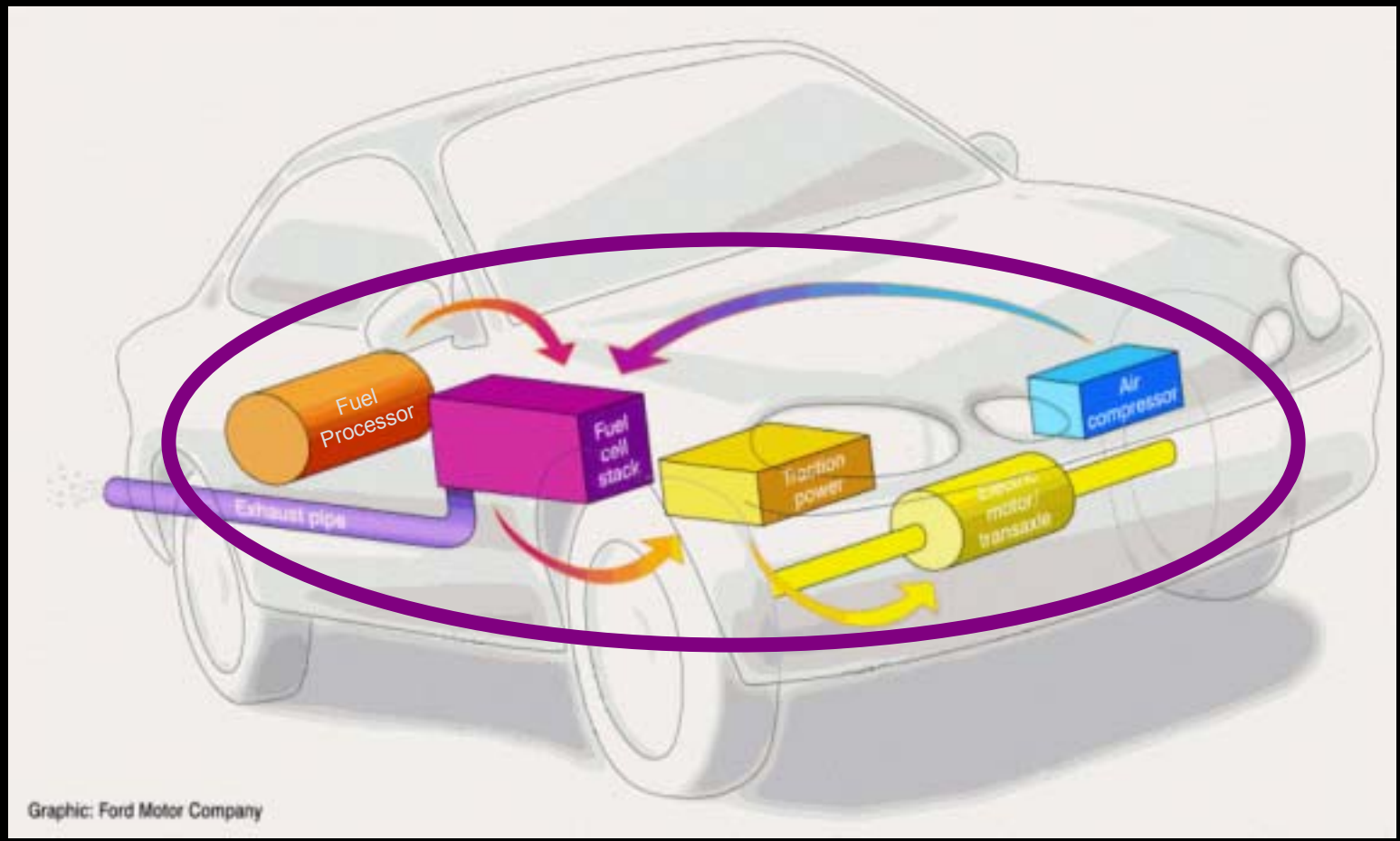
Fuel Cell Modeling and Analysis



Chris Bordeaux

Targets and Status

50 kWe (net) Integrated Fuel Cell Power System

Characteristics	Units	2001 status	2005	2010
Operating on Tier 2 gasoline containing 30 ppm sulfur, average				
Power density	W/L	140	250	325
Cost	$/kW	300	125	45
Durability	Hours	1000	2000	5000
Operating on direct hydrogen				
Power density	W/L	400	500	650
Cost	$/kW	200	125	45
Durability	Hours	1000	2000	5000

Fuel Cell Modeling and Analysis

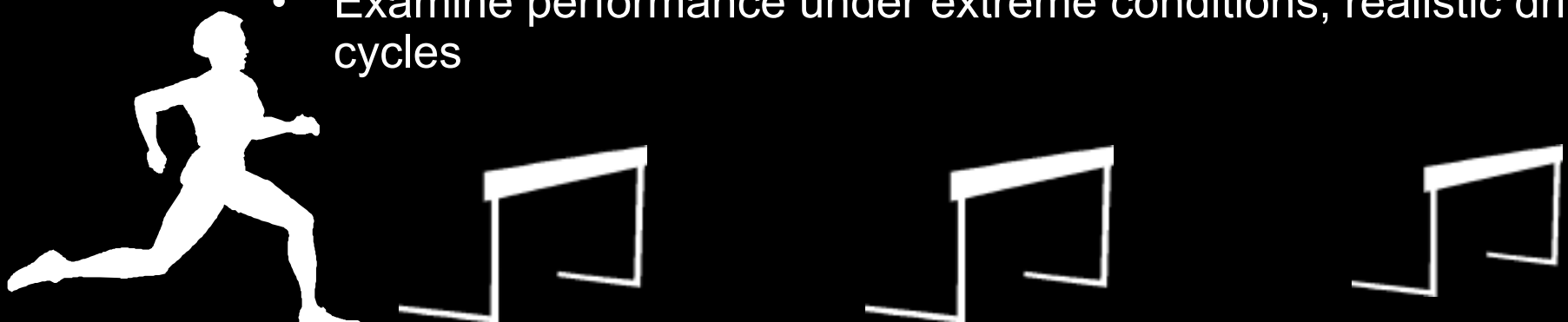
Hurdles and Objectives

HURDLES

- Air/Water/Thermal management
- Balance-of-plant component development (compressors, humidifiers, heat exchangers, sensors, controls)
- Fuel cell stack and system design and performance improvements

OBJECTIVES

- Identify key parameters for fuel cell performance and examine tradeoffs - to enable optimized stack and system design
- Identify critical issues, e.g. what affects start-up, transient response
- Examine performance under extreme conditions, realistic drive cycles



Modeling/Analysis Projects

LABS / UNIVERSITIES

- Argonne National Lab: Fuel Cell Systems Design & Analysis
- National Renewable Energy Lab: Fuel Cell Vehicle Systems Analysis
- University of Miami: Fuel Cell Modeling

INDUSTRY

- Arthur D. Little: Cost Analyses of Fuel Cell Stacks/ Systems
- Directed Technologies, Inc: DFMA Cost Estimates of Fuel Cell/ Reformer Systems at Low, Medium, and High Production Rates
- Arthur D. Little: Precious Metal Availability & Cost Analysis for PEMFCs
- Arthur D. Little: Analysis of Fuel Cell Auxiliary Power Units
- Society of Automotive Engineers: Fuel Cell Codes & Standards Initiative

Industry Interactions / Technology Transfer

- ANL system analysis software (GCTool) is available to industry; licensed to a variety of organizations
- ANL works with ADL on system cost analysis and with Nuvera on model validation
- NREL web seminar with 15 industry participants
- U. Miami is subcontractor to 3M (developing low-cost MEAs)
- Informal interactions with other fuel cell developers (via non-disclosure agreements)

Discussion Points

- Balancing complexity of model (computing time) with realism, applicability of model

- Detailed verification of model is often difficult
  - lack of measurement techniques
  - lack of existing fuel cell systems and performance data