

Use Same Propellants in All Stages

Space Propulsion Technology  
Assessment Workshop

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# Current Baseline

## Use Same Propellants in All Stages

- Currently concepts for future vehicles include concepts using multiple stages
  - Two stage or stage-and-a-half
- Thrust augmentation could be used in some architectures
- Upper stages (space transfer stages) may be used
  - If upper stage is a pre-packaged payload to the ETO vehicle, then this briefing does not necessarily apply
- Every propellant brings with it a large ground infrastructure
  - Particularly true for high flight rate Gen 3 type transportation systems as opposed to one of a kind proof of principle vehicles such as DC-X
  - Infrastructure includes not only the immediate vehicle supply facilities, but also
    - Significant logistics train to maintain the facility
    - Different fluids and procedures for cleaning and safety
    - Increased needs for serial processing adding to turnaround timeline
    - Etc.

## Potential Solutions and Technologies (TRL) (Cont'd)

### Use Same Propellants in All Stages

- Use same propellants in all stages of main vehicle (9)
- Use same propellants in thrust augmentation devices as used in main vehicle (6)
- Use same propellants in upper stages as used in main vehicle (6)
  - At least for stages which are loaded at the launch facility

## Drawbacks/Considerations/Observations

### Use Same Propellants in All Stages

- Lox/HC rockets probably require multiple stages
- Lox/HC combined cycles are viable
- Significant development costs for thrust augmentation devices
  - Solids are the only currently developed solution for large vehicles
- Very large infrastructure and operating cost savings can result from this solution
  - Can offset any needed development costs

# Technologies to Implement Solutions (TRLs)

## Use Same Propellants in All Stages

- Although using the same propellants in all stages is mostly a programmatic choice, there are technologies which would improve the performance of some variants of this solution, and/or increase the range of options available
  - HC fuel improvements (2/5)
  - Hybrid motor improvements (4)
    - Only LOX as a fluid
    - The rubber is inert and does not count as a propellant in the sense of this briefing
  - LOX/HC high performance, closed cycle technology
    - Shutdown without coking (3)
  - LOX/hydrogen OMS and RCS thrusters(4/5)

# Cost to Mature Technology

## Use Same Propellants in All Stages

\$100K	
\$500K	
\$1M	
\$5M	
\$10M	
\$30M	
\$50M	
\$100M	
\$500M	

6 Mo	
1 Yr	
18 Mo	
2 Yr	
3 Yr	
4 Yr	
5 Yr	
5 Yr+	