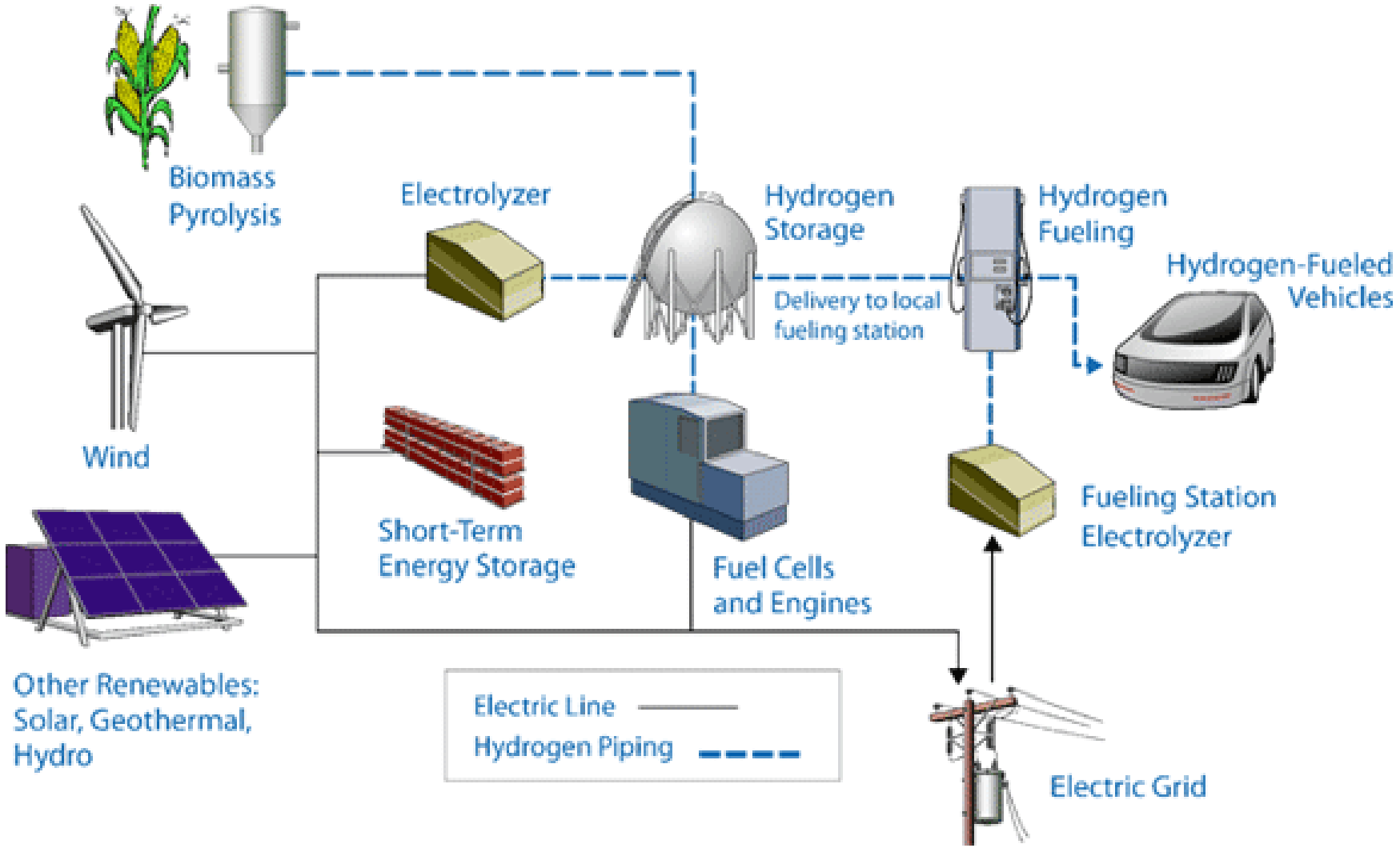
Information about the course MVKF25

Hydrogen, Batteries and Fuel Cells

Professor Emeritus, Senior Professor Bengt Sundén

How can we use Renewable Energy Sources?



Electrochemical Devices - Key Components

- Batteries
- Fuel Cells
- Electrolyzers

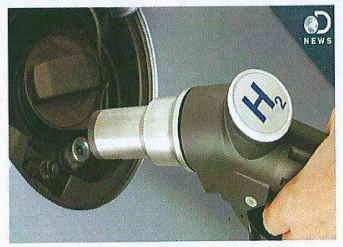
Development of Transportation

Feeding by straw

Gasoline, Diesel refill

Battery electric car
Charging battery

Fuel Cell Vehicle
Hydrogen Fill up



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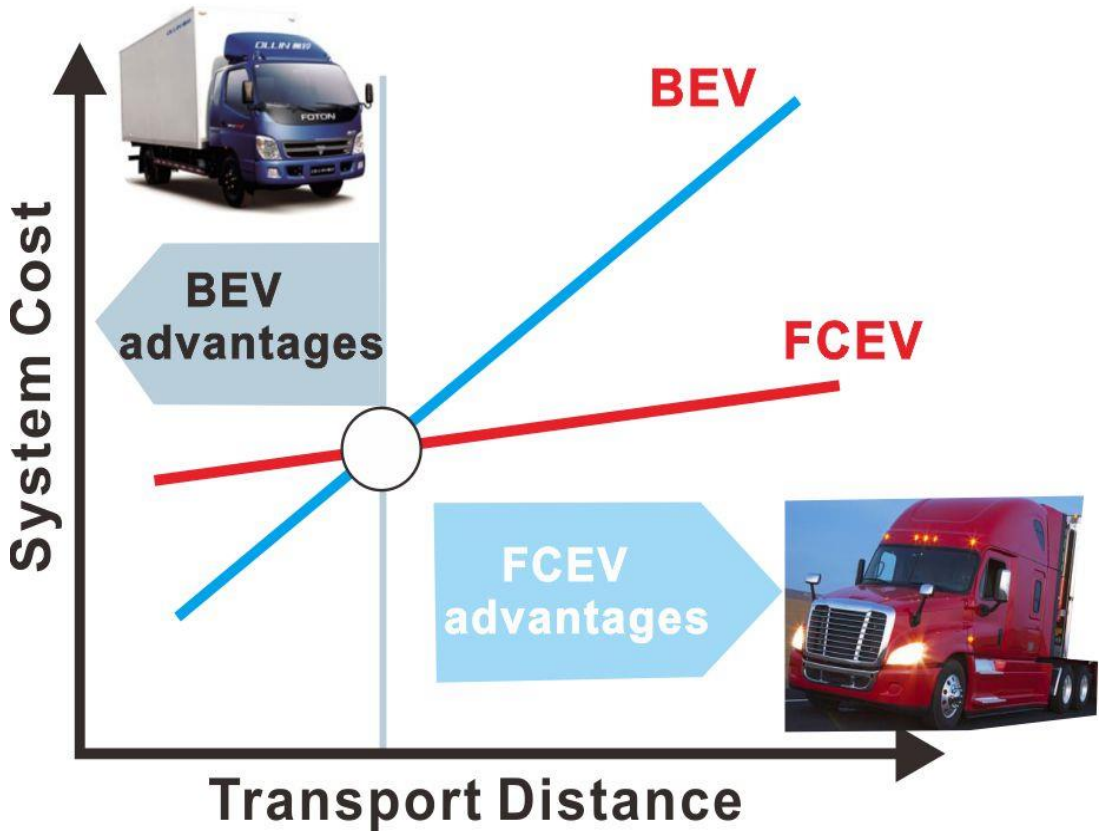
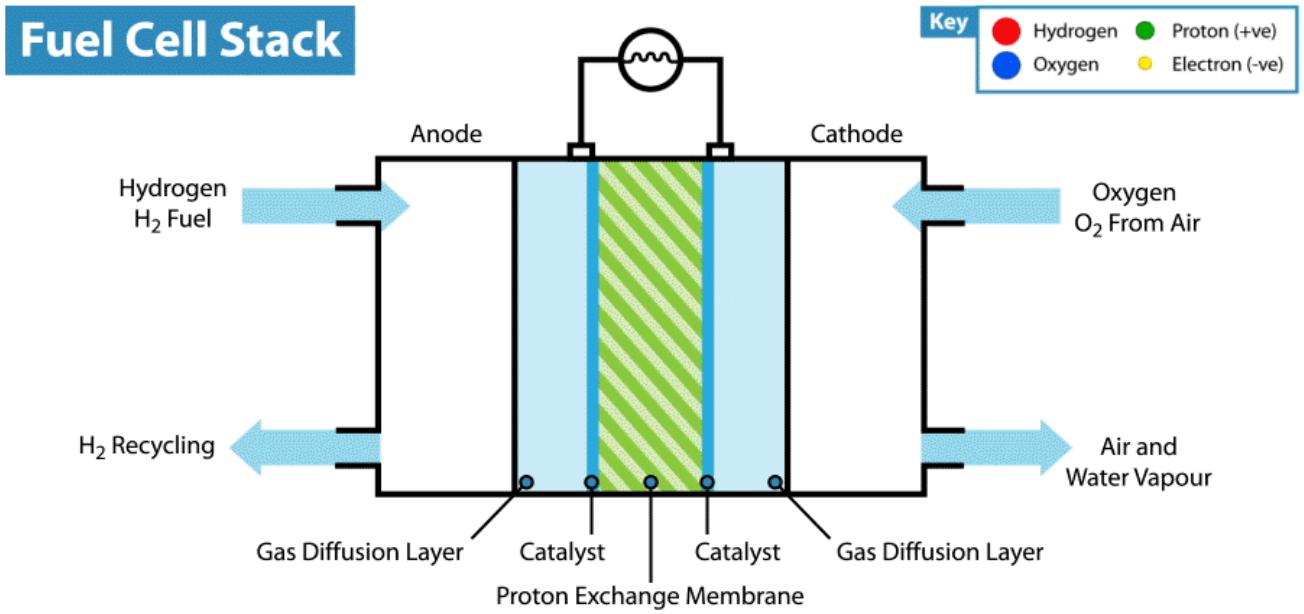
FCEVs versus BEVs



FCEV = fuel cell electric vehicle,
BEV = battery electric vehicle

Introduction

❖ How do PEM fuel cells work?



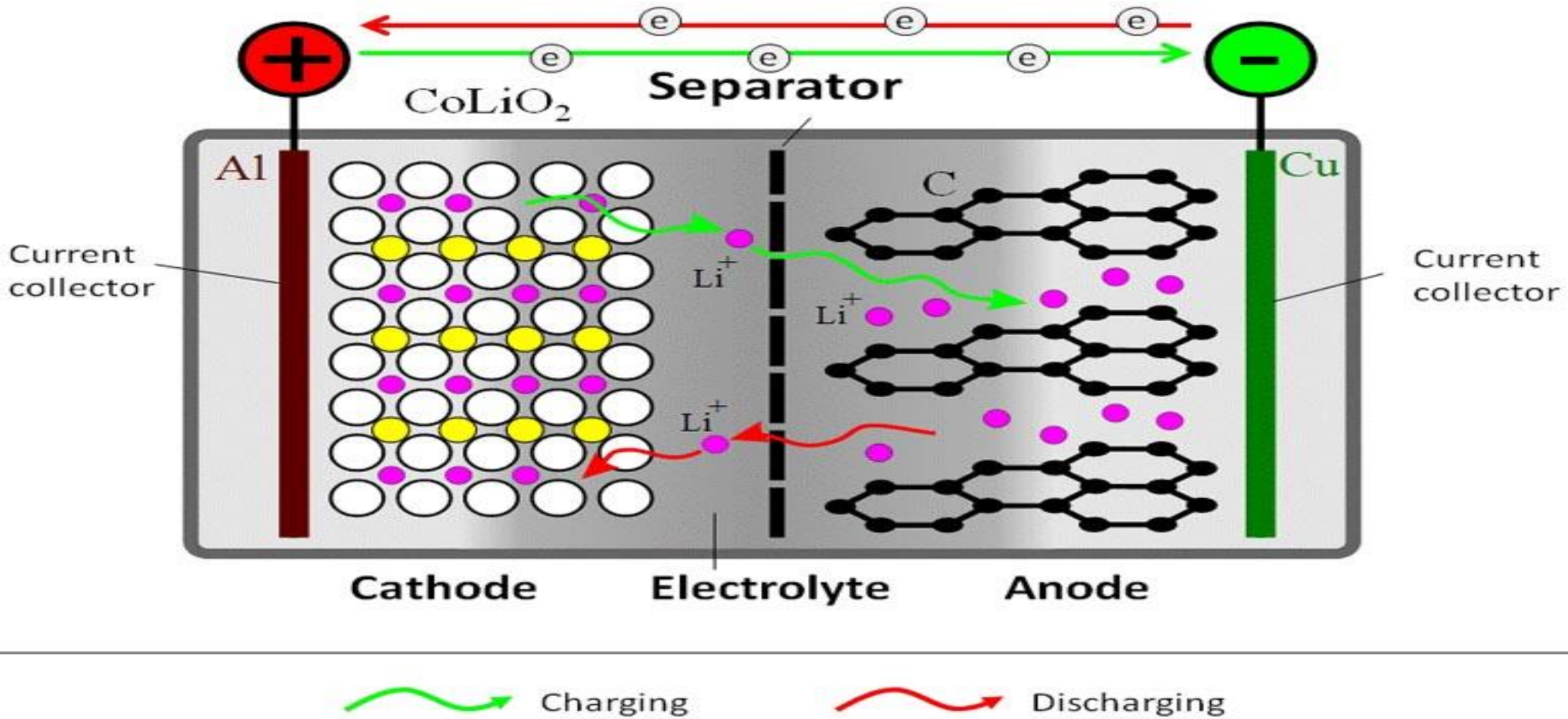
$$\boldsymbol{Overall}: H_2 + \frac{\mathbf{1}}{\mathbf{2}} O_2 \rightarrow H_2O$$

$$\boldsymbol{Anode}: H_2 \rightarrow 2H^+ + 2e^-$$

$$\boldsymbol{Cathode}: 1/2\, O_2 + 2H^+ + 2e^- \rightarrow H_2O$$

http://www.intelligent-energy.com/technology/technology-faq/ (Animation)

Li-ion battery principles charging-discharging



Looking for the future emerging technologies, one needs to study

- **Hydrogen**
- **Fuel cells, Electrolyzers**
- **Batteries**

Suitable Background courses and Complementary topics

- Thermodynamics, heat transfer

- Mass transfer, materials

- Electrochemistry – introduction and necessary stuff will be taught in the course

In general suitable for engineering students in mechanical engineering, chemical engineering, engineering physics, ecosystem engineering and others

Aims of Course

- To provide the students with knowledge and understanding concerning hydrogen as an energy carrier and how to produce and store it.
- Description, applications and analysis of electrochemical devices like batteries, fuel cells and electrolyzers.
- The basic mechanisms of momentum, heat, mass, charge (ion and current (electrons)) transport phenomena are analyzed.
- Thermal management (and water management in low temperature fuel cells) is presented.

Course Literature

- B. Sunden, Hydrogen, Batteries and Fuel Cells, Elsevier-Academic Press, 2019 (e-book available via Lund University Library)
- Lecture notes and handouts

Complementary book (not mandatory):

H. Berg, Batteries for Electric Vehicles, Cambridge University Press, UK, 2015 (e-book available via Lund University Library)

Examination

- A written exam including theoretical/descriptive questions and simple problems. Maximum 50 p. Passing the written exam, 40 % of the maximum number of credit points is required.
- The assignments (homeworks) concern theoretical issues, literature review of a specific topic or solving of numerical problems. Every student must hand in her/his own solution to every assignment. Up to 10 credit points can be provided.
- A compulsory project must also be carried out in groups of 2-5 students. The project must be finalized by a brief report (maximum 10 pages, 1-2 pages of Figs., one page of refs.) and presented orally in a seminar at the end of the course. Up to 25 credit points can be achieved.
- The final grade is based on the written exam, assignments and project.

Schedule

Lecture hours:

Tuesday, Wednesday, Thursday, 10-12 am.

2021

Distance teaching/learning using ZOOM (real time online) and CANVAS

- **Hopefully you will learn a lot about important subjects of future emerging technologies**

- **Welcome to the course**