Thermal Management of Power Electronics Task at NREL

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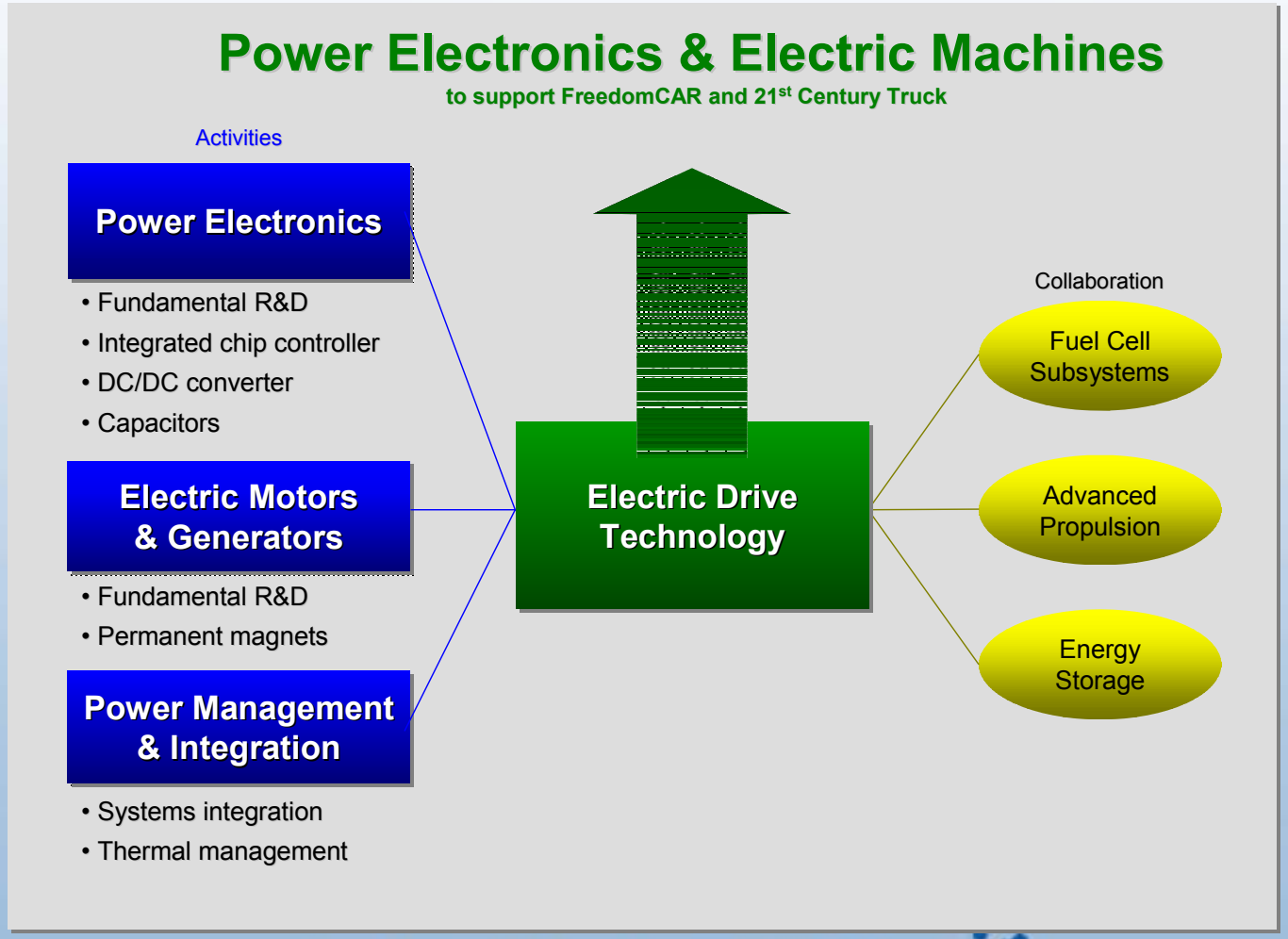
Thermal Management of Power Electronics Task at NREL



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Barriers

1. Volume and thermal management: bulky and difficult to package for automotive applications. Existing thermal management techniques are inadequate to dissipate high heat fluxes (~250 W/cm^2)
2. Cost: Material and processing technologies too costly for automotive industry, limitation requires operation at less than 125 ^oC
3. Weight: Current components are too heavy and require additional structural support

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Goals

- Demonstrate enabling technologies to improve heat rejection from power electronics ~ 250 W/cm2
- Reducing system cost, increasing reliability, specific power, power density, and efficiency

Objectives for FY04

- Demonstrate the viability and advantages of two-phase cooling techniques such as spray cooling, and jet impingement

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Deliverable for FY04

- Report on viability of spray-cooling and jet impingement for high heat flux heat removal
- Modeling of existing power electronics units with spray cooling and jet impingement
- Propose potential new designs for the heat sink

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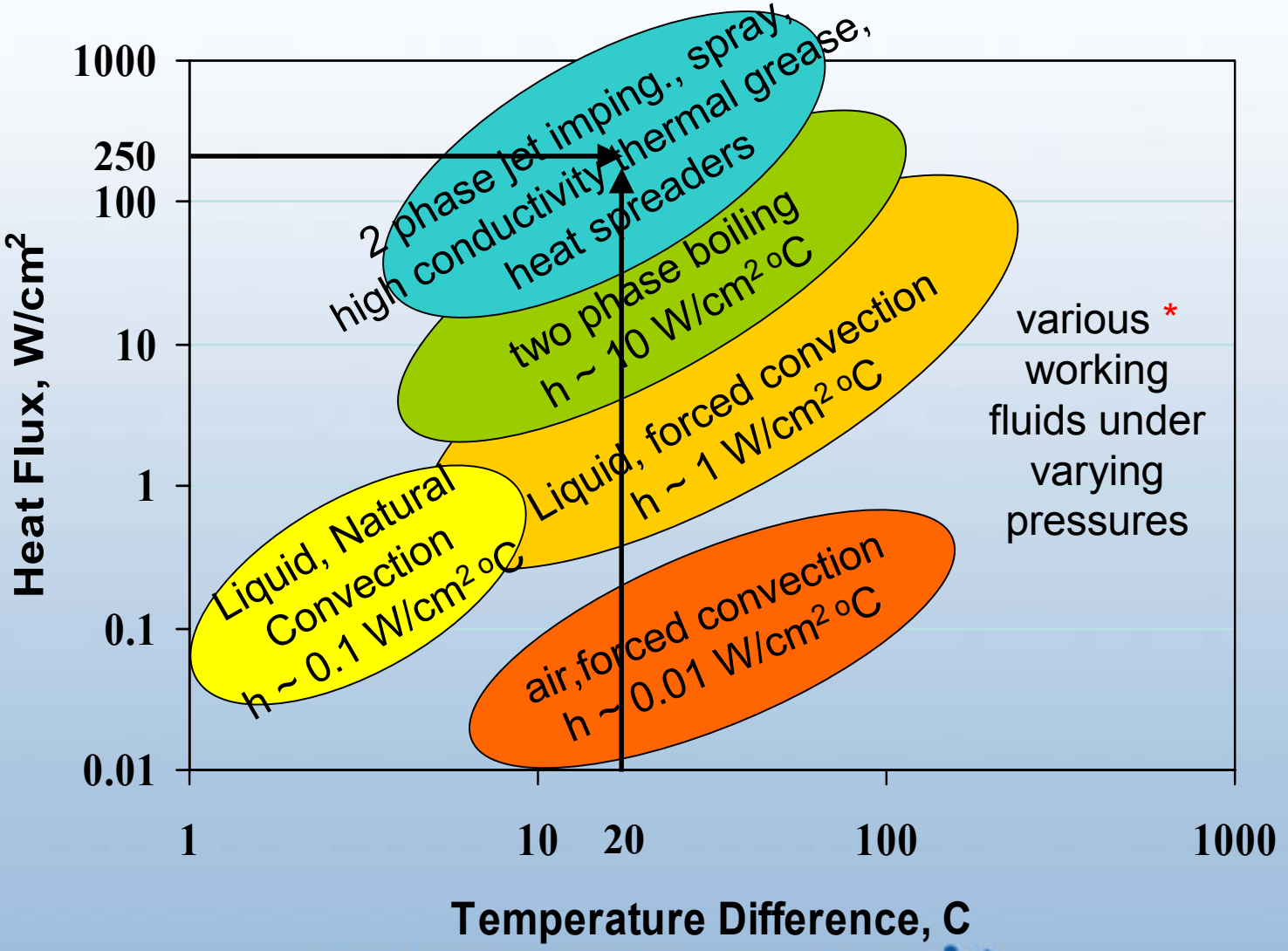
Approach

- Model and validate spray-cooling and jet impingement for high heat flux heat removal
- Model spray cooling and jet impingement cooling of an actual hardware
- Collaborate and coordinate modeling and testing with ORNL and subcontractors such as ISR, Rockwell Scientific, and Georgia Tech

High Heat Flux Heat Removal Techniques



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Accomplishments

Jet impingement model:

- shows major resistance is in the heat sink plate,
- 4 fold increase on the liquid side heat transfer coeff.

Spray cooling model:

- custom code modification to handle spray cooling
- validated spray cooling on a single chip (Purdue University data)
- application to an actual hardware in progress

Industry support:

- Interact with industry such as ISR, Rockwell, Delphi, Allison etc. to support testing activities

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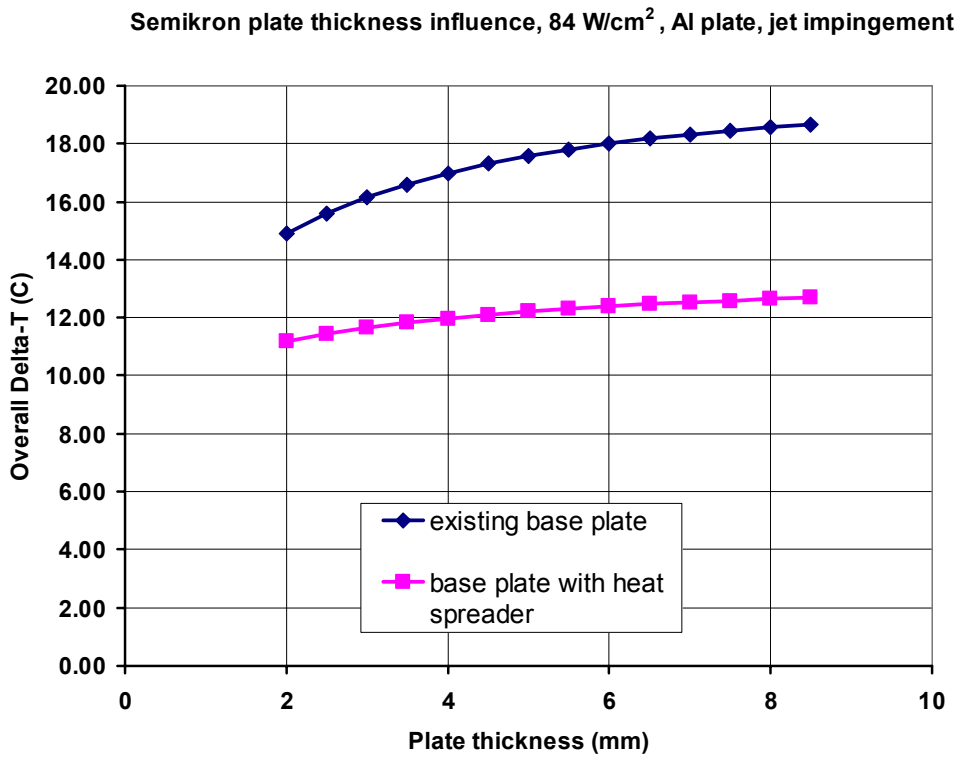

Future

- Mod … val tech… 1)
- Enha… ace mate…
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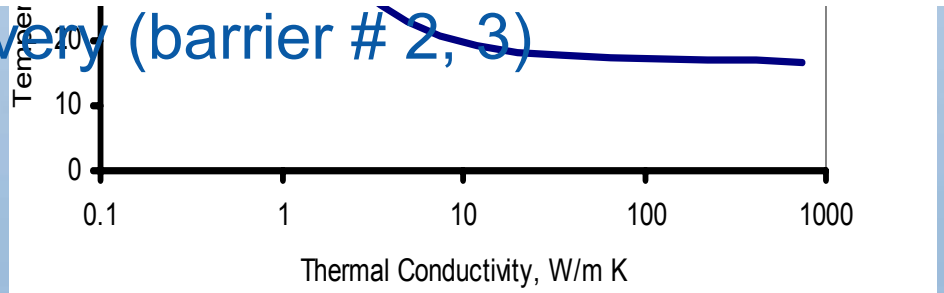
- Integ… ste heat recovery (barrier # 2, 3)



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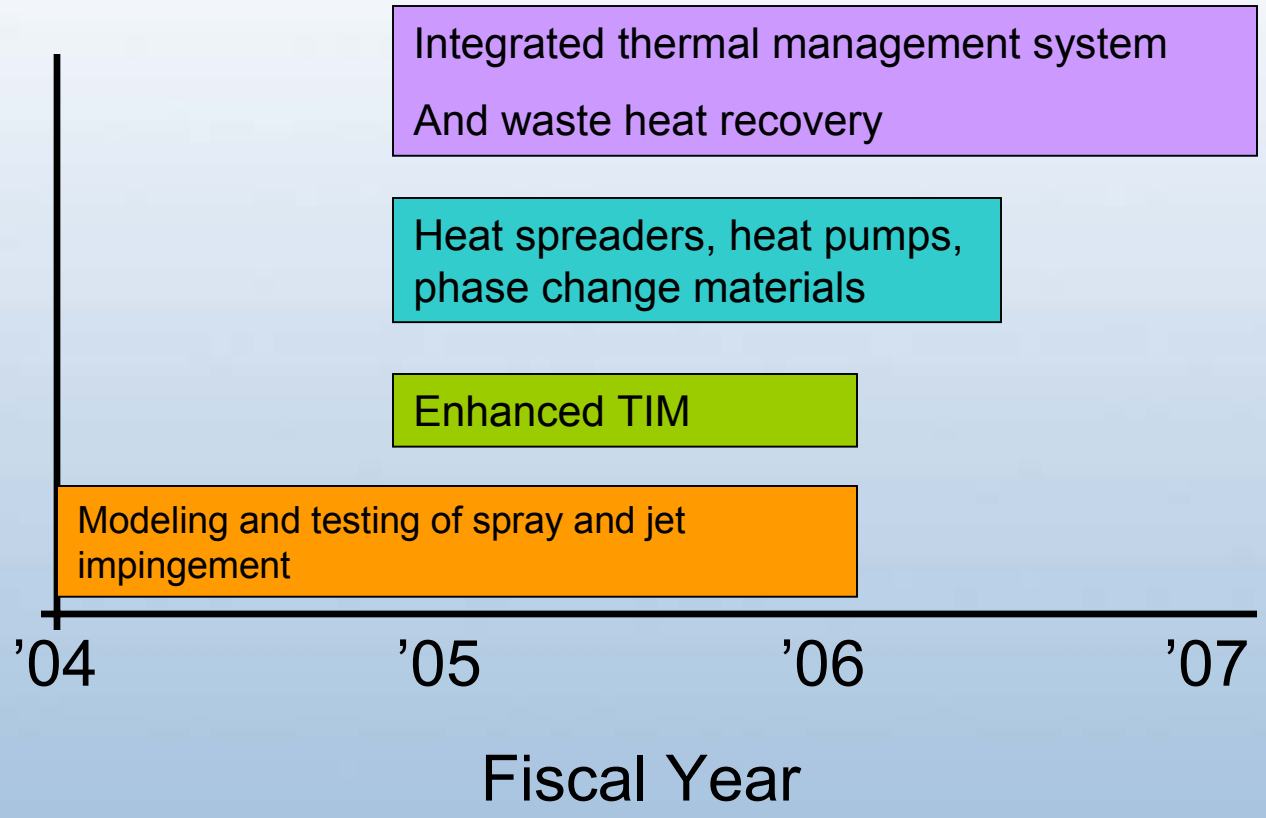

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