

## ETM 518 – Energy and Mobility Spring 2022

### Course Instructor

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### Class Format

Hybrid. Online attendance will be possible via :

<https://sabanciuniv.zoom.us/j/99933247371?pwd=Wlp0VWhkeHpieHR2ZGkxZHpZQXAYUT09>

Meeting ID: 999 3324 7371

Passcode: mobility

(You need to connect via your SU Credentials.)

### Purpose of The Course

This course aims to provide basic concepts towards the following topics:

- Fundamentals of the transportation technology.
- Low-carbon and sustainable transport.
- Energy and mobility interaction.
- Environmental effects of transportation.
- Smart and integrated mobility solutions and their prospective effects in energy use and security.
- Current and future transportation policies, their economic, societal and environmental interactions.

### References

There is no specific textbook for the material presented in this course. Some resources that can be used for each week's topic are listed under Course Contents below. Additional reading materials will be shared at SUCourse when necessary.

### Grading Policy

In Class Presentations (40%), Attendance + Active Participation (15%), Quizzes (20%), Take-home Exam (25%)

- There will be random in-class quizzes (minimum 4, might be more depending on how we proceed). Each quiz will be based on lecture material during the class and will be held via SUCourse+.
- In-class presentations will involve 15-minute overviews of key topics and short class discussions. Groups of two students will be free to pick a topic related to items from potential topics that will be introduced during the first class. You are also welcome to introduce a new topic not given in the list that you are interested in to investigate.
- Take-home exam will be distributed via SUCourse+. More details on that later.

## Intended Course Content and Tentative Outline

### Class 1, March 12

#### Transportation and Mobility Basics, Historical Trends, Current Issues

- Mandatory reading:
  - Chapters 3, 5 and 20 from "[Sustainable Energy – without the hot air](#)"
- Further reading (suggested):
  - Sections 1, 2 and 4 from Maria Figueroa, Oliver Lah, Lewis M. Fulton, Alan McKinnon, and Geetam Tiwari (2014), *Energy for Transport*, Annual Review of Environment and Resources Vol. 39:295-325, DOI: 10.1146/annurev-environ031913-100450  
<https://www.annualreviews.org/doi/pdf/10.1146/annurevenviron-031913-100450>
  - Chapter 2 (The Global Demand for Passenger Travel) from: Andreas Schäfer, John B. Heywood, Henry D. Jacoby, Ian A. Waitz (2009), *Transportation in a Climate-Constrained World*, Cambridge, MA: MIT Press. (Available online in Sabanci University Information Center)  
(Also read Chapter 1 if interested)

### Class 2, March 18

#### Light Duty Vehicles: Technology and Powertrain Options

- Pre-reading (mandatory)
  - Technical chapters Cars II from "[Sustainable Energy – without the hot air](#)"
- Class (intended) content:
  - Comparison of powertrains: Conventional, hybrid, plug-in hybrid, battery electric and fuel cell vehicles
  - Design fundamentals, basic principles
  - Efficiency and performance estimations

- Internal combustion engine
  - Otto and Diesel Cycles
- Efficiency estimations, improvement potential, limits
- Further reading (suggested):
  - Pages 103 to 118 and 125 to 130 from Chapter 4 (Road Vehicle Technology) of: Andreas Schäfer, John B. Heywood, Henry D. Jacoby, Ian A. Waitz (2009). Transportation in a Climate-Constrained World. Cambridge, MA: MIT Press.
  - Chapters 2, 3, and 4 (pages 9 to 62) from: John Heywood and Don MacKenzie (Editors) (2015). On the Road toward 2050: Potential for Substantial Reductions in Light-Duty Vehicle Energy Use and Greenhouse Gas Emissions. MIT Energy Initiative Report. Cambridge, MA: Massachusetts Institute of Technology. <http://energy.mit.edu/publication/on-the-road-toward-2050/>

### Classes 3 & 4 (March 19&25)

#### Vehicle Electrification

- Pre-reading (mandatory):
  - Electric Vehicles in Europe, 2016, European Environmental Agency Report (<https://www.eea.europa.eu/publications/electric-vehicles-in-europe>) (Particular focus on sections with the titles , *“Electric Vehicles: how do they work”* , *“The different types of electric vehicles”* and *“How are electric vehicles charged?”* . Reading the rest of the document is optional).
- Class (intended) content:
  - Batteries and Fuel Cells: Basic Working Principles
  - Charging and Hydrogen Infrastructure
  - Electrification of buses, trucks and other transport modes (including current discussion on e-planes)
- Further reading (suggested) :
  - Executive Summary (pp. 9 to 14), Chapter 2 (Vehicles, pp. 19 to 35 only), and Chapter 5 (Batteries, pp. 59 to 73) from: International Energy Agency (2018). Global EV Outlook 2018: Towards Cross-Modal Electrification. Paris: IEA Publications. <https://www.iea.org/gevo2018/>

### Class 5, March 26

#### Transportation, Energy and Climate

- Pre-reading:
  - TBA
- Class content
  - Conventional and alternative fuels in transportation
  - Renewable energy and transportation

- Transportation, greenhouse gas emissions and air pollution: data, facts, historical trends, future estimates
- Effects of other modes of transport: air, rail and water
- Possible solutions and how to assess their actual potential
- Life cycle analysis
- Further reading
  - TBA

### **Class 6, April 1**

#### **Smart and Integrated Transport, Future Trends in Transportation**

- Pre-reading:
  - TBA
- Class content
  - Autonomous Vehicles
  - Shared mobility services
  - New modes of logistics services
  - Micromobility
- Further reading
  - TBA

### **Class 7, April 2**

#### **Other Issues: Policy, economy, customer behavior**

- Pre-reading:
  - TBA
- Class content
  - Policy trends and their effects
  - Economic issues, trends, future estimates
  - Customer adaption: how to analyze, predict and fasten customer adaption
- Further reading
  - TBA