Potential Use of Nano Technology in MIL-STD ECUs

presented to the

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Frank E. Calkins, P.E.

U.S. Army Communications-Electronics
Research, Development, & Engineering Center
C2 Directorate
Environmental Systems and Fuel Cell Branch
10108 Gridley Rd. Suite 1
Fort Belvoir, Va. 22060-5817
Comm. (703) 704-2628 DSN 654-2626
Fax (703) 704-2005
fcalkins@armypower.army.mil

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Environmental Systems

Presentation Outline

- US Army Refrigeration Applications
- Status of Current Development Strategy
- Developmental Roadmap/Progress to Date
- Conclusions

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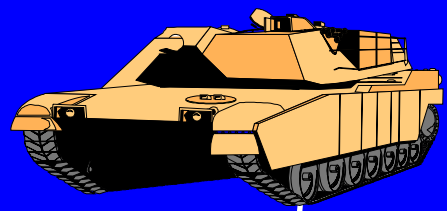
Environmental Systems

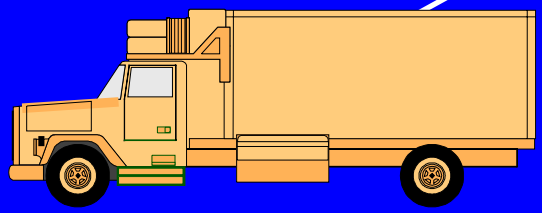


Tracked Vehicles

Aircraft

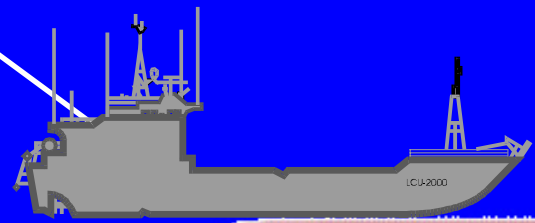
Individual Soldier

Platforms Supported



Shelters\Vans

Wheeled Vehicles



Watercraft

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Environmental Systems

SICPS Rigid Wall Shelter

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Environmental Systems

Current Army ECU Fleet

- 9,500 Authorized
- 22,000 on Hand

■	6,000 BTUH
■ ■ ■ ■ ■	9,000 BTUH
■ ■ ■ ■	18,000 BTUH
■	24,000 BTUH
■ ■ ■	36,000 BTUH
■	54,000 BTUH
■	60,000 BTUH

- Vertical and Horizontal Configurations

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Short Term — **CFC Elimination Strategy**

CFC → HFC Retrofits

Medium Term — **IECU Development**

HCFC → HFC Blends → Natural Substances

Long Term — **Cogeneration Power and Cooling Development**

Waste Heat from Power Source → Heat Actuated Cooling

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Environmental Systems

40 kW Fuel

10 kW Diesel Generator

Efficiency = 25%

5 kW Electricity

3.75 kW Electricity

Vapor Compression Air Conditioner

COP=2

7.5 kW Cooling

Today

16.2 kW Fuel

Efficiency = 75%

Reformer

4 kW Heat

Efficiency = 40%

Fuel Cell

7.3 kW Heat

5 kW Electricity

Heat Actuated Heat Pump

COP=.67

7.5 kW Cooling

Tomorrow with Heat Actuated Cooler and Fuel Cell

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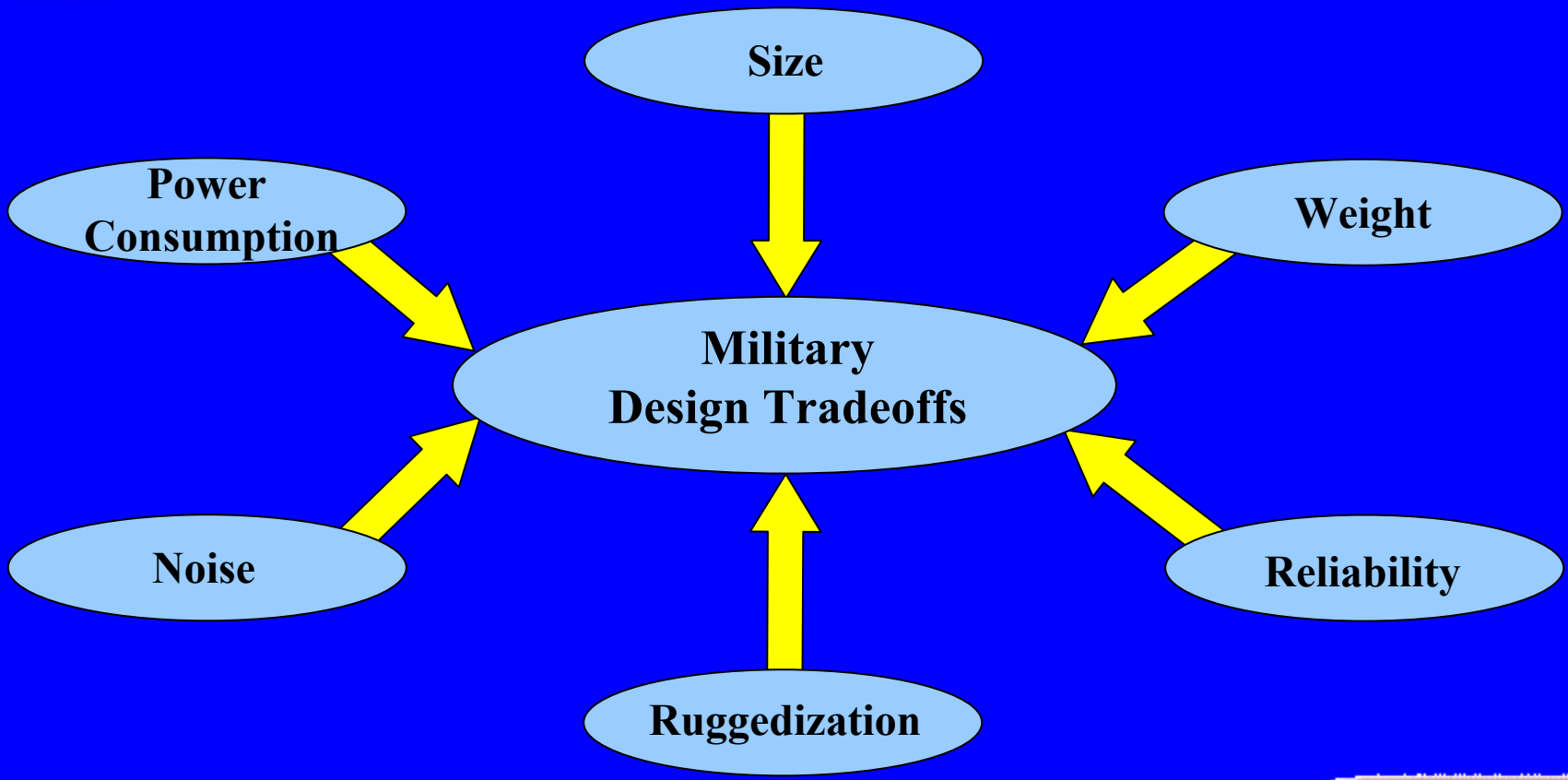
Military Design Tradeoffs



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Environmental Systems

R&D Challenges and Payoffs

- Accommodate Higher Heat Rejection Temperatures
- Develop Effective Heat Exchangers
- Scale HX/Absorber/Desorber Up/Down
- Overcome Internal System Inefficiencies
- Develop Unique Components as Required
- Integrate System Safety Considerations
- Militarize Equipment and Demonstrate Producability/Affordability
- **Warfighter Payoff**

➢ REDUCE LOGISTICS BURDEN - reduced fuel consumption by 50%,
➢ INCREASED MOBILITY - reduced size & weight by 20%
➢ PROVIDE SILENT OPERATION – reduced noise level to 70 dBA

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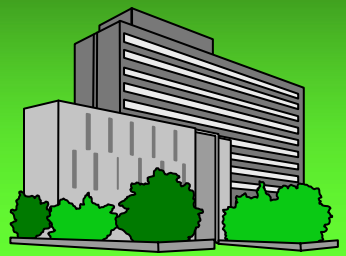
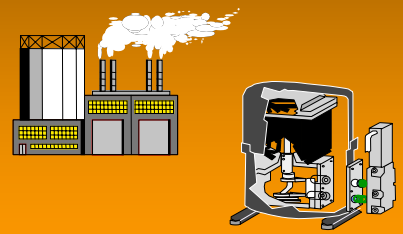
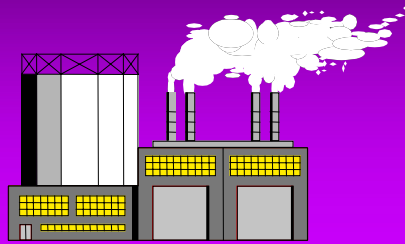
Environmental Systems

Key Players

6.2	6.3	6.4	6.5
UNIVERSITY or FEDERAL RESEARCH LAB	UNIVERSITY INDUSTRIAL CONSORTIUM	UIC or COMPONENT SUPPLIER or PROTOTYPING COMPANY	PROTOTYPING COMPANY or ORIGINAL EQUIPMENT MANUFACTURER







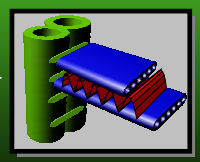
Environmental Systems

CO_2 Development Roadmap

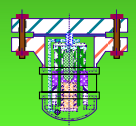
Component

System

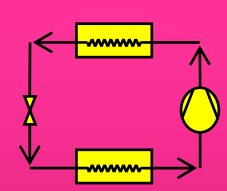
Theoretical Modeling



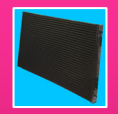
Experimental Measurements

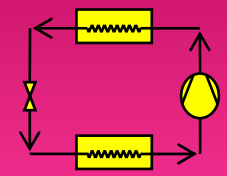


Early Component Devel.



Unitary





Automotive

Breadboard Modeling

Controls

Compressors

Heat Exchangers

Expansion Devices

Advanced Component Development

Early System Prototypes

Full Scale Unitary Prototypes

Split Systems

Full Scale Vehicular Prototypes

Engineering & Manuf. Devel.

FY 2000-04

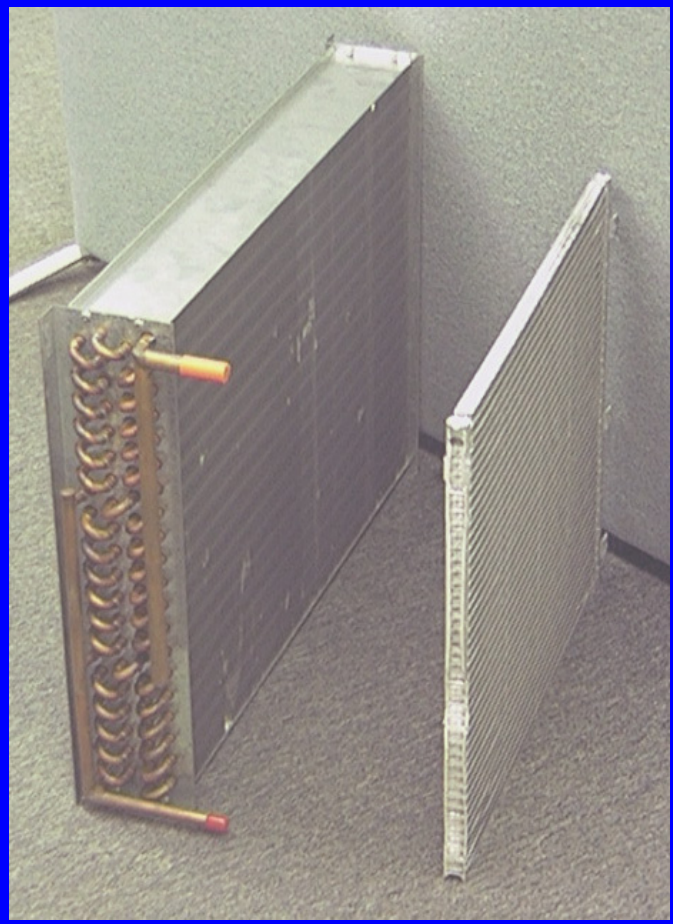
FY 2005-06

FY 2007-08

FY 2009-2010

Environmental Systems

Heat Exchanger Comparison



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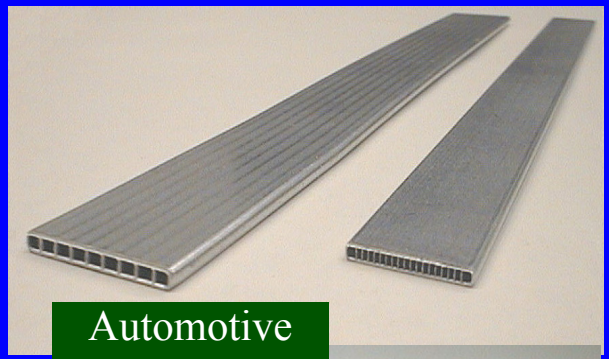
Extruded Aluminum
Microchannel Heat Exchangers



Automotive
R-134a

Serpentine 180° Bend
Single Pass Type

Custom Designs

Multi-Port
Parallel Flow (PF)

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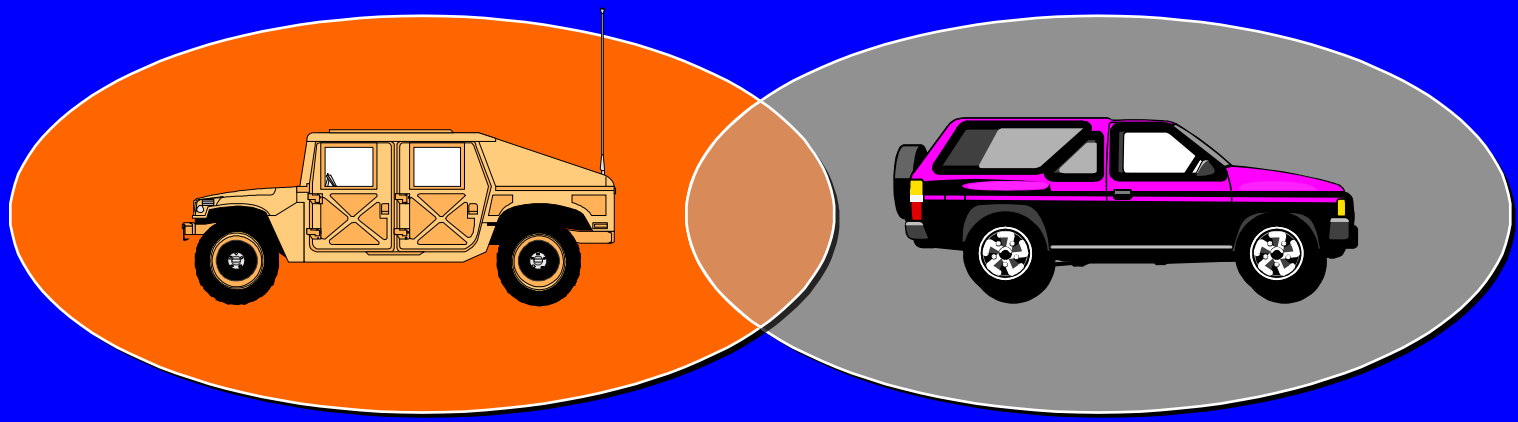
Environmental Systems

Military vs. Commercial Applications

Military | Commercial



- Low Life Cycle Cost
- Shelter Cooling
- Rugged
- Reliable & Maintainable / Sustainable
- Extreme Temperatures
- NBC Survivable

- Affordable
- Lightweight
- Compact
- Higher Efficiency
- Environmentally Friendly

- Low Initial Cost
- Passenger Space

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Environmental Systems

Conclusions

- Primary Design Concerns Weight and Size
- Absorption Fundamentally Feasible
- Timing is Right for Development
- Developmental Path Identified
- Potential Funding in Available
- New Partners Sought - Accelerate Development

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