Tanks	Accumulators	6	2	2	-	0	7	43	0	0	0	0	0	0	0

HRST TECHNOLOGIES ASSESSMENT

Sorted By Time Frame

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
CPS Hydrocarb RBCC (w/Lw Spd Catapult)	HTHL-SSTO-3-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Avionics	TVC	EMAs	5	2	2	4	1	54	9	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Body Systems	Doors	EMAs	6	2	2	-	0	54	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Control Actuators	Control Surfaces	EMAs	5	2	2	4	1	54	45	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	5	2	2	4	1	54	29	0	0	0	3	3	6	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Landing Gear	Feed Lines & Valves	Electric Operated Chill-Down Pumps	9	2	2	-	0	5	18	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Main Propulsion System	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Propulsion (Passive)	Reaction Control System (RCS)	Tanks	Aluminum/Inconel	6	2	2	-	0	15	43	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Active)	Surface Control Actuation	Actuators/Mechanisms	Pneumatic Actuators	6	2	2	-	0	9	29	0	0	0	0	0	0	0
Rocket HTHL (w/ Low-Speed Catapult)	HTHL-SSTO-2-LA	Vehicle (Passive)	Thermal Protection System (TPS)	Internal Insulation	MLI Blankets	9	2	2	-	0	15	26	0	0	0	0	0	0	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Engine Cowl	Actively-Cooled	5	3	3	9	1	30	3	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-11	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edges	Actively-Cooled	5	3	3	9	1	30	20	0	0	0	3	3	9	0
Virtual Veh. SSTO (SESJ)	HTHL-SSTO-10	Vehicle (Active)	Thermal Protection System (TPS)	Wing	Actively-Cooled	5	3	3	9	1	30	18	0	0	0	3	3	9	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Avionics	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Body Systems	Non-Tank Primary Structure	TMC	6	1	2	-	0	5	18	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	EMAs	4	1	2	4	2	54	29	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Actuators/Mechanisms	Hydraulic Actuators (High Pressure)	3	1	3	9	3	1	29	0	1	2	3	6	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	Doors	TMC	5	1	3	3	1	5	18	0	0	0	3	3	3	
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Landing Gear	STRUCTURE	TMC	5	1	2	2	1	5	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	COWL	Actively-Cooled	5	2	3	6	1	30	1	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	DUCTED ROCKET INJECTOR	MACH 0-2.0,	4	1	3	6	2	1	1	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	FOREBODY COMPRESSION RAMPS	MORE HOT STRUCTURE	5	2	2	4	1	1	2	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	LEADING EDGE	Actively-Cooled	5	2	3	6	1	30	4	0	0	0	3	3	6	0

HRST TECHNOLOGIES ASSESSMENT

Sorted By Time Frame

Concept Name	Concept ID No.	Vehicle System Category	Major System-Technology Group	Advanced Technology System/Subsystem	Specific Technology Subsystem/Component	TRL (1-9)	RD3 (1-4)	Tech Need?(1-3)	m	ΔTRL	Specific Technologie	Advanced Technolo	TRL 2-3	TRL 3-4	TRL 4-5	TRL 5-6	Total Time	Years from Start	Time-Frame Adjustec
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.0-5.6	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	RAMJET	MACH 2.8-4.0	6	1	3	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 11.8-CUTOFF	5	1	3	3	1	1	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Rocket	MACH 12.0-CUTOFF	6	1	2	-	0	1	2	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	BOOST PUMPS	5	1	2	2	1	2	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	EMAs	5	1	2	2	1	54	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Filters	4	1	2	4	2	2	6	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	SERVO VALVES	5	1	2	2	1	2	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	ROCKET, RAMJET	Turbopumps	5	1	2	2	1	4	6	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Main Propulsion System	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Orbital Maneuvering System (OMS)	Thrusters	PRESSURE-FED GH/GO	5	2	1	2	1	3	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Reaction Control System (RCS)	LOX Tank (NO DENSIFIED)	PRESSURE-FED GH/GO	5	2	1	2	1	3	2	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MLI	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	Internal Insulation	MULTI-LAYER	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Tail Systems	TAIL (2)	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	2	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC (SIC/B21) HOT STRUCTURE	6	2	2	-	0	7	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Body-Windward Surface	TMC HOT STRUCTURE	6	2	2	-	0	1	26	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	Leading Edge	NB,	6	1	2	-	0	3	4	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Thermal Protection System (TPS)	Nose Cap	TMC	6	1	2	-	0	5	19	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	TAIL	NB,	6	1	2	-	0	3	17	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Propulsion (Active)	Thermal Protection System (TPS)	THRUSTERS	Actively-Cooled	5	2	3	6	1	30	28	0	0	0	3	3	6	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Thermal Protection System (TPS)	WING	NB,	6	1	2	-	0	3	18	0	0	0	0	0	0	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	EMAs	4	1	2	4	2	54	45	0	0	2	3	5	5	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Active)	Wing Systems	Control Surfaces	TMC AERO SURFACES	5	1	2	2	1	1	45	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Intertank	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	19	0	0	0	3	3	3	0
NDV SSTO (LACE/SESJ)	HTHL-SSTO-1	Vehicle (Passive)	Wing Systems	Primary Structure	TMC (SIC/B21) HOT STRUCTURE	5	1	2	2	1	7	1	0	0	0	3	3	3	0

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Strategic Insight provided key inputs to NASA by performing an integrated analysis of high-interest system concepts selected in Phase III and conducting a technology sequencing analysis to validate maturity of major components for selected system concepts. Strategic Insight's efforts shall provide key inputs to confirm the payoff of HRST concepts as building blocks in NASA's long range space transportation plans.

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