

2008 Solar Annual Review Meeting

CSP Advanced Systems
3M Company
Hardcoats

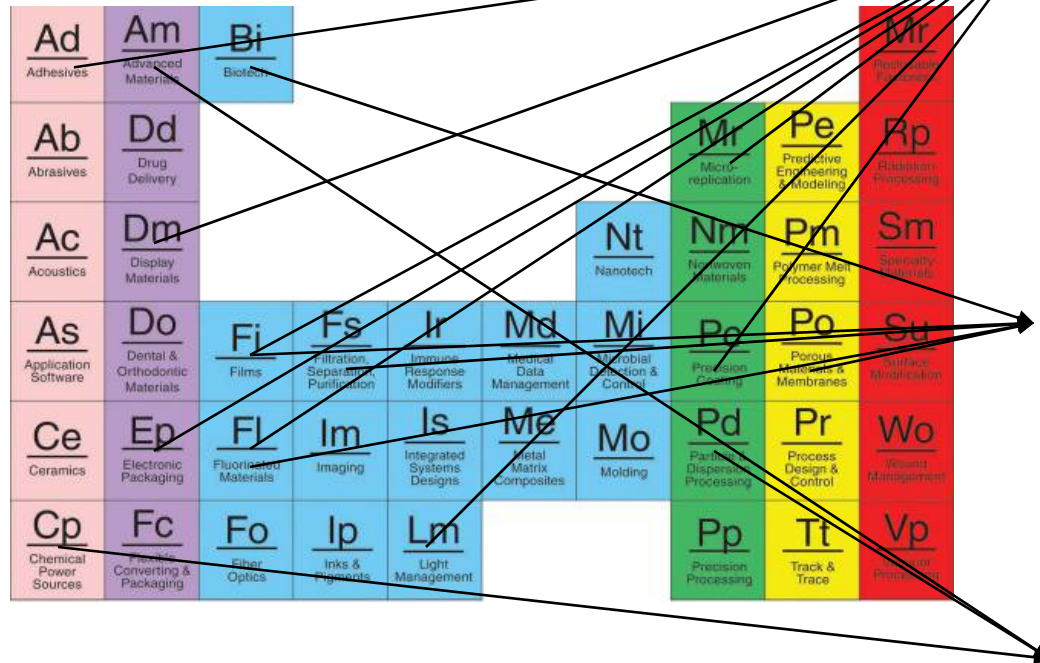


Susannah Clear
Bob Messner
3M Energy Markets
rpmessner2@mmm.com



3M Renewable Energy

....connecting customer needs to 3M products, capabilities and technologies...



Solar



Bio-Fuels



Wind



Toolbox of Films – Materials & Processes



*Variety of fluoropolymers
(environmental durability)*



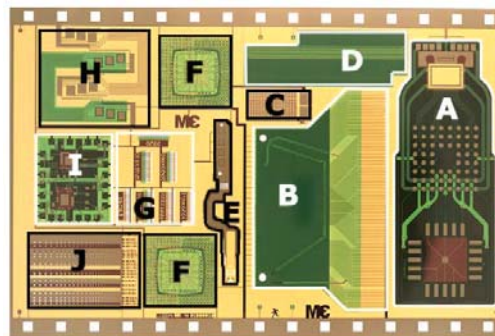
*Reflective Films
(50 yrs of experience)*



*High strength polymers for
(blast protection)*



*Multi-layer Optical Films
(100's of layers to impact
Light transmission)*



*Vapor Deposition
(flexible circuits to barrier
films)*



*Micro-replicated Films
(various functionalities)*



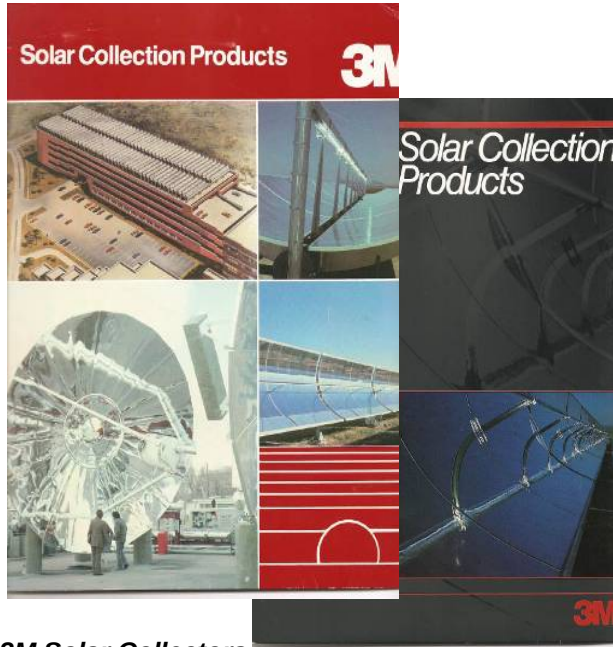
3M Products Exposed to the Elements



3M Weathering Resource



3M Pioneering Work in Solar Concentration



3M Solar Collectors
(ca. 1980-96)



Lajet solar concentrator
(1984)

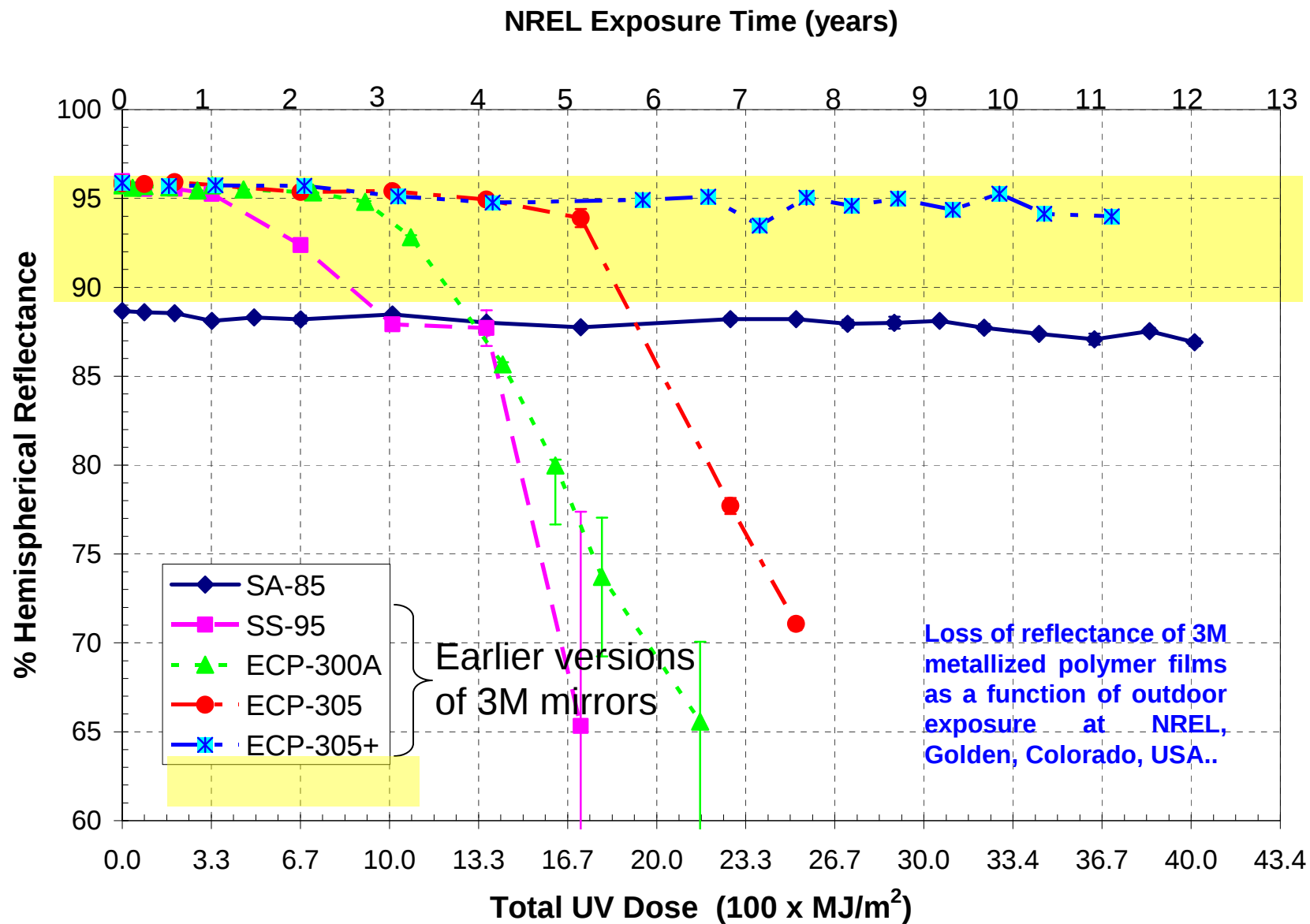


Entech Fresnel Linear Concentrators (1985)



NASA Lewis Space Station (1990's)

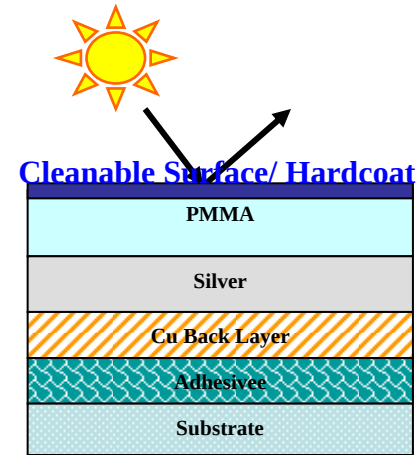




Development of improved mirror films

Focus Areas

- UV durability
- Retention of optical properties
- Proper lamination & substrate selection
- Compatibility with CSP system designs

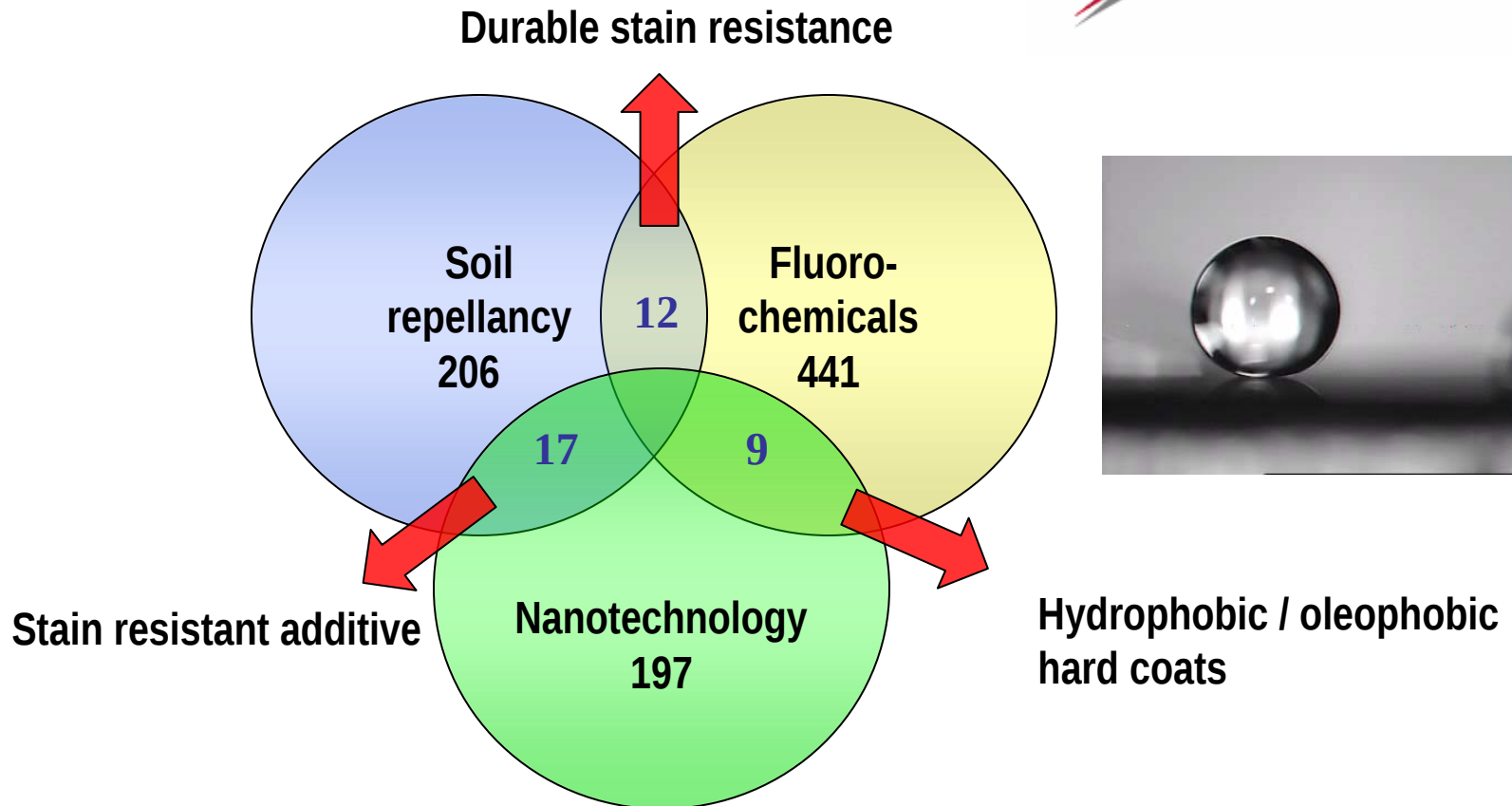


US DOE SAI Award

Goal: Develop cleanable surfaces and hardcoats to extend the life and improve performance of polymeric reflective mirrors for CSP applications



3M Soil Resistant Materials Platforms



3M Precision Coating platforms

- Web handling and coating are core **3M** competencies
- Potentially applicable recent advancements:
 - **Ultra-clean processing**
 - **Patterned coatings**
 - **Precision web-handling**

3M currently manufactures more than *100 M m²* of optical quality durable easy-clean coatings annually





Relationship to Solar Program Goals

“... to make CSP cost competitive in the intermediate power markets by 2015 (~7¢/kWh with 6 hours of storage) and in baseload power markets (~5¢/kWh with 16 hours of storage) by 2020.”

Project overview and description:

- **Develop novel optical coating materials** specifically for application to or integration into silvered polymeric mirrors with PMMA front surfaces. These coatings will have one or both of the following characteristics:
 - ***Durable hardcoats***
 - ***Cleanable surfaces*** that may be either durable or economically reapplied
- **Demonstrate manufacturing processes** for these novel optical coatings and incorporation onto silvered polymeric mirrors with PMMA front surfaces.
- **Demonstrate performance** of coated silvered polymeric mirrors made using these novel optical coatings in field trials.
- **Validate the impact... on the LCOE** of CSP system in field trials.



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Major FY08 Activities, Milestones, and FTE Budget

Total DOE award \$349,530 of \$437,000 (Phase 1 – Concept Feasibility)

Phase	Task	2008			
		Q1	Q2	Q3	Q4
Pre-Award	1) Sign Contract				
Concept Feasibility	1) Screen candidate coating materials		675	675	500
	2) Develop economic model for value of novel optical coatings on LCOE and performance requirements				150
	3) Perform weathering and performance testing		55	55	55
	4) Identify possible manufacturing routes				





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Link project to Program Plans & Goals

Polymeric Films offer a new avenue for impacting key cost driver – the reflector

- Polymeric solutions have successfully replaced glass in multiple optical applications (eyeglasses, other lenses)
- Films particularly applicable to high volume applications
- **3M** ECP 305+ demonstrated the possibility of a consistent, highly reflective polymeric solution
- Easy-clean hardcoats will enhance the long term durability of these products





FY08 Progress Report

What has been accomplished thus far?

- *Technical highlights; what's gone well? what has not gone well?*
 - ↑ Initial screening underway
 - ↑ Performance testing protocols defined:
 - Hardcoat abrasion (sand, brush scrub, tabor)
 - Easy-clean quantification
 - Accelerated weathering
- *Issues that have come up; solutions proposed*
 - none to date
- *Costing (current level; projected end-year balance)*
 - on-track with projected costs



Future Activities

FY09, FY10 Planned Activities

Technology Design and Prototype Development (Phase 2)

Demonstrate coated mirror film manufacturing with top candidate coating materials.

Evaluate candidate coatings on mirror films for durability (including weathering) and performance at pilot scale.

Continue to build out model of the differential impact of the optical coating material improvement on the LCOE.

Field Validation (Phase 3)

Demonstrate performance and reliability of coated mirror film in multiple field locations.

Validate effect of optical coating material improvement on LCOE of system.

