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ELECTRIC VEHICLE CENTER
UNIVERSITY OF MICHIGAN

# Alan Taub
## Director

EV Center Director Alan Taub is a longtime auto industry executive and Robert H. Lurie Professor of Engineering in Materials Science and Mechanical Engineering at U-M. Taub earned a PhD in Applied Physics from Harvard University.

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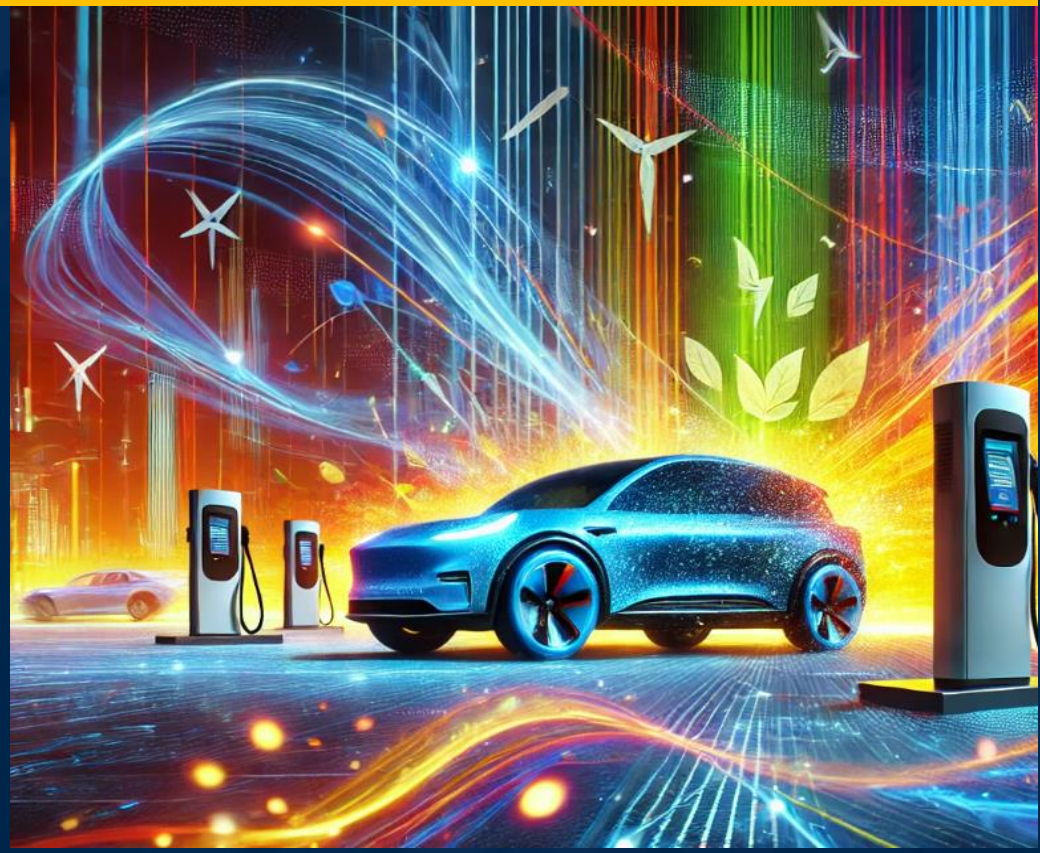
# Revolution in Motion

## Shaping the Future Landscape of Sustainable Mobility



Alan Taub

MAGMA Council Meeting
12/06/24

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# What It Takes for a Sustainable Transition

**Clean Electricity Production** → **Robust Grid** → **Available Chargers** → **Vehicle Cost of Ownership**

- Low cost, sustainable, electron production
- Getting electrons to chargers when the driver wants
- Home, workplace, public
- Purchase + operating cost

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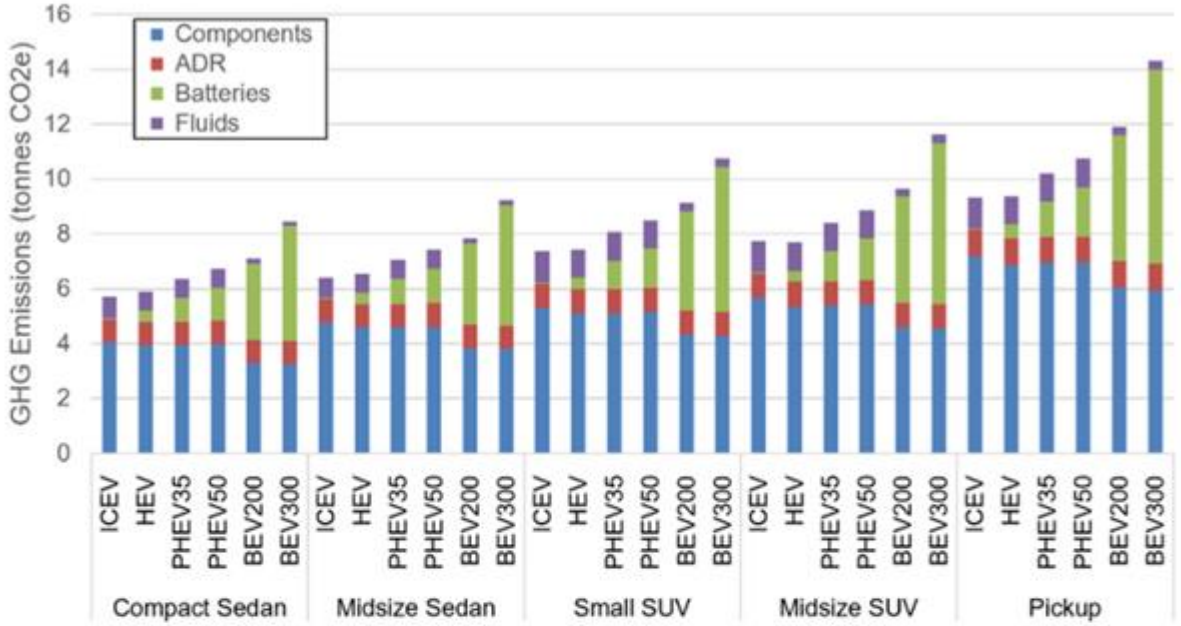
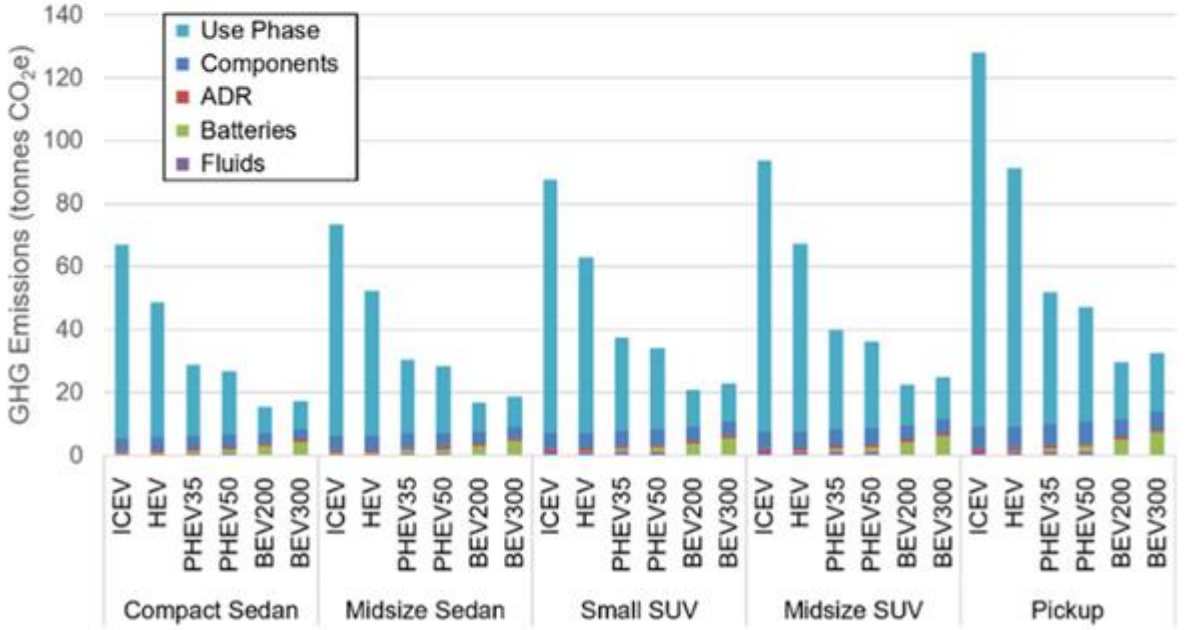
# Vehicle Cycle Research

The battery accounts for 48-51% of vehicle cycle emissions for the BEV300 compared to 1% for the ICEV

Use-phase emissions make up 92% and 88% of the lifecycle emissions for ICEVs and HEVs, respectively

Use phase for BEVs and PHEVs make up about 50-60% and 75-80% of lifecycle emissions, depending on battery size

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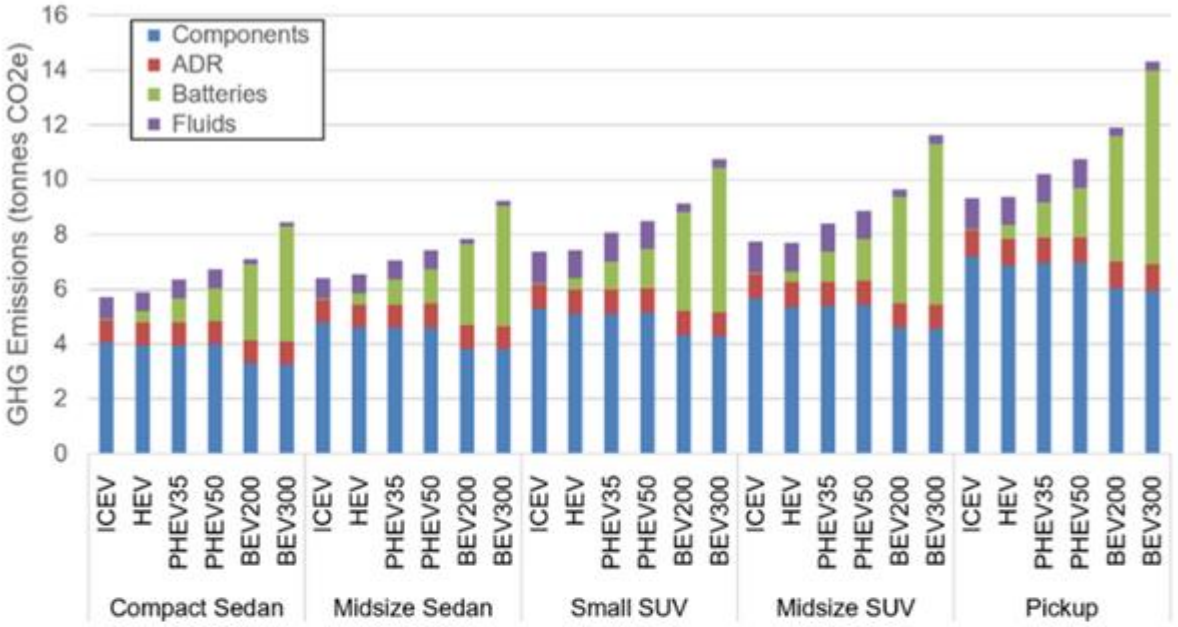


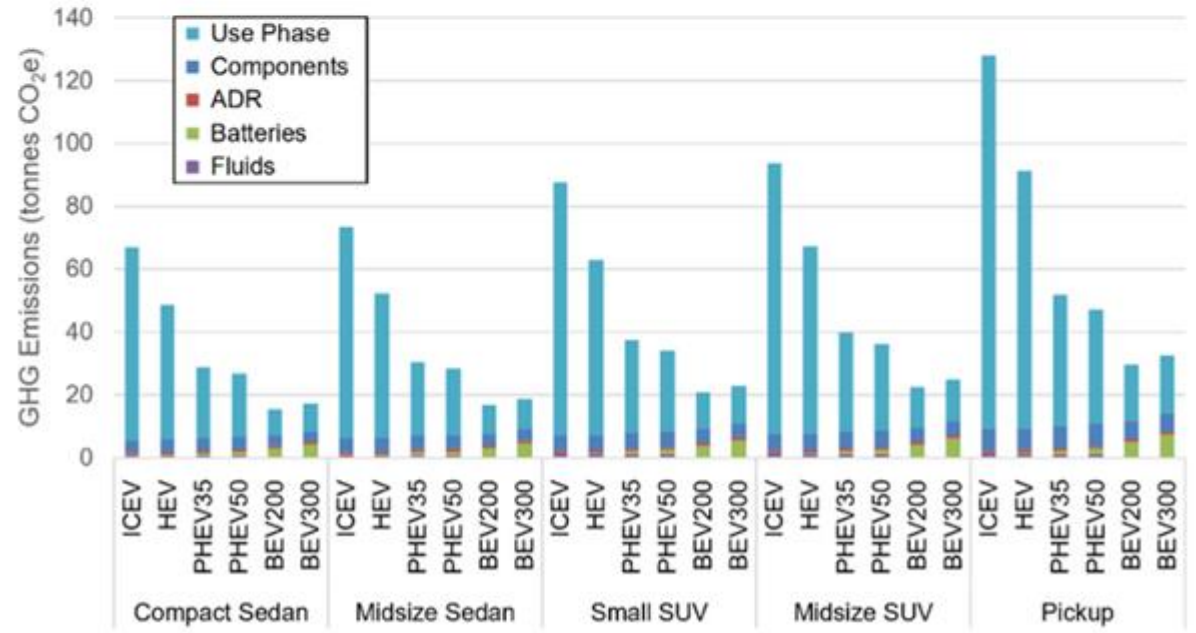


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# Greenhouse Gas Reductions Driven by Vehicle Choice and Use Patterns

Elizabeth Smith[1], Maxwell Woody[2], Timothy J Wallington[1], Christian Hitt[1], Hyung Chul Kim[3], Alan I Taub[1,4,5], Gregory A Keoleian[1,2,] (to be submitted)

## Takeaway

- **Electrified vehicles offer benefits to ICEVs nationwide *in all counties***

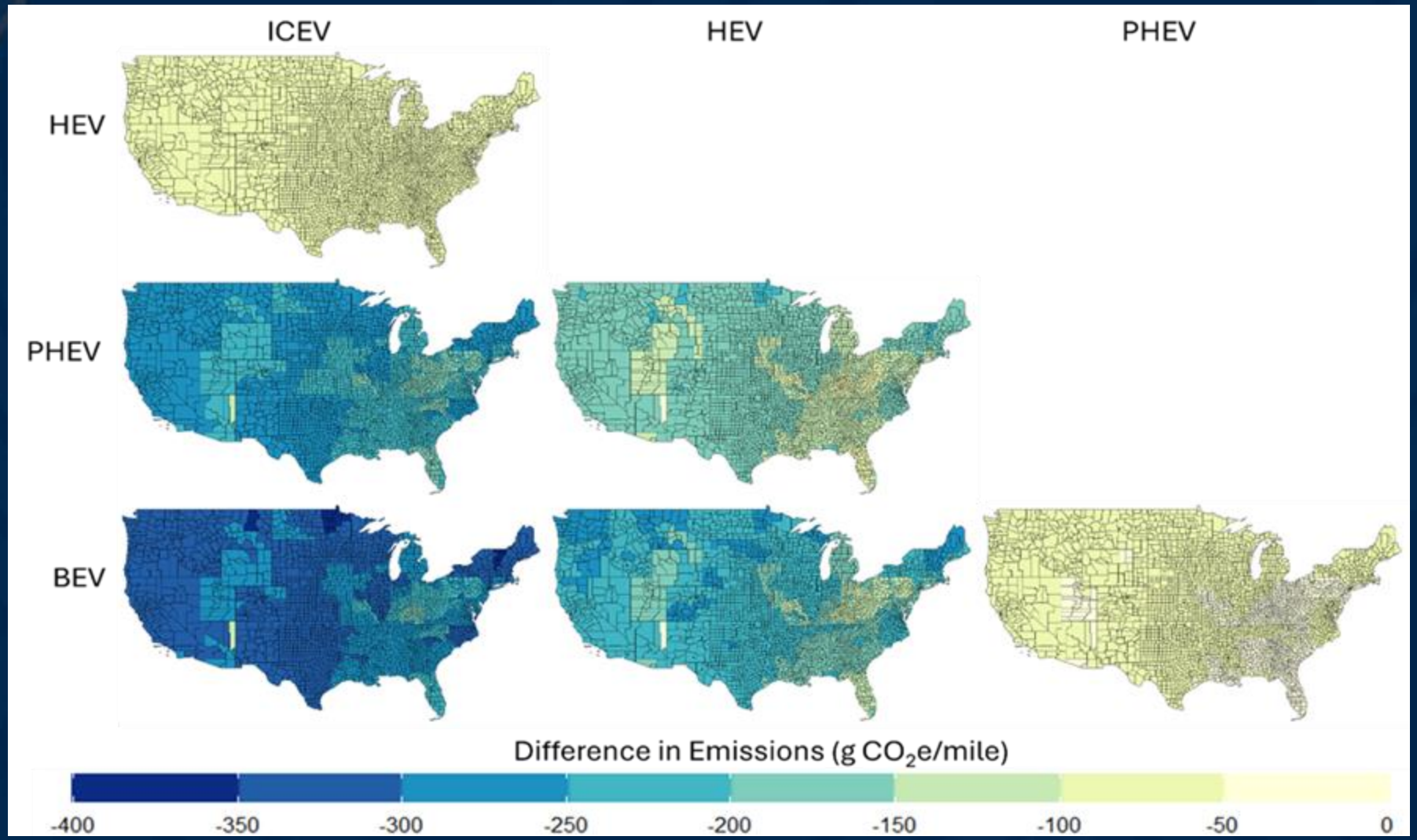


Figure 3: Lifecycle emissions (g CO2e/mile) benefits of increased electrification (powertrains on the vertical axis replace those on the horizontal axis, e.g., left-hand column shows benefits of HEV, PHEV, and BEV replacing an ICEV) for a midsize SUV across the U.S.

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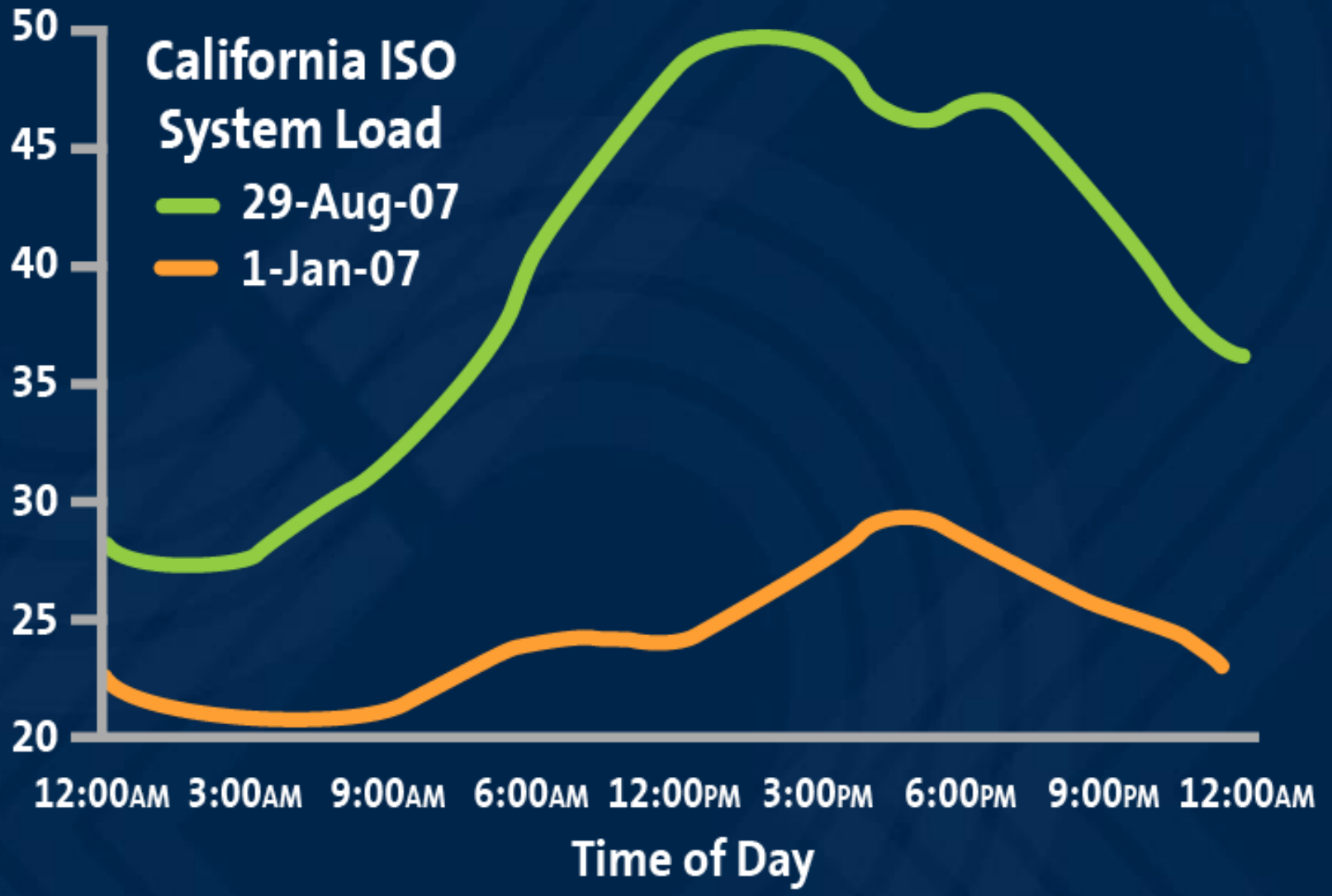
# Electric Grid Designed for Peak Demand

Note data is from 2007 but trends are same today

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# Battery Electric Vehicle Charging

- BEV charging is more flexible and at the same time more challenging
- Where do we place the chargers?

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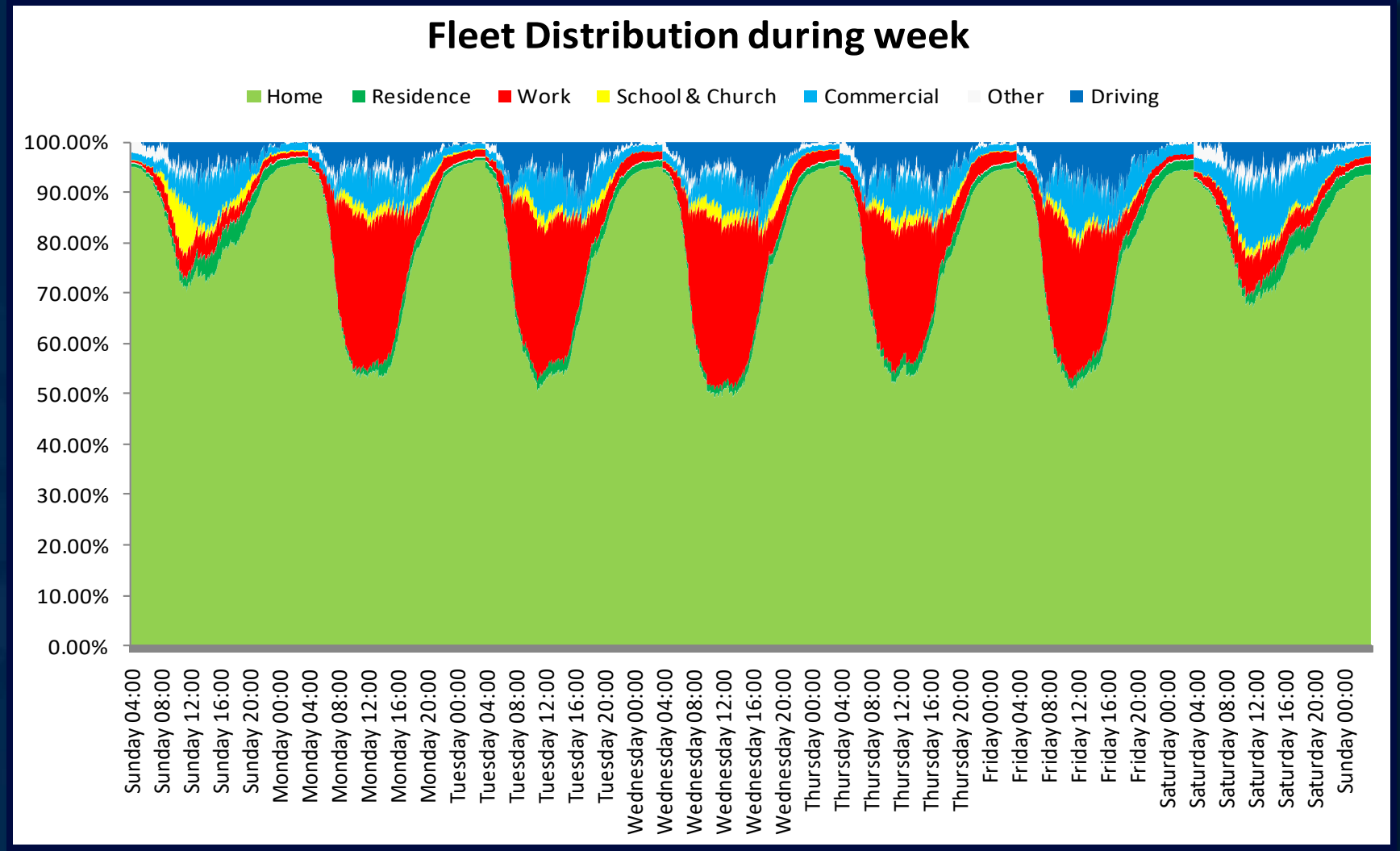
# Where Are the Cars?

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# Battery Technology Challenges

1. Increase energy density for range / weight reduction
2. Improve battery runaway safety
3. Cost <$100 / kWhr
4. Last life of vehicle
5. Last life of vehicle with extensive ultrafast charging

**Required for Cost of Ownership BEV < ICEV**

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- **Can we get there by 2030?**
- **Requires gov't/academic/industry collaboration/coordination**

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# Michigan Lt. Gov. Garlin Gilchrist II and Director Alan Taub Celebrate Launch of $130M Electric Vehicle Center at U-M

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# Our Mission

We Educate,
Innovate
& Engage
to Accelerate
the Future of
Electric Mobility

# Our Vision

To Make Michigan
the E-Motor Capital*

*and to Make Detroit the E-Motor City

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# Industry Engagement

- Goal is to work with industry to establish the high-level priorities on Technology, Workforce Development, and Education
- Execute resulting roadmap project portfolio as a partnership of academia, industry, and government

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# Strategic Pillars

- **Facilities Expansion**
- Education
- Workforce Development
- Technology
- Foundation:
  - Excellence
  - Collaboration


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# BATTERY LAB 1.0

## Pilot Scale Capabilities

- Mixing up to 10 L / batch
- Roll-to-roll processing of webs up to 300mm wide
- 675 sq. ft. -40ºC dew point dry room housing:
  - 18650 assembly line
  - Prismatic pouch assembly line (72x110 mm – up to 10 Ah)

## Characterization

- ~300 cycler channels (30µA – 50A)
- Full suite of analytical tools
- Accelerating Rate Calorimeter for thermal abuse testing

## Solid State

- 475 sq. ft. -40ºC dew point dry room housing:
  - Mixing
  - Coating
  - Prismatic pouch assembly (45x58 mm)
- Lithium metal deposition
- Sputter coating tool for films and powders


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# BATTERY LAB 2.0

- Ellsworth leased building, capabilities will include:
  - Cylindrical cells
    - 18650
    - 21700
      - Capacity of ~5Ah
  - Pouch cells
    - 45 x 58mm
    - 72x110mm
    - 100x150mm
      - Capacity up to ~60Ah
  - Coin cells
- Pilot line equipment factory sign-off


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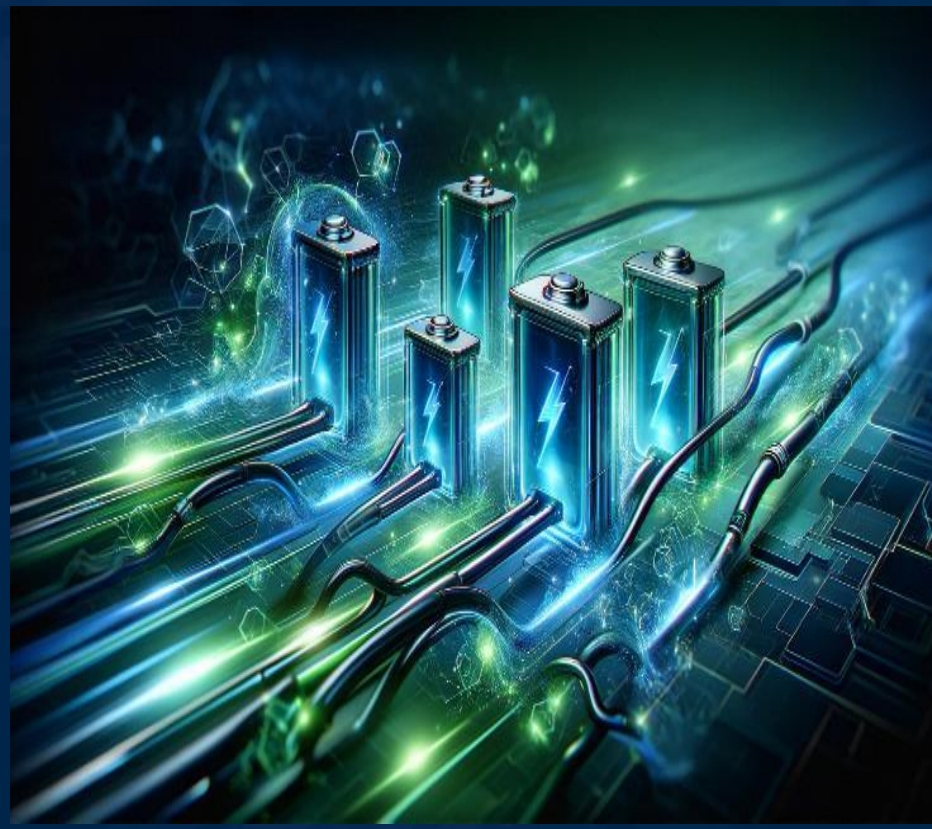
# BATTERY LAB 3.0

## New / Enhanced Facilities

- Completed programming requirements for new facility to house Electric Vehicle Center
  - Working with design team to finalize planning that meets requirements and available budget
- Exploring opportunities and technical requirements for enhanced educational facilities, including potential synergies with existing facilities and programs
  - $500K donation for educational equipment



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# Industry-Driven Priorities

- Undergraduate, Graduate, and Professional Education
- Workforce Transformation
- Foster Collaboration
- Energize Organization Transformation
- Sparking PK-12 Minds

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# Master's in Battery Engineering (in development)

- A proposed 27 credit hour curriculum could be completed in 1 year (with a spring semester laboratory)
- A new undergrad/graduate course in battery manufacturing in development
- Partnership with SEAS (Environment and Sustainability) and CFE (Entrepreneurship) for electives that provide a broad experience
- Hand on learning opportunities for battery system engineering and testing
  - HIL BMS programming lab
  - Leverage Faculty expertise and testing labs in EV thermal management and optimization
- Option for an online degree program offering after first residential cohort

Occupation Target: Engineer

# Undergraduate Research Experiences in EV Tech

- EVC sponsored an inaugural cohort of 5 students for the Research Experiences Undergraduate (REU) in EV Tech
- EVC students joined with M-SHORE, MRSEC and NSF EFRI programs (a total cohort of 42 students) hosted at the Lurie Nanofabrication facility at U-M
- Each student received a stipend, housing, on-campus programming, and worked in faculty research lab alongside other graduate students on real-world problems
- The REU students presented lightning talks and posters on their research to culminate many weeks of hard work

Occupation Target: Graduate Student Researcher

# Employer Portal (in development)

- Focus on efficient access to EV sector opportunities for employers
- Engagement with members to drive content and functionality
- Drafting request-for-proposals with successful vendor to advise on:
  - Portal design and functionality
  - Content scope
  - Content update strategies (e.g., manual, automated data feeds, user-generated submissions)
  - Opportunities for personalization


Target: All EV employers

# Strategic Pillars

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# U-M EVC Prioritization of Industry Technology Needs

- Batteries
- Electric Machines & Drives
- Vehicle/Component End-of-Life
- Thermal Management
- Light-weighting
- Raw Materials & Supply Chain
- Electric Infrastructure & Charging Equipment
- Data Collection, Modelling & Analysis

} Reduce cost of BEV ownership and manufacturing carbon footprint

"Fueling" experience

Mobility experience

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# Electric Vehicle Center

## *Driving EV Tech & Talent*

At the University of Michigan's new Electric Vehicle Center (EVC), we educate, innovate and engage to accelerate the future of electric mobility.

Fueled by a $130 million investment from the state of Michigan's Department of Labor and Economic Opportunity (LEO), we drive EV tech and talent by uniting researchers, educators and industry leaders to tackle challenges and expand opportunities in transitioning to vehicle electrification.

Join Us

evc.engin.umich.edu/

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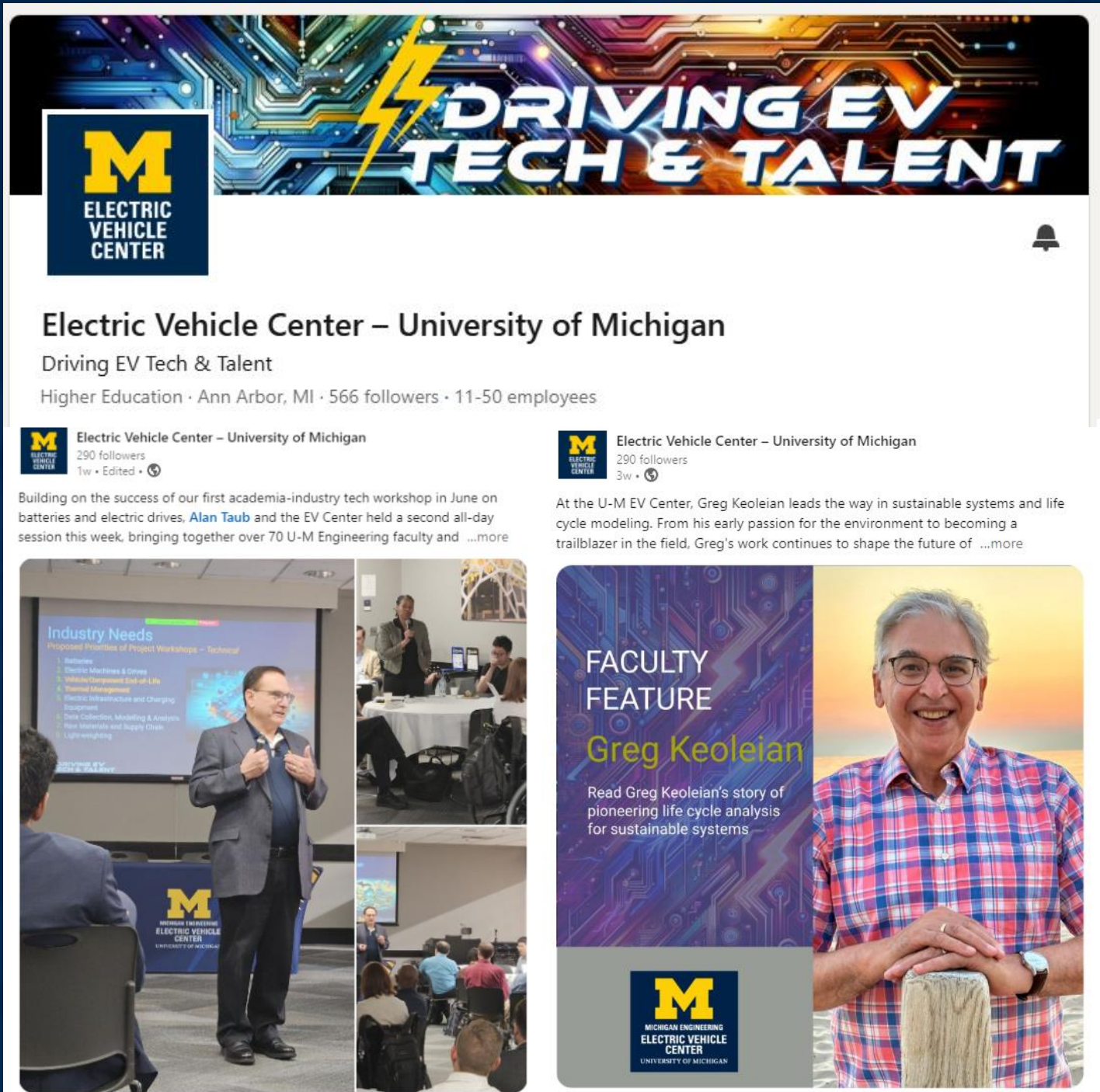

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December 10


December 16

Register Today

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Registration
Now Open

April 1-2

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