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# Evaluating the Effectiveness of Different NEO Mitigation Options

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## MITIGATION NAME

Chemical Propulsion

Gravity Tractor

Laser Ablation

Mass Driver

Magnetic Flux Compression

Kinetic Impactor (without Explosive)

Kinetic Impactor (with Explosive)

NEO-to-NEO Collision

NEO Painting

NEONet

Nuclear Explosives - Standoff

Nuclear Explosives - Surface

Nuclear Explosives - Subsurface

Solar Mirror / Concentrator

Solar Sail

SpaceTug (VASIMR)

NEPTug (Ion or Hall)

Space Pebbles

## DESCRIPTION

Attach chemical rocket

Deflect with spacecraft's gravity

Deflect with Earth/space-based laser

Ejects materials from the surface

EMP generates mag force

Impact with spacecraft

Impact with spacecraft and on-board explosive

Collide with another NEO

Paint to increase solar effect

Momentum net (Georgia Tech)

Standoff nuclear explosion / vaporization

Surface nuclear explosion

Subsurface nuclear explosion

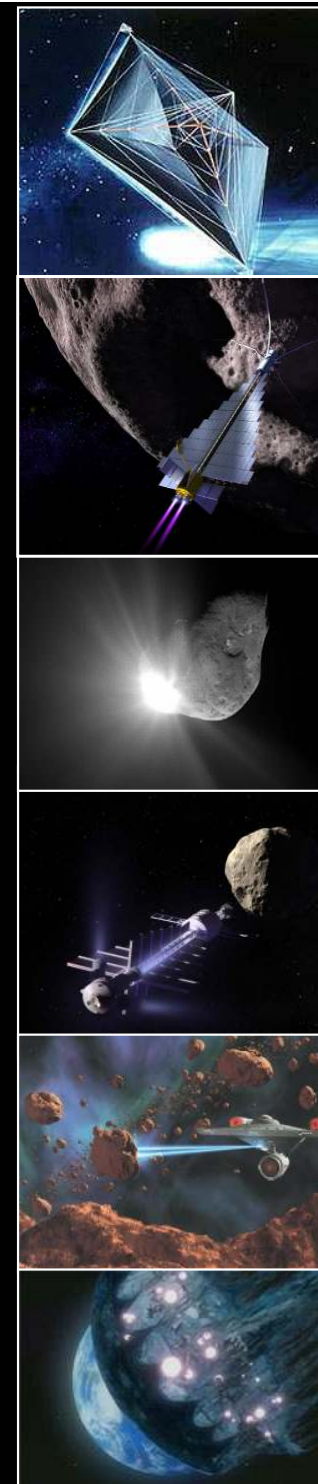
Reflects and concentrate sunlight to deflect

Catch solar wind

Nuclear powered electric propulsion (VASMIR)

Nuclear powered electric propulsion (Ion or Hall)

Metallic swarm kinetic impact



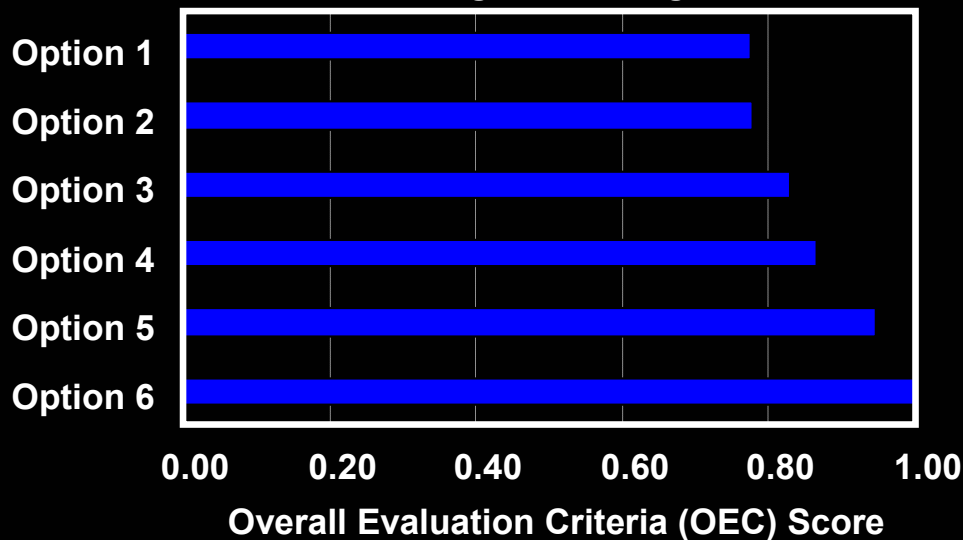
O P T I O N S



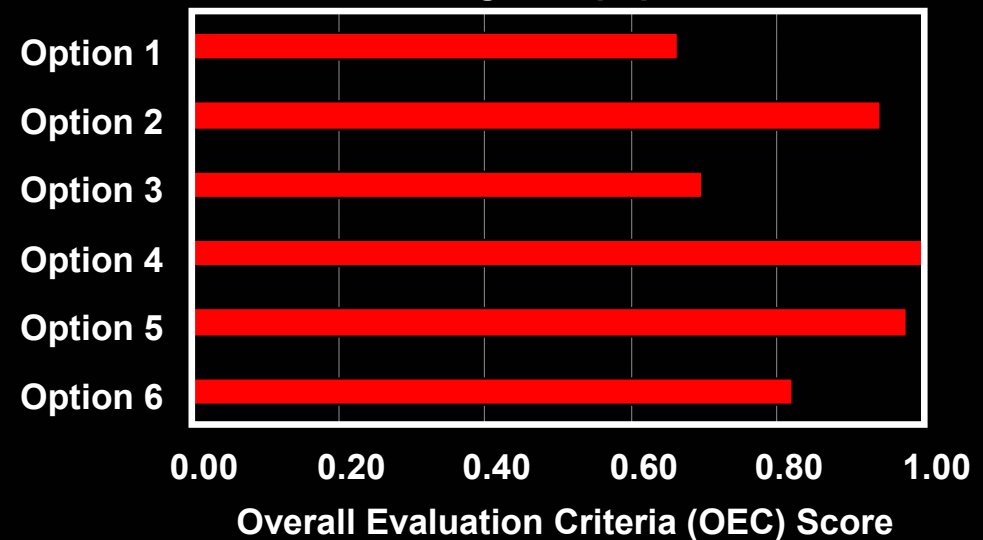
H O W   D O I   C H O O S E ?

- SpaceWorks Engineering, Inc. (SEI) is developing a **comprehensive process** for comparing different Near Earth Object (NEO) mitigation concepts
  - **CONSISTENCY**: Use consistent methodology and common analysis assumptions, allows better trade studies
  - **VALUE SCENARIOS**: Compare multidisciplinary metrics (mass, cost, reliability, technology readiness, etc.) for each option, **emphasis can be given to different metrics using various weighting scenarios**
  - **BREADTH**: Evaluate over multiple (>15 different NEO mitigation concepts)
  - **VARIOUS THREATS**: Evaluate options against a range of potential NEOs
  - **EVALUATION**: Include both expert judgment and simulation modeling

Target = D'Artagnan



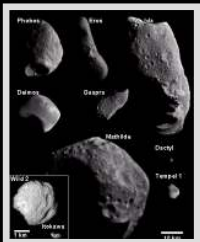
Target = Apophis



C O M P A R I N G O P T I O N S

4 = sample value

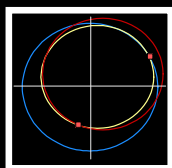
### Asteroid Database



### Launch Vehicle Database



### Trajectory



Outbound and arrival delta-v calculations

### Mitigation Modeling

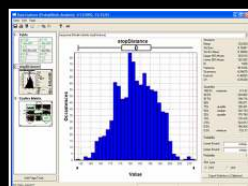


Parametric sizing for each option

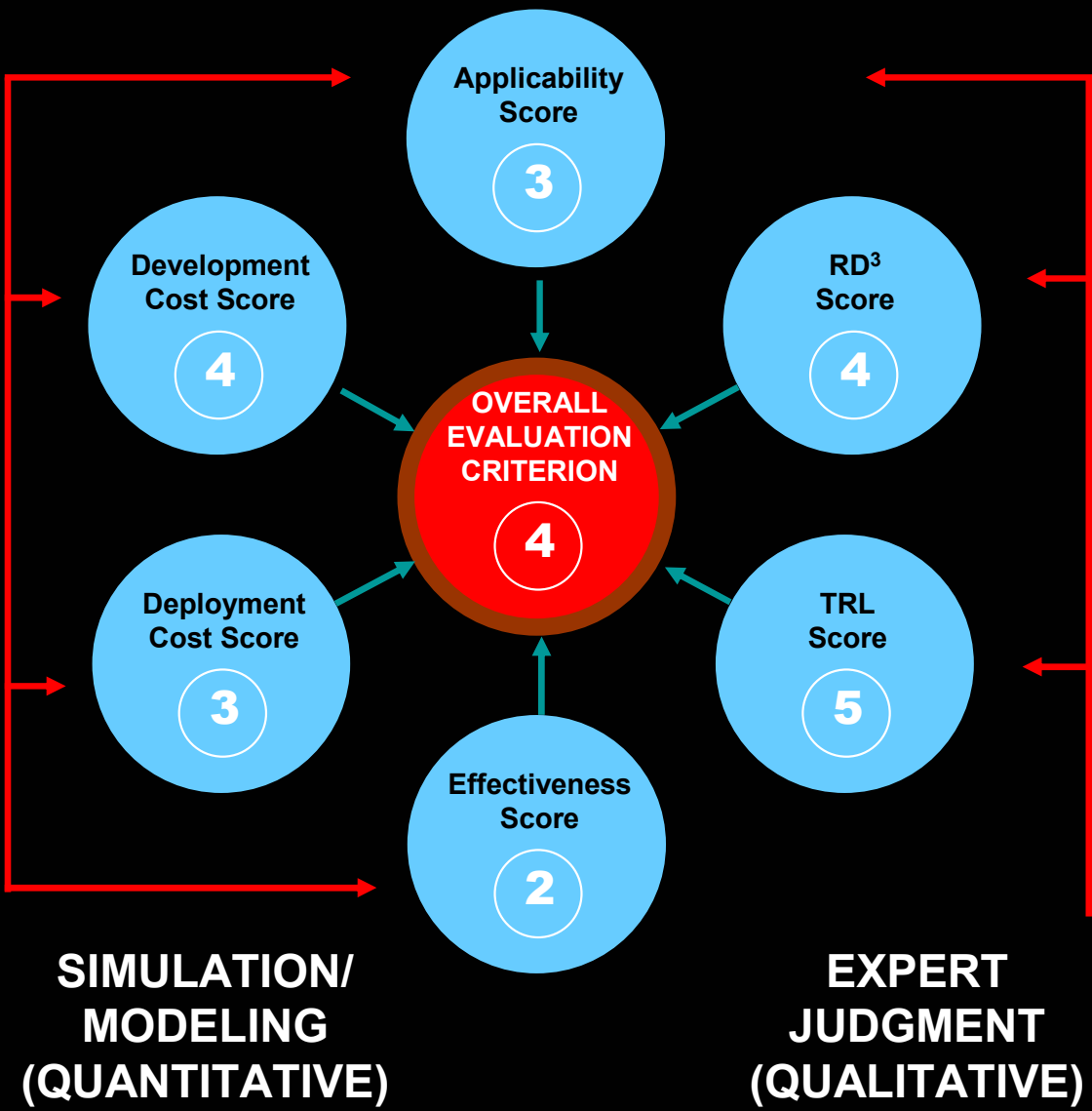
### Mitigation Option Database



### Cost Modeling



Development and deployment costs



# P R O C E S S