Why should you take EJ2201?

- information to come back to if your motivation drops

After this lecture you should be able to:

- Decide whether you want to take this course
- Be aware of development trends
- Give examples of the fundamental parts of an electrical drive

Outline

- Who am I?
- A bit of history about electrical machines
- What are electrical machines and drives used for today?
- Challenges
- Other courses to consider
- Jobs

About me

Juliette Soulard juliette@ee.kth.se

- MSc Electrical Engineering, Ecole Normale Supérieure de Cachan (1993)
- PhD University of Paris 6 (1998)
- KTH as post-doc (1998) and researcher (1999)
- Docent in electrical machines (2007) and drives and senior lecturer (2009)

- French high school teacher in Electrical Engineering (1994)
- Director of studies EME/E2C 2007-2011
- EES Educational developer (January 2014-?)

- Permanent magnet synchronous machines, modelling and design

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Have you taken a course about electrical machines before?

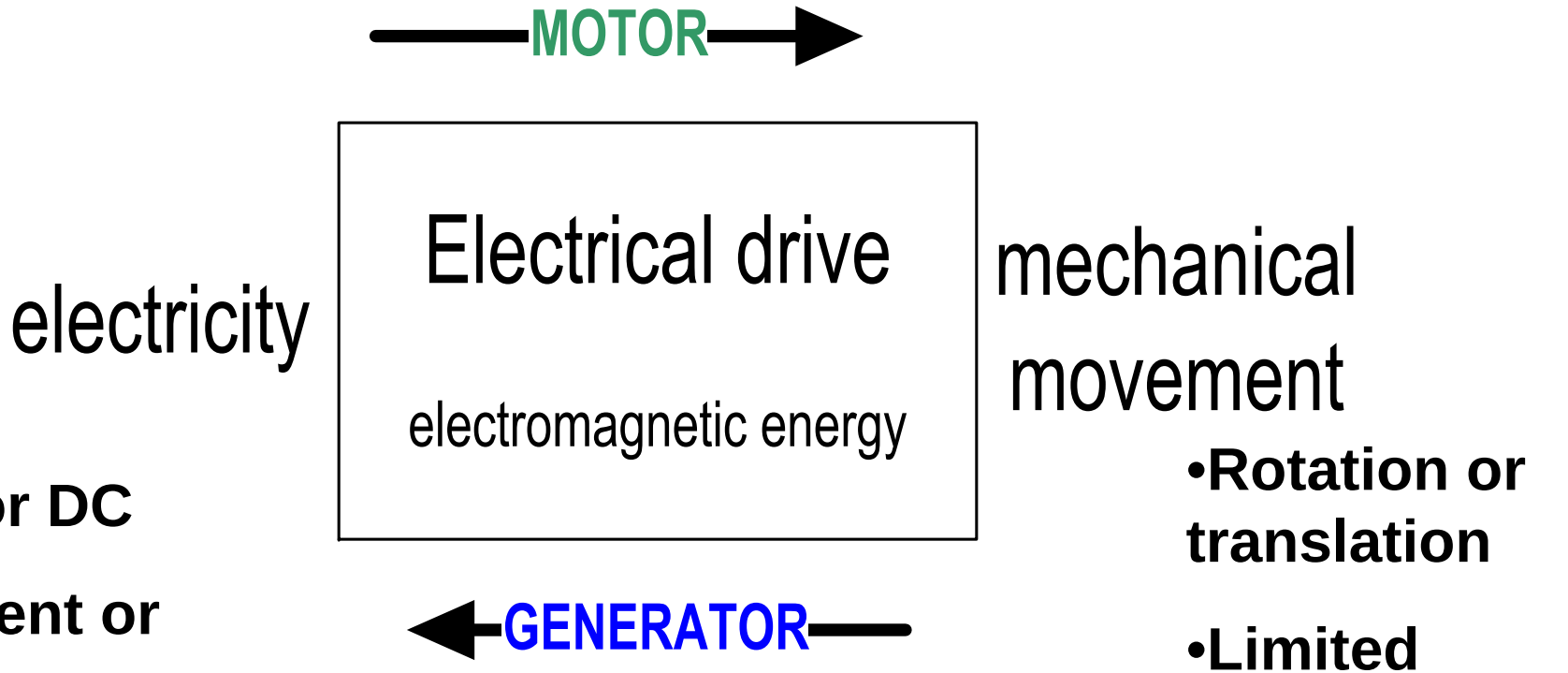
1. yes
2. no
3. I do not remember

An electrical machine is

1. A motor: producing movement from electric energy
2. A generator: producing electricity from movement
3. Both a motor and a generator

Machine= motor and/or generator

Electrical machine = Energy converter



- **AC or DC**
- **Current or voltage source**
- **Rotation or translation**
- **Limited displacement or not**

A bit of history

E. Laithwaite, “The influence of Michael Faraday on power engineering”, IEE Power Engineering Journal, pp209-219, Sept.1991.

10 years!

- 1820 Oersted PM-coil, linear movement
  Ampère coil-coil, linear movement
- 1821 Faraday PM-coil, rotating movement
- 1831 Faraday created a current in a coil by plunging a permanent magnet in it.

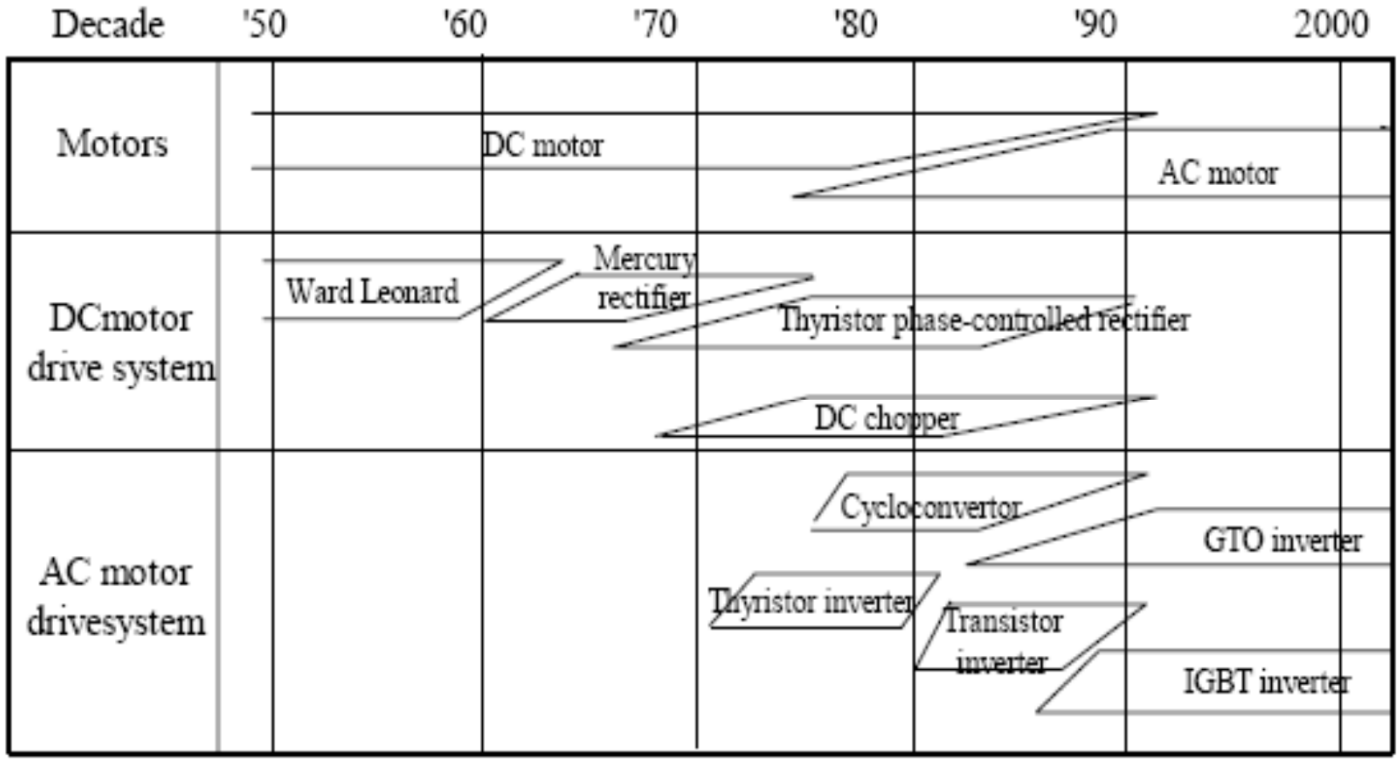
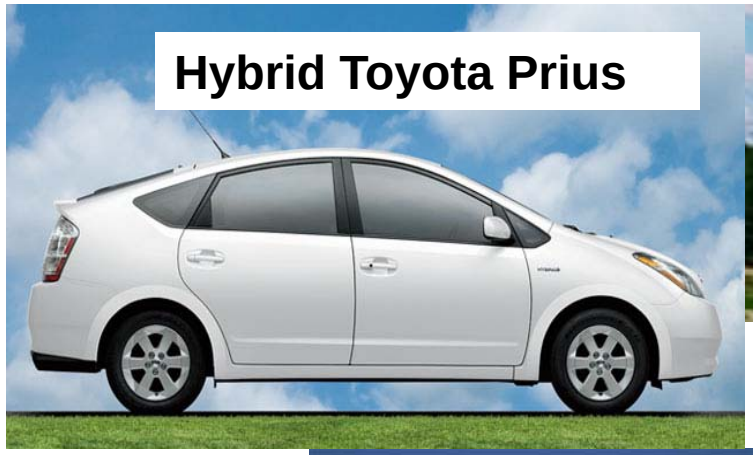


Fig. 8. History of motors and their drive systems.

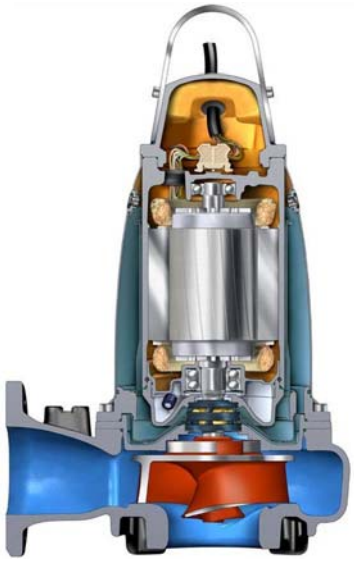
- Faraday’s work led to DC motors and generators
- 1888 Tesla : Induction motors

M. Yano. “History of power electronics for motor drives in Japan”, IEEE Conf. on the History of Electronics, Bletchley Park, UK, 2004.

What are electrical machines and drives used for today?



Servo-motors in robots



Hydro, wave and tide generation

Nuclear and geothermal power generation

How many electrical machines are there in a car with combustion engine today?

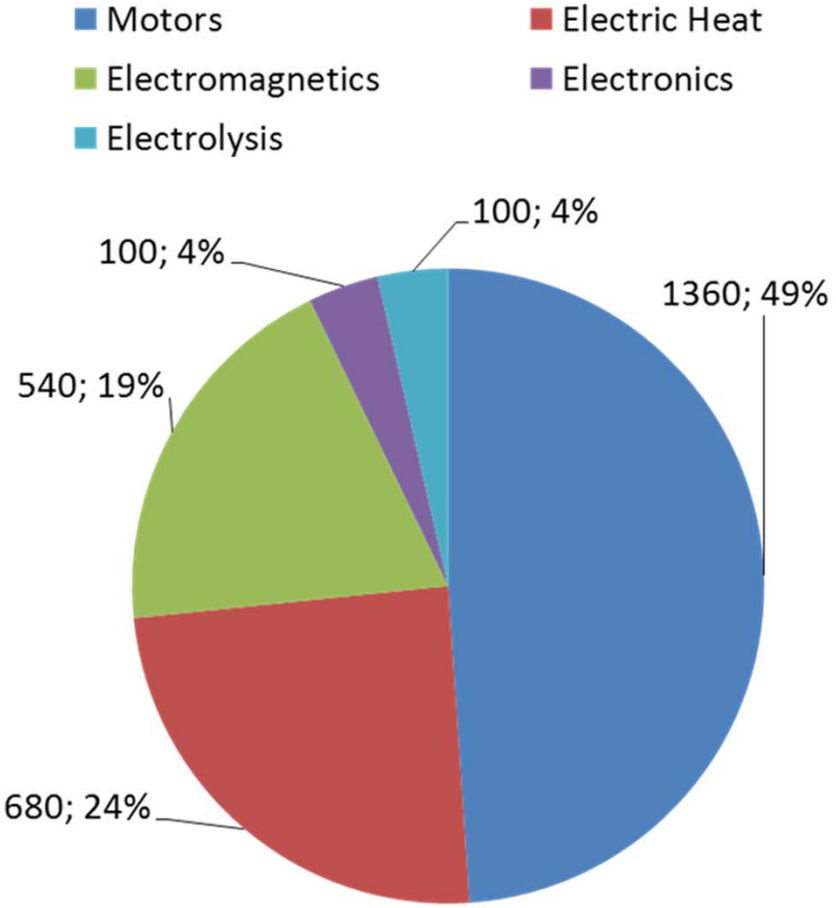
1. 0-5
2. 10-20
3. 40+

Energy Consumption of MDS

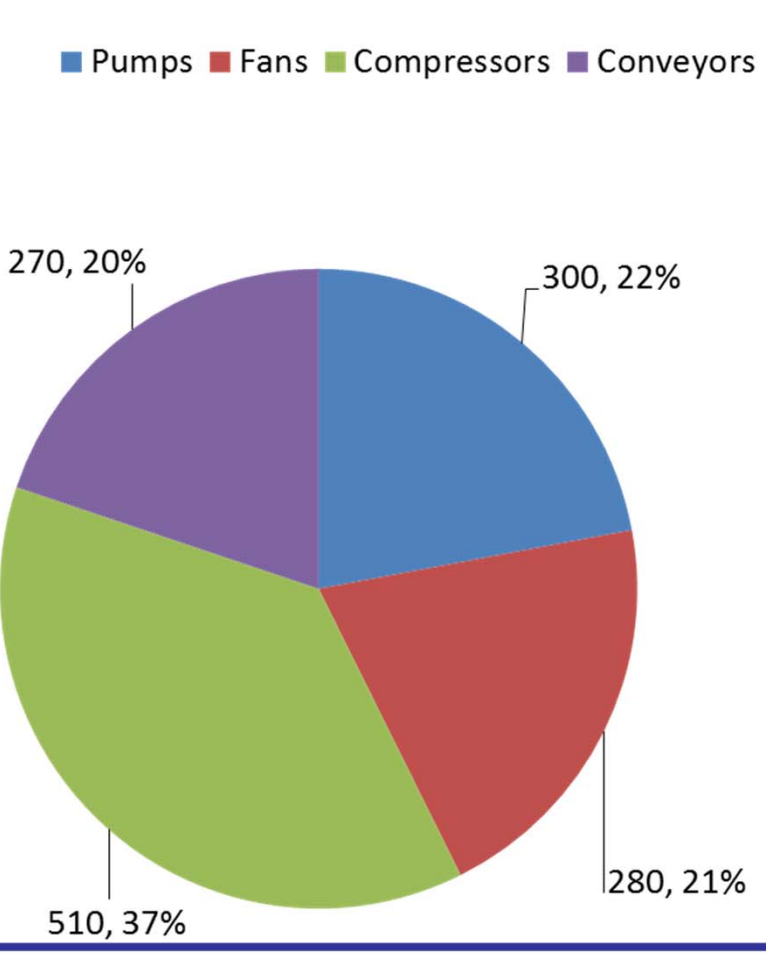
European Commission

STEM hearing
131208 Stockholm

Electricity consumption by use [TWh] – EU27 (2007)



Electricity consumption on motors [TWh] – EU27 (2007)



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Total: 2780 TWh

Total: 1360 TWh

Energy Consumption of MDS

European Commission

STEM hearing
131208 Stockholm

Motors: single speed, three-phase, squirrel cage induction

*U*N < 1000 V, *P*N between 0,75 kW and 375 kW

16/06/2012 — 01/01/2015 — 01/01/2017

IE2

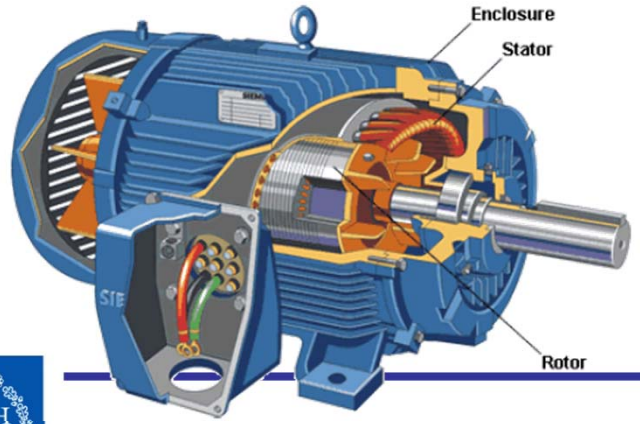
IE3
IE2+VSD
>7.5 kW

IE3
IE2+VSD
>0.75 kW

Efficiency Levels	Efficiency Classes	Testing Standard	Performance Standard
	IEC 60034-30	IEC 60034-2-1	MEPS
Premium Efficiency	IE3	Low Uncertainty	USA Europe 2015* (>7,5kW), 2017 Canada Korea 2015
High Efficiency	IE2		USA Mexico Canada Australia New Zealand Brazil Korea China Europe Switzerland
Standard Efficiency	IE1	Medium Uncertainty	China Brazil Costa Rica Israel Taiwan Switzerland

* IE3 or IE2 + VSD

Source: Lot 30 Preparatory study. Task 1 report (draft)



Estimated savings: 135 TWh (2020)

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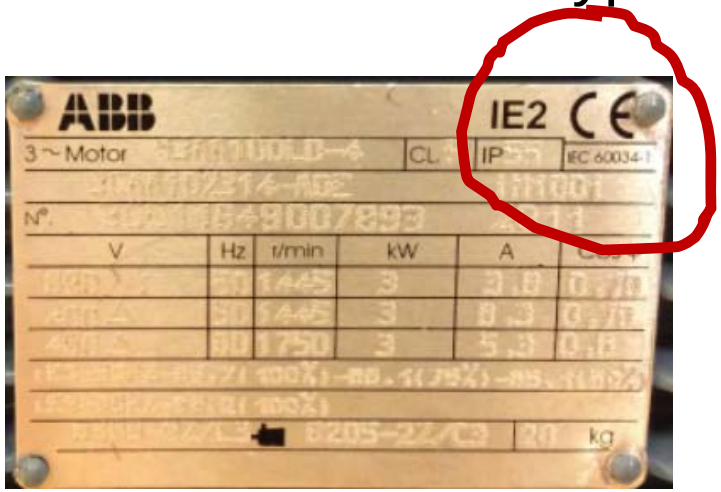
Development trends

- Eco directives with efficiency classes on stand-alone induction motors 0.75kW to 750kW are being extended to embedded drives and other motor types



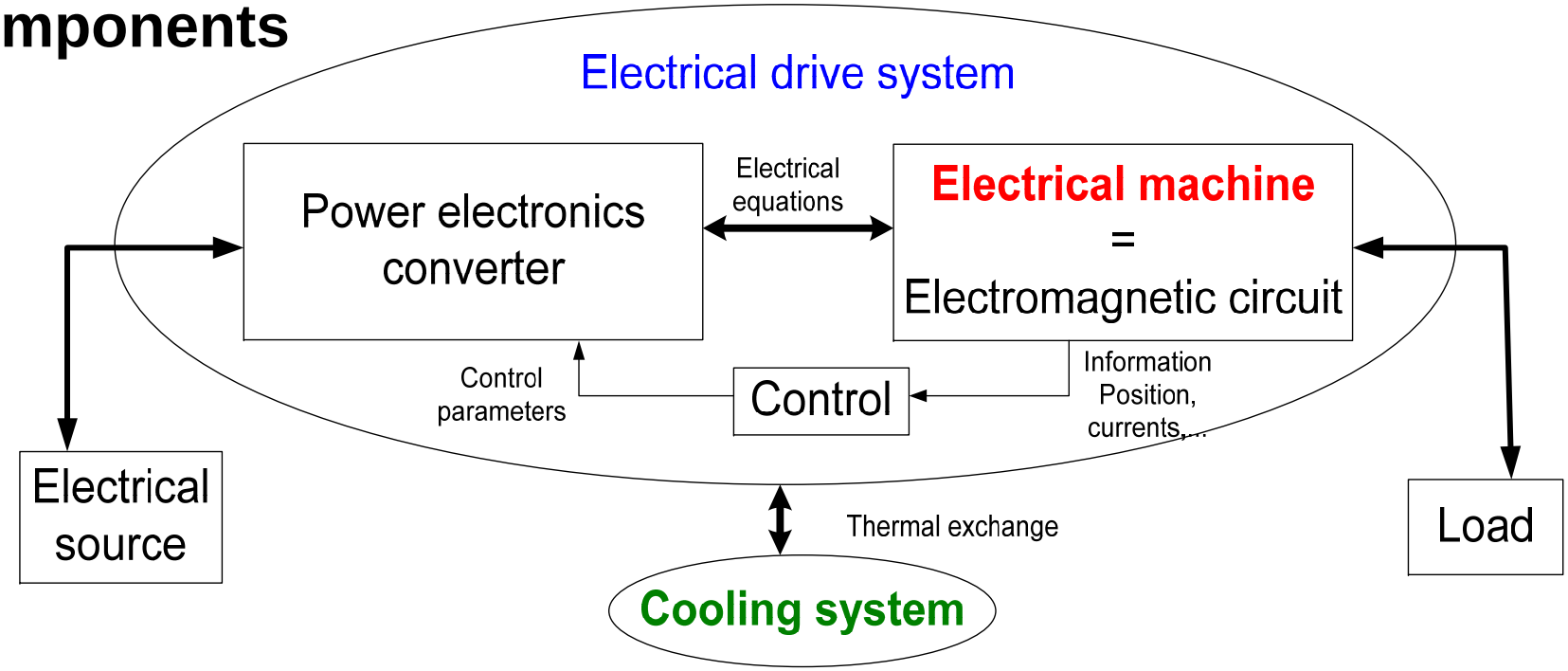
- Variable-speed introduction to adapt to load conditions

Example: pump applications with variable flow

- In 2012, ABB's "new" synchronous reluctance motors with IE4 version (with variable frequency drive)

Electrical drive systems

- **Components**



Complex system that requires knowledge on :

- **electricity**
- **magnetism**
- **mechanics,**
- **thermal exchanges**

…as well as control theory

Other courses to consider

- **EJ2301 Power electronics (6 ECTS P1-2)**

- EJ2230 Control in electric energy conversion, M1 P4, 6 ECTS
- EJ2440 Electric transportation, M1 P4, 6 ECTS

- EJ2222 Design of electrical machines, M2 P1, 7.5 ECTS
- EJ2120 Project in electric energy conversion, M2 P1-2, 9 ECTS

- **EJ210X MSc final degree project in electrical machines and drives, 30 ECTS**

Jobs

Survey Dec13 MSc final degree project
EJ210X 2010-2013, 27 students/13 answers

- MSc project at KTH/companies: 3/10
- Time to first job: max 4 months
- Where:

6 Sweden, Norway, Portugal, 2 Germany, Italy, Pakistan, Bangladesh

LEARN SWEDISH NOW!

- Title:

10 engineers (motor design, HV equipment subsea pumps, power system, power supply, design, development IM drives, drive systems, electrical designer),

2 lecturers at university, 1 associate scientist