**pilot teaching week**

“(Personal) energy efficient mobility in the future”

**KU Leuven, campus De Nayer**

**11-15 March 2024.**

# Introduction:

* “Challenges related to mobility are changing rapidly due to e-commerce, working from home, limited (public) space, autonomous vehicles, transportation injustice, etc. Changes are not only driven by technological developments, but also societal developments (including environmental issues) and individual needs. Therefore, these challenges need to be addressed in an integrated way from all three perspectives.” (mission statement of Leuven institute of mobility).
* One of the current major debates in society is on the future of (personal) mobility.
* The current situation of the organization of personal mobility is far from sustainable.
* As engineers are the most technical experts is a country it is absolutely important that at least engineers can understand the numbers to have a critical and realistic voice in the debate and to suggest real solutions (evidence based).

Therefore, in the pilot teaching we want to take students from the level of data-gathering (in newspapers and other sources) to extract the information and come to knowledge about this problem.

* + Data<>information<>knowledge<>wisdom
  + Students should have knowledge about numbers
  + Students should be able to analyze the numbers
  + Students should disseminate these numbers in a comprehensive way to peers and to non-peers

Creating knowledge:

* Insight in modes of personal mobility, energy impact, economical aspects, consumption, transport, energy and material resources, space claim, CO2-footprint…etc.

Learning outcomes:

* Overarching competences
* Competences on team dynamics, distributed teams, digital ecosystems, sustainability, digital twins.

# Organizational issues:

* In the pilot teaching different student groups will participate from within the Work4ce project but also regular KU Leuven students.
* groups of 4-5 students, mix of all study fields.
* Each teams decides on a team name.
* Division lectures/group work: see elaborated scheme on the webpage.
  + \*Daily Scrum: Scrum Event that is a 15-minute time-boxed event held each day for the Developers. The Daily Scrum is held every day of the Sprint. At it, the Developers plans work for the next 24 hours. This optimizes team collaboration and performance by inspecting the work since the last Daily Scrum and forecasting upcoming Sprint work. The Daily Scrum is held at the same time and place each day to reduce complexity.
* Lectures from different partners: KU Leuven, KNUCA, NU ZP, FH Dortmund, EHU, AzuAC

# Teams.

* On Toledo
* All is responsible for the whole of the team work, during the mobility week, during the pitch, for making the final report.

# Learning activity plan:

## Assignment upfront of the block week:

* + literature reading (Factfulness (H. Rosling))
  + Belbin role test (to assign teams)
  + collect personal energy data (how much energy you use for heating, electricity, transport at home, numbers and characteristics (e.g. type of heating, nominal power, invoices for gas and electricity)

## Seminars/micro-lectures:

## According the schedule: on the webpage

* + All seminars is on-campus
  + Tuesday afternoon: company visit. Bus leaves campus at 4pm. Returning to campus near 8.30pm or drop off in Antwerp.

## Social activities:

* Day 1 (Monday): fries and snacks at campus and board game night. Group members get to know each other and the staff, inspiration for the making of a board game.
* Day 3: (Wednesday) cantus organization by the combined “studentenkringen”.

# Assignment:

* Collect and interpret data to get to knowledge about a specific area (e.g. household, transport, energy transition, construction, mobility modes, ….)
* Design a (prototype of a) board game to present knowledge, solutions, correct numbers on personal (and public) transport, energy and systems to a general public.
* Pitch your prototype as if it was a business case
* Illustrate with some articles containing faulty or badly presented information.

# Assignment - output/outcome:

## Assignment.

* Thematic divide with 4 themes (each team selects a theme)
  + Personal transport and resources
  + Personal transport and construction
  + Personal transport and electrification
* Pre-track: literature reading (Factfulness (H. Rosling)), Belbin role test (to assign teams), collect personal energy data (how much energy you use for heating, electricity, transport at home, numbers and characteristics (e.g. type of heating, nominal power, invoices for gas and electricity)
* Design a board game on this content and make a prototype with paper/post-its: : e.g. trivial pursuit, quartet, energy colonists of the world, energy-risk……
* Pitch/presentation on Friday: 5 min per group + 5-10 min feedback (on the proposed solutions, on collected data, on the prototype of the board game, suggestions for policy). Best pitch will be rewarded.
* Self-reflections on the group dynamics (written report of the daily scrums: what went good, what went wrong, where to focus/work more)
* Final written report (due 29 March): final report with the final version of the board game and with structured information on (energy efficient) personal transport.

## Workflow

* Get to know eachother, set up efficient communication.
* Brainstorm on personal transport/exchange of ideas: think about the theme and questions which come to your mind.
* Search for evidence and numbers in libraries/internet/papers to support your ideas and to answer questions on your theme.
* Brainstorm about a game concept to communicate your findings to a general audience in a non-formal way.

## Inspirational questions in the thematic topics.

### Shared questions:

* What is the transport mode mix people use in cities, in the countryside?
* How much energy is used by households, transport, country?
* How much km inhabitants do at an average per year in different transport modes?
* What/how much does an energy source/system bring? In total, at an average (and under which conditions) in relation to the energy it costs to make the system?
* How much energy does a windmill/solar panels/sun boiler generate (transform) and much energy it costs to make these systems?
* Where is energy going to in a country (Sankey diagrams Europe)
* Where/what is the biggest and quickest win for energy usage reduction in transport?

### Personal transport and construction

* What is the meaning of energy ratings for houses (EPC/EPB, …)?  Is there a difference between countries?
* What is the price (energy cost) of transport, of a shower, of washing in the washing machine.
* What is hidden losses of energy (in household, in personal transport)? (e.g. computers, smart house/domotics systems, fridge, battery chargers, standby mode of TV/modems/customer products, evaporation of fuel)
* How do you heat your house? What is nominal power? How much you use in electricity/transport/heating
* How does construction of houses/roads/infrastructure influence on mobility? Modular Design: Integrating modular design into construction processes can significantly enhance energy efficiency. This approach minimizes waste by leveraging prefabricated components, while also promoting energy efficiency through optimized resource utilization during the design phase. Additionally, the dismantling capability inherent in modular design facilitates the efficient use of (sustainable) materials. Moreover, construction conducted off-site mitigates on-site impacts, further contributing to overall energy efficiency. Furthermore, the ease of transportation afforded by prefabricated elements enhances the advantages of modular design. Additionally, it enables rapid construction, further facilitating the building process.
* Parking garages: Exploring strategies for multifunctional parking garages that accommodate both cars and bikes. Is it feasible for bikes to navigate the same slopes as cars when accessing dedicated bike parking areas? Also take into consideration the multi-functionality and/or repurposing of this type of infrastructure.
* Road planning: Investigating the reorganization of tunnels and bridges to facilitate the simultaneous passage of cars and bikes. For instance, what would be the implications if all roads were situated underground? Lowering road elevation beneath ground level could reduce the necessity for constructing high bridges, but what additional advantages might this offer?
* City planning: Same as resources, how to optimise the use of land?

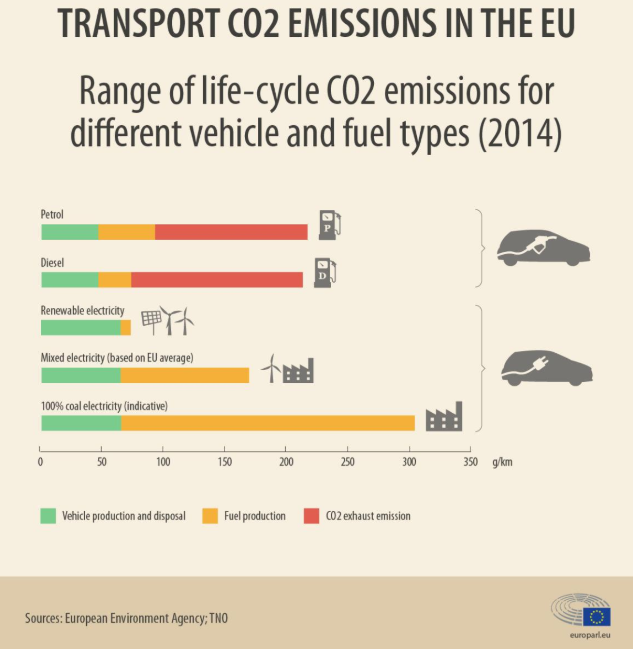
### Questions for the theme Personal transport and resources

* Any means of transport requires resources to produce means of transport. Can you estimate the resource requirements for different modes of transport?
* What about the usable payload in comparison to the amount of resources necessary and use of transport modes?
* Recyclability Considerations: Which materials are readily available, and how can they be optimized (e.g., weight and transportation efficiency)?
* Is there threats and risks in the supply chain for necessary resources?
* Embodied Energy Reduction: What strategies can be implemented to minimize embodied energy? EG lean design, increase of bio-based resources, smaller vehicles, self-driving cars…
* Ownership Dynamics: The question of ownership is pivotal, influencing practices such as carpooling and car leasing, but also ownership of land and infrastructure.
* City planning: Optimising the use of land and space claim of transport modes. One of the major resources by looking at multi-functionality and/or repurposing. City planning optimised for personal transport?

### Personal transport and electrification/energy

* Energy transition: how does it impact different capacities (of types of energy), how does it impact society (time spread of energy use, electric cars, V2G, cost structure….)
* Exhaust and energy: C2O emissions
* What is the evolution of energy usage in a country/Europe and what is the evolution of sustainable energy (wind, sun) in this respect?
* What are the energy losses in production and distribution? (Efficiency of power lines, energy conversion (in power plants).
* What types of (large scale) energy storage does exist? What is the energy efficiency of each of those systems?
* Cars: how is fuel consumption impacted by speed? Mass? Is speed reduction (like in the Netherlands max 100 km/h) an efficient measure.
* Zero emission mobility or zero-tailpipe mobility?
* Mobility: charging of vehicles? Charging losses?
* Energy carriers for transport: petrol, diesel, H2, electricity, CNG, LPG difference, how much energy loss in production
* Solar panels for the charging stations: Exploring multiple functions such as charging and heating.
* Embodied energy: Evaluating the use of electric power instead of gas for heating to reduce embodied energy. EG Solar panels integrated into the Electric Arc Furnace for steel production.

# Some useful links:

* [www.electricitymap.org](http://www.electricitymap.org/)
* <https://www.co2emissiefactoren.nl/lijst-emissiefactoren/>
* <https://www.fueleconomy.gov/feg/Find.do?zipCode=10001&year=2018&vehicleId=39840&action=bt3>
* 
* [Optimization Model for reducing Emissions of Greenhouse Gases from Automobiles (OMEGA) | US EPA](https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases)
* [Vlaamse Energiebalans | Vlaanderen.be](https://www.vlaanderen.be/veka/energie-en-klimaatbeleid-in-cijfers/vlaamse-energiebalans)
* [Energiegebruik | Vlaanderen.be](https://www.vlaanderen.be/statistiek-vlaanderen/energie/energiegebruik#bronnen)
* [Energy flow diagrams - Energy - Eurostat (europa.eu)](https://ec.europa.eu/eurostat/web/energy/energy-flow-diagrams)
* [Germany’s energy consumption and power mix in charts | Clean Energy Wire](https://www.cleanenergywire.org/factsheets/germanys-energy-consumption-and-power-mix-charts)
* [www.vestas.com](http://www.vestas.com)
* [VEKA (energiesparen.be)](https://apps.energiesparen.be/energiekaart/vlaanderen) , <https://apps.energiesparen.be/energiekaart/vlaanderen>
* [www.c-power.be](http://www.c-power.be)
* <https://www.elia.be/en/grid-data/balancing/current-system-imbalance?csrt=6269710082824019571>
* <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_statistics_-_an_overview>
* [www.iea.org/data-and-statistics/data-tools/real-time-electricity-tracker?tracker=true&from=2023-1-15&to=2023-2-14&category=generation&country=BEL&fuel=Renewables](http://www.iea.org/data-and-statistics/data-tools/real-time-electricity-tracker?tracker=true&from=2023-1-15&to=2023-2-14&category=generation&country=BEL&fuel=Renewables)
* [IEA Sankey Diagram](https://www.iea.org/sankey/) [www.iea.org/sankey/](http://www.iea.org/sankey/)
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