Propulsion Materials Research Update

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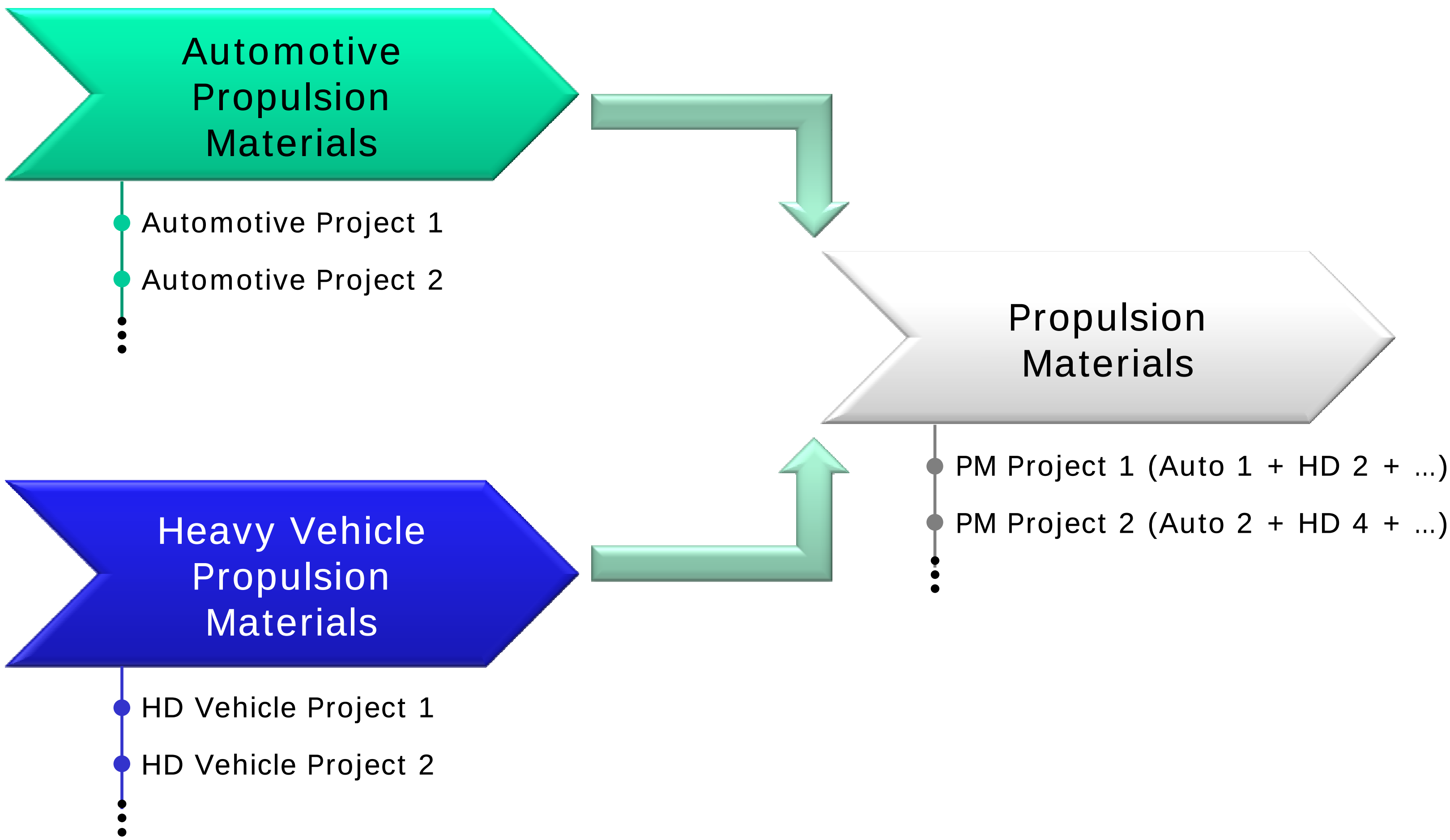
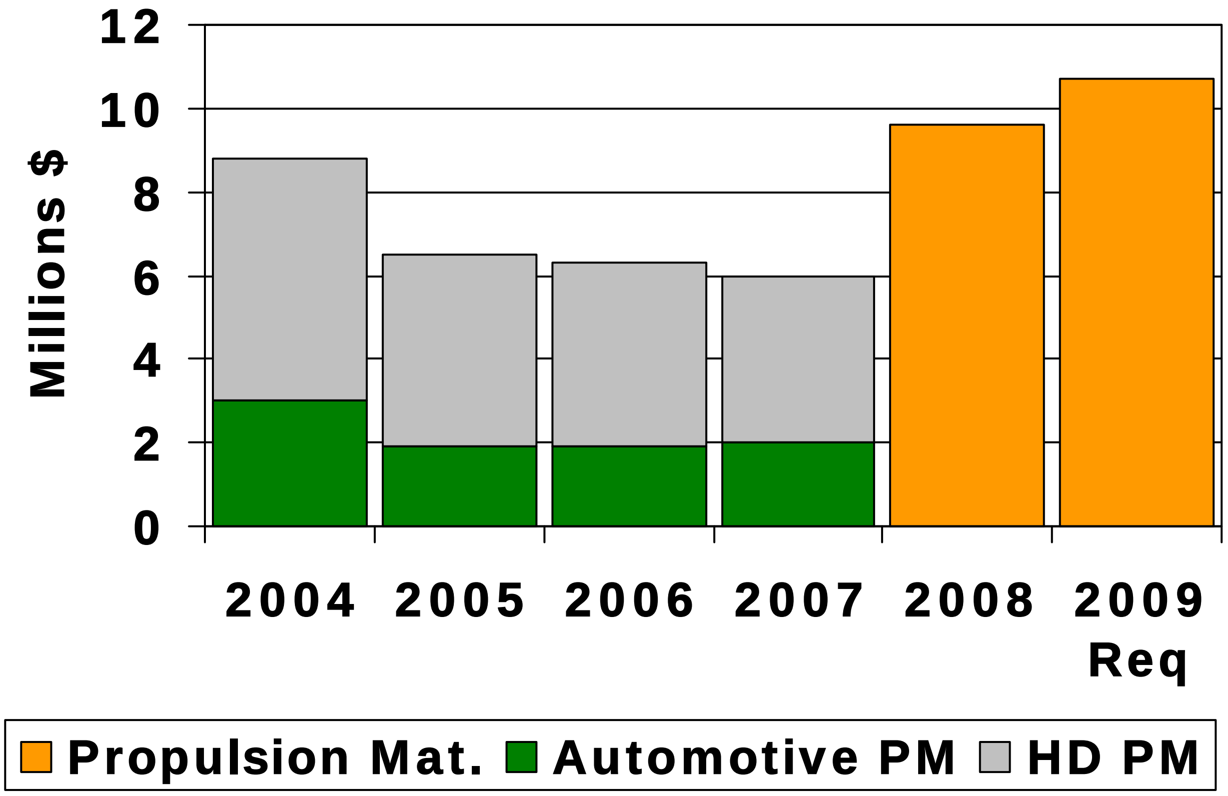
Vehicle Technologies Program

Office of Energy Efficiency and Renewable Energy

Historical Evolution of Propulsion Materials Program



Budget History



Propulsion Materials Research Relevant to VT Goals

- Improve efficiency of advanced vehicles through innovative material solutions
- Critical enabler supporting combustion, Thermoelectric, and Hybrid-Drive Systems
  - Materials for HCCI / HECC engines
  - Material compatibility for Alternative Fuels
  - Materials for 45% thermal efficient LD engines
  - Materials for 55% thermal efficient HD CIDI engines
  - Thermoelectric materials
  - Materials for reliable high performance hybrid and EV drive systems

Propulsion Materials Projects and Goals

- Materials for Electric and Hybrid Drive Systems
  – Address materials issues impacting power electronics, motors, and other hybrid drive system components
- Combustion System Materials
  – Address materials issues impacting H2, HCCI, FFVs, and other light duty combustion regimes
- Materials for High Efficiency Engines
  – Address materials issues impacting high efficiency engines (valvetrains, rotating mass, fuel injectors, etc.)
- Materials for Exhaust and Energy Recovery
  – Develop materials for exhaust aftertreatment, turbo-machinery, and thermoelectric applications
- Materials by Design
  – Using advanced characterization and modeling techniques identify and develop new application specific materials

Propulsion Materials Activities

Materials for Combustion Systems / High Efficiency Engines
Turbocharger, Valve train, Fuel Injection, Structural Components Head/Block, Sensors, Materials/Fuel Compatibility

Materials for Exhaust and Energy Recovery
DPFs, Catalysts, Thermoelectric Materials, Materials for high temperature structures

Materials for Electric and Hybrid Drive Systems
High Temperature Power Electronics Materials, Solder Joints, Materials/Coolant Compatibility, Electric Drive Motors, and Thermal Management

Materials By Design
Materials Synthesis, Characterization, Multi-Scale Computer models, Testing Standards, and Coatings

VTP Team Collaborations

Advanced Combustion Engine

Hybrid Electric Systems

Fuels Technologies

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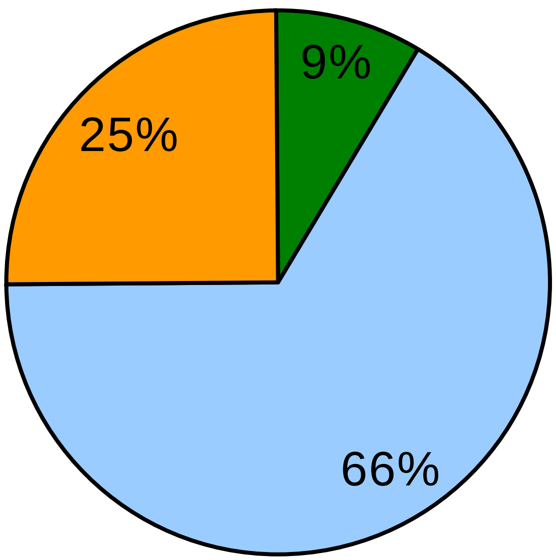
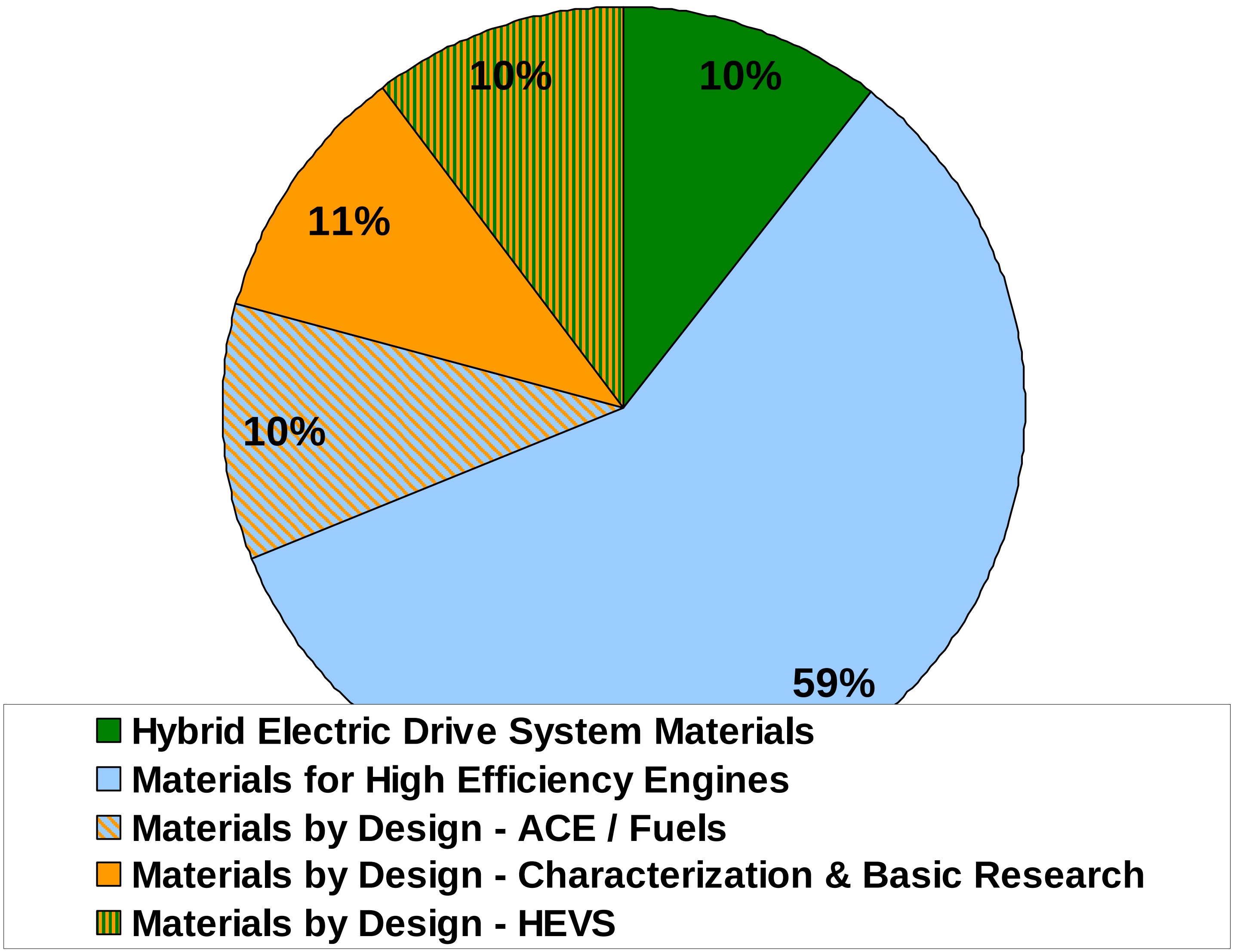
2007 Resource Allocation
$5.8M



2008 Resource Allocation
$9.6M



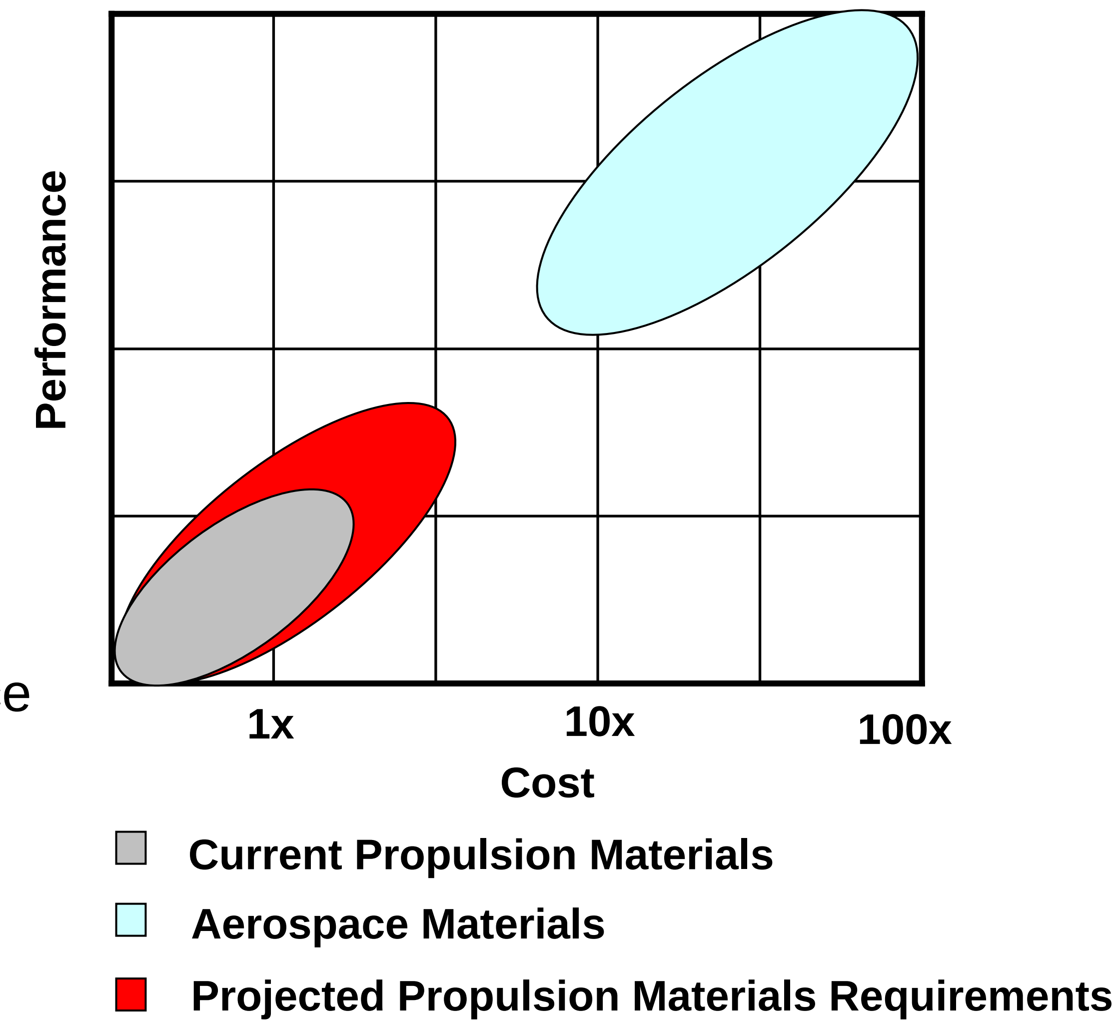
Propulsion Materials Needs and Limitations

Propulsion Materials

Develops materials that meet projected operational performance parameters without exceeding cost constraints

Sample Performance Parameters

- Structural Strength
- High Temperature Tolerance
- Strength to Weight Ratio
- Thermal Conductivity
- Corrosion Resistance
- Manufacturability



Prospective New Agreements in Each Technology Area are Evaluated On:

- Relevance to Vehicle Technologies Program Objectives
- Supported Team's Priorities
- Industry Support for Activity
- Perceived risk/benefit to program
- Mechanism for Technology Transfer

- Existing activities are evaluated annually
  - Identify activities that should be transitioned to other VTP Teams or Industry
  - Identify activities requiring changes in effort
- Approximately 12% of activities are retired each year

Changes to Propulsion Materials Projects

- Current Projects
  - Materials for Electric and Hybrid Drive Systems
  - Combustion System Materials
  - Materials for High Efficiency Engines
  - Materials for Exhaust and Energy Recovery
  - Materials by Design
- Revisions to Project Portfolio
  - Combustion System Materials
    - To be incorporated into Materials for High Efficiency Engines.

Conclusion

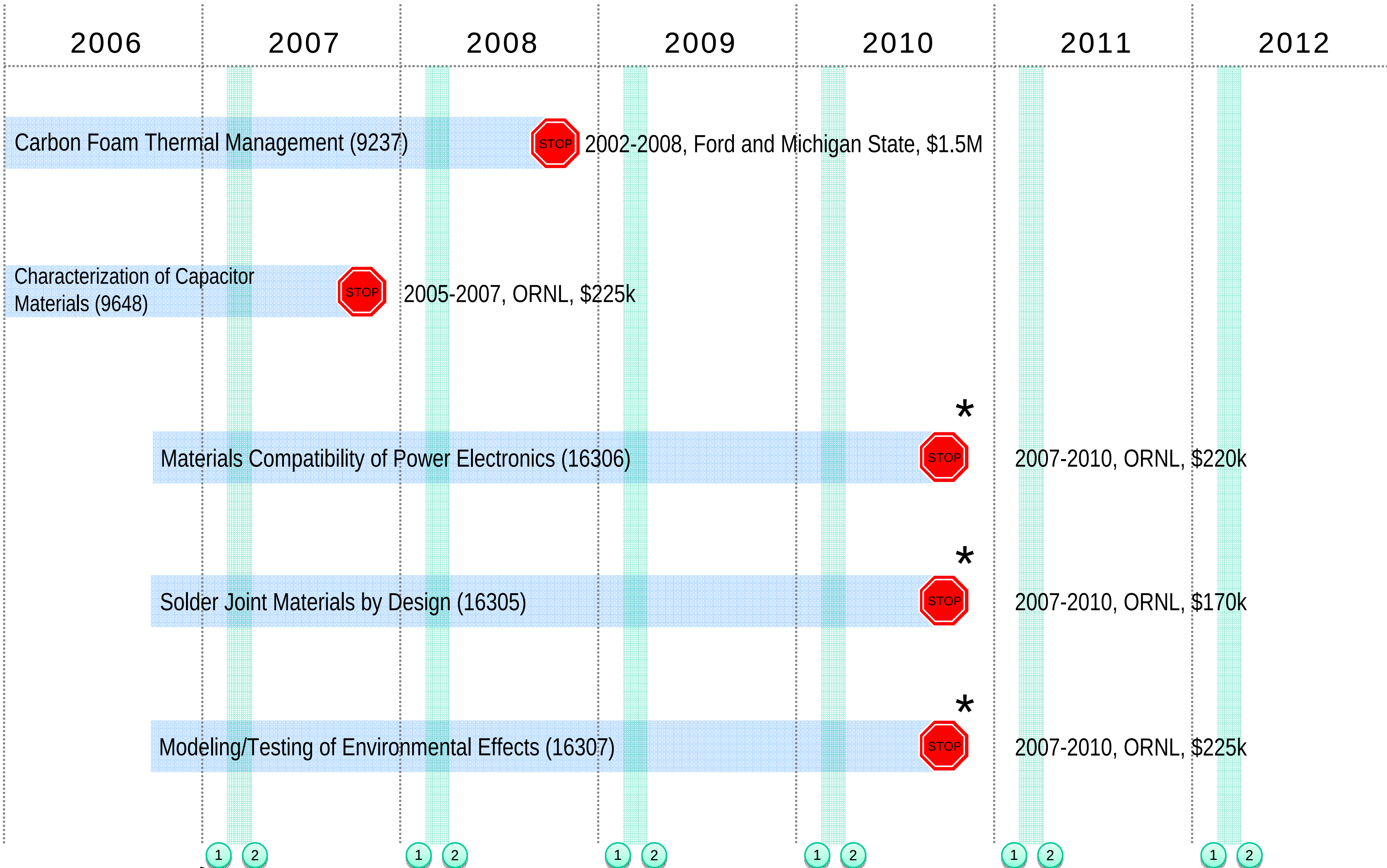
- Projects are evaluated annually, using strategic objectives.
- Over 10% of projects are retired annually.
- New projects are selected in accordance with identified Office of Vehicle Technologies needs.
  - Advanced Combustion Engine Team
    - Internal Combustion Engine Materials
    - Thermoelectric Materials
    - Catalysts and After-treatment Materials
    - Materials for Engine Sensors
    - Materials for High temperatures and turbo-machinery
  - Hybrid Electric Systems Team
    - Power Electronics Materials
    - Materials for Energy Storage
  - Fuels Technologies Team
    - Alternative Fuels / Materials Compatibility

Thank You

Supporting Slides

- Following slides provide details about:
  - Activity duration
  - Activity funding to date
  - Activity projected end date
- Each Slide Represents the Activities within a Project Area

Project 1: Materials for Electric and Hybrid Drive Systems (18516)



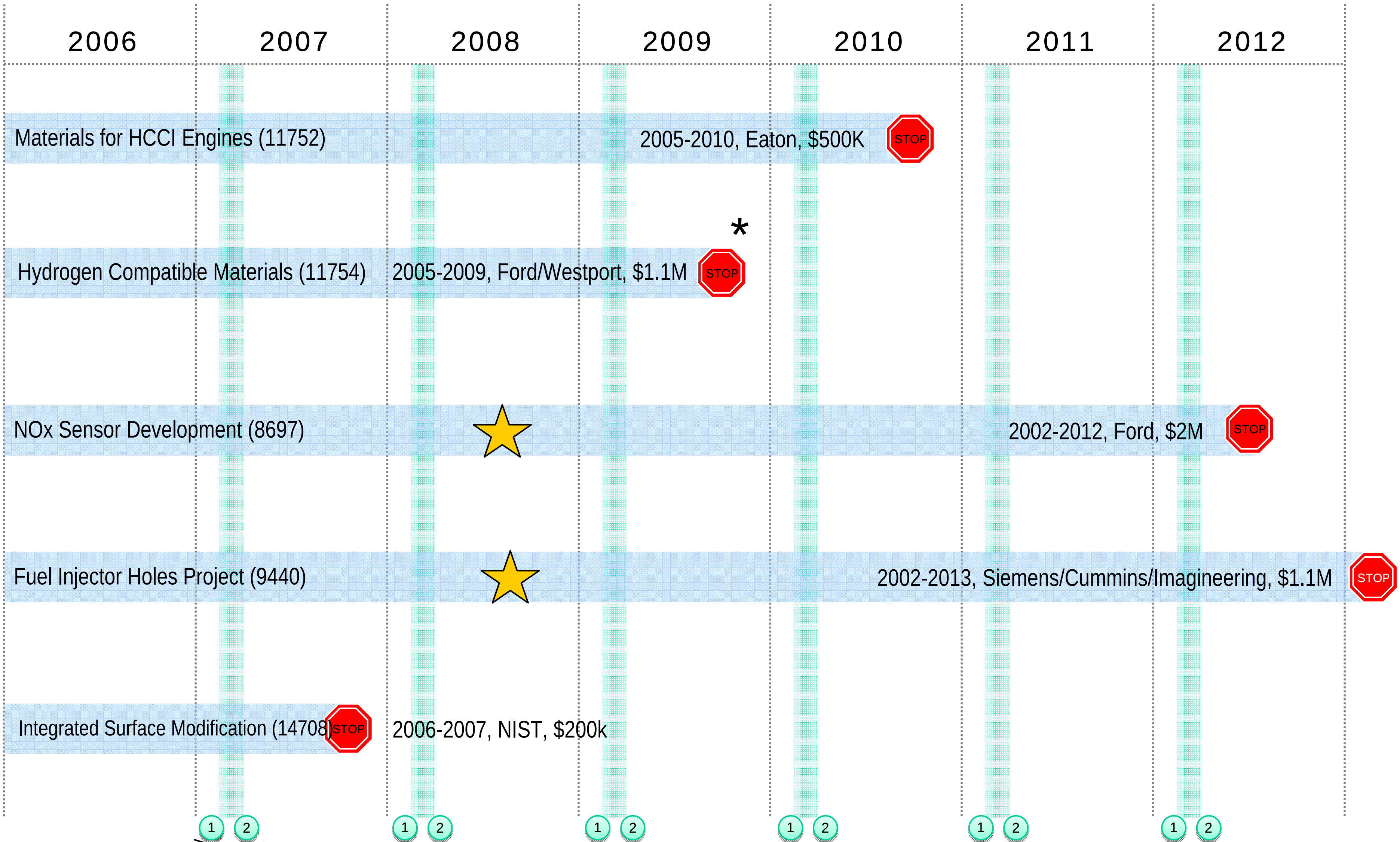
1. Annual Merit Review 2. Project Decision Point

Critical Decision Point

* = Project end dates TBD

Project 2: Combustion System Materials (18517)

(All to be moved to 18518)



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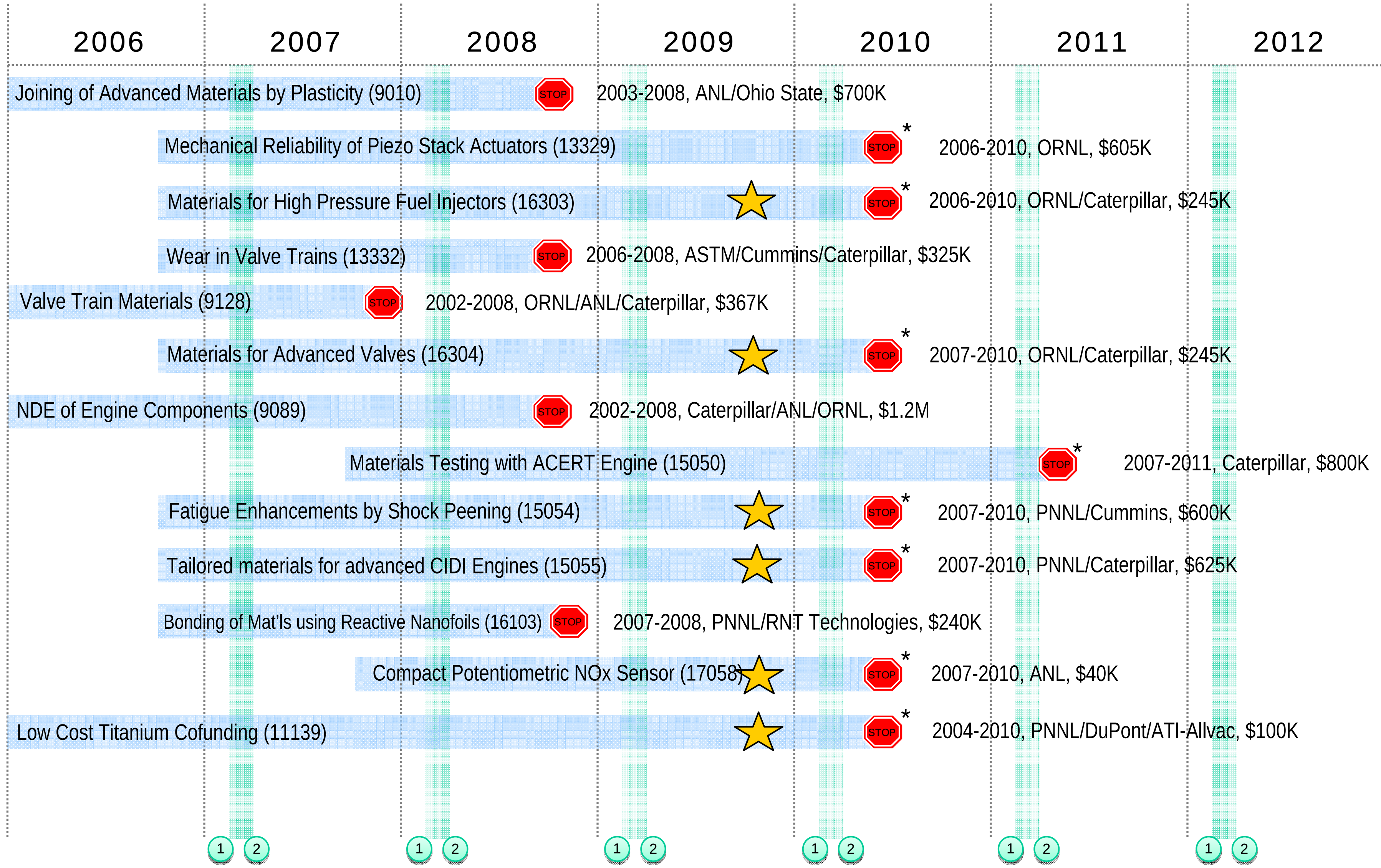
Project 3: Materials for High Efficiency Engines (18518)



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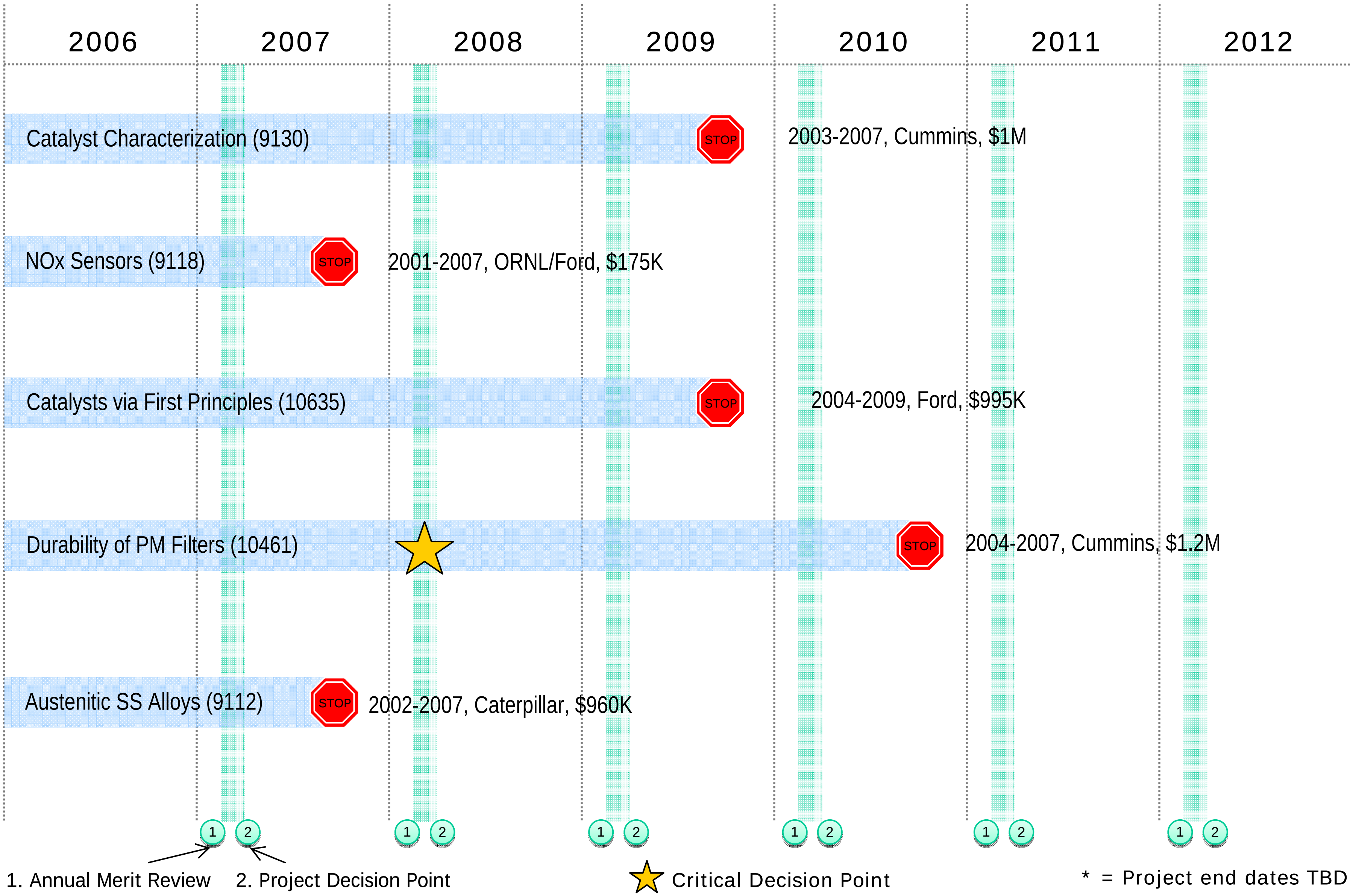
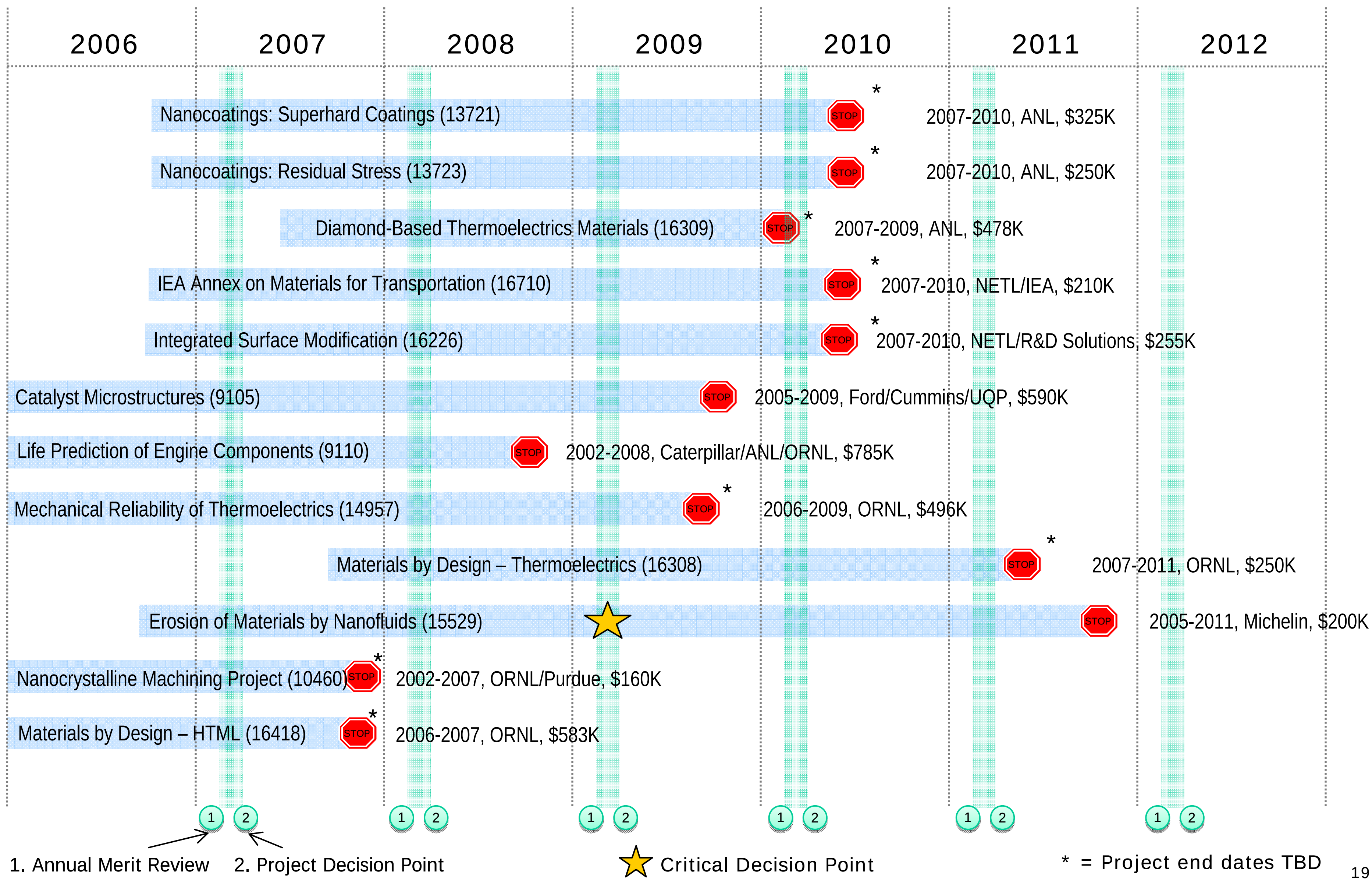
Project 4: Materials for Exhaust and Energy Recovery (18519)



Project 5: Materials by Design (18865)



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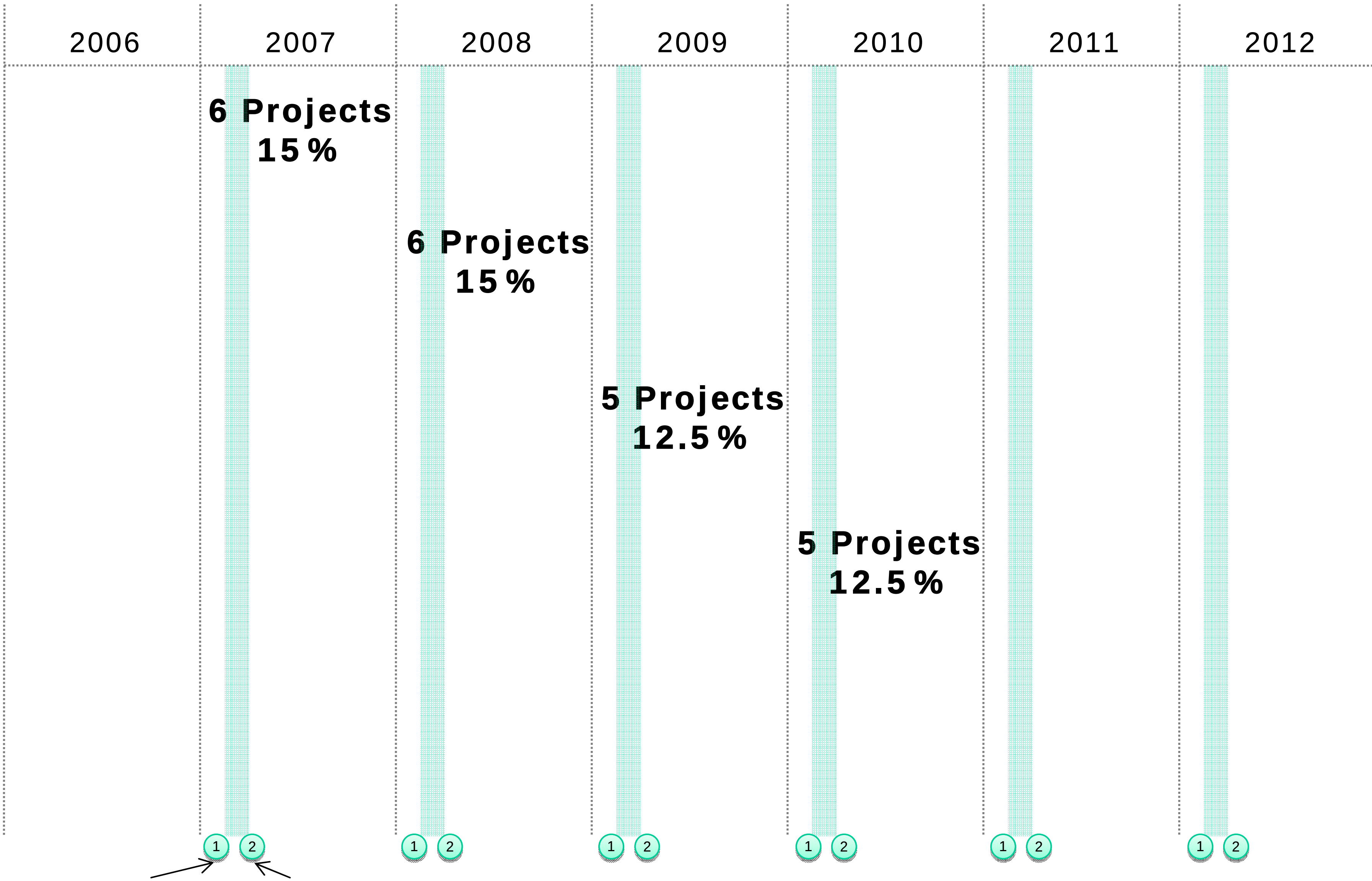
Annual Portfolio Turn Over



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FreedomCAR Partnership Goals Supported

- Electric Propulsion System with a 15-year life capable of delivering at least 55kW for 18 seconds, and 30kW continuous at a system cost of $12/kW peak.
- Internal combustion engine powertrain systems costing $30/kW, having a peak brake engine efficiency of 45%, and that meet or exceed emissions standards.
- Electric drivetrain energy storage with 15-year life at 300 Whr per vehicle with discharge power of 25 kW for 18 seconds and $20/kW.

21st Century Truck Partnership Goals Supported

- Develop and demonstrate an emissions compliant engine system for Class 7-8 highway trucks that improves the engine system fuel efficiency by 20% (from approximately 42% thermal efficiency today to 50%) by 2010.
- Develop technologies which will achieve a stretch thermal efficiency goal of 55% in prototype engine systems by 2013, leading to a corresponding 10% gain in over-the-road fuel economy over the 2010 goal.
- By 2010, identify and validate fuel formulations optimized for use in advanced combustion engines exhibiting high efficiency and very low emissions, and facilitating at least 5% replacement of petroleum fuels