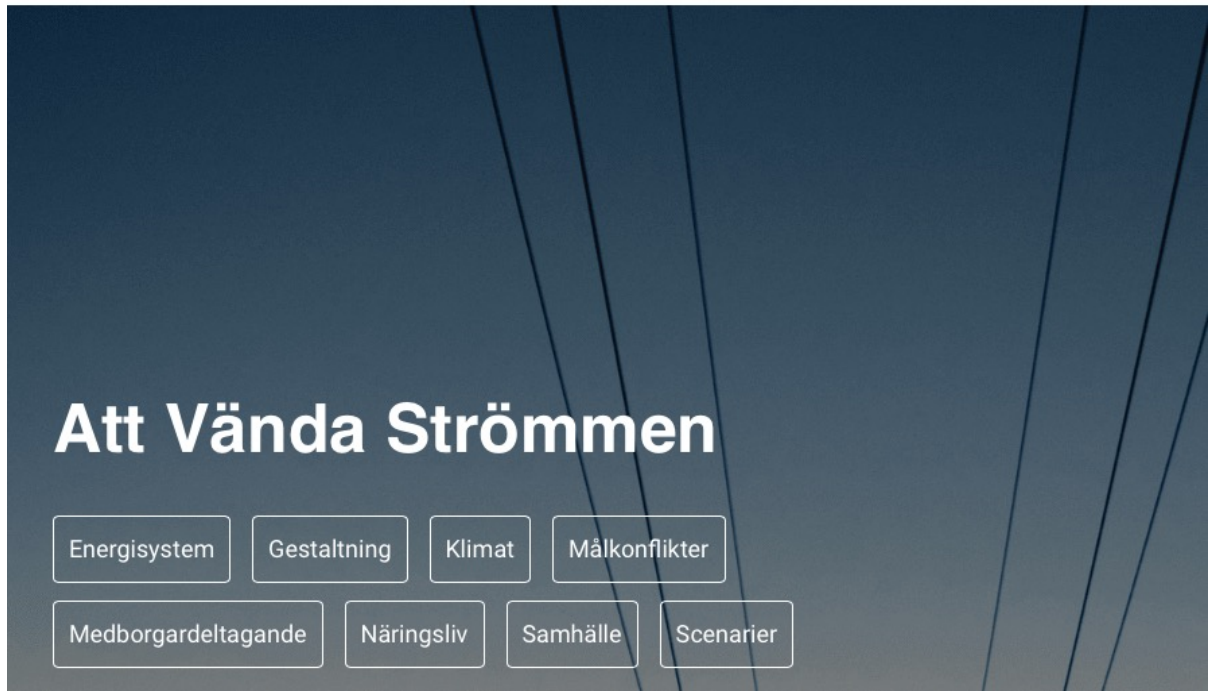
OpenModelica use for forecasting in the MegaGame Energy Project

Lena Buffoni

(LiU)

LINKÖPINGS UNIVERSITET

Att vända strömmen (Switching the current)



A cross disciplinary project between Linköping University, Högskolan i Skövde and Jönköping University

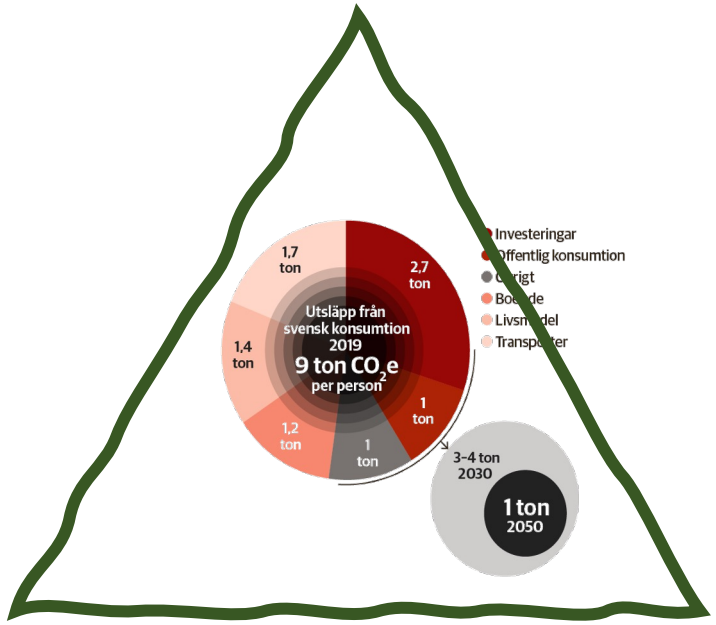
"The project aims to create increased understanding of different stakeholders' perspectives on energy systems, society, environment and climate "

Learning together

- The first step to a sustainable future is understanding the different pespectives and conflicts and getting a better overall view of the complexity of energy systems
- Mega game = game with 20-100 participants

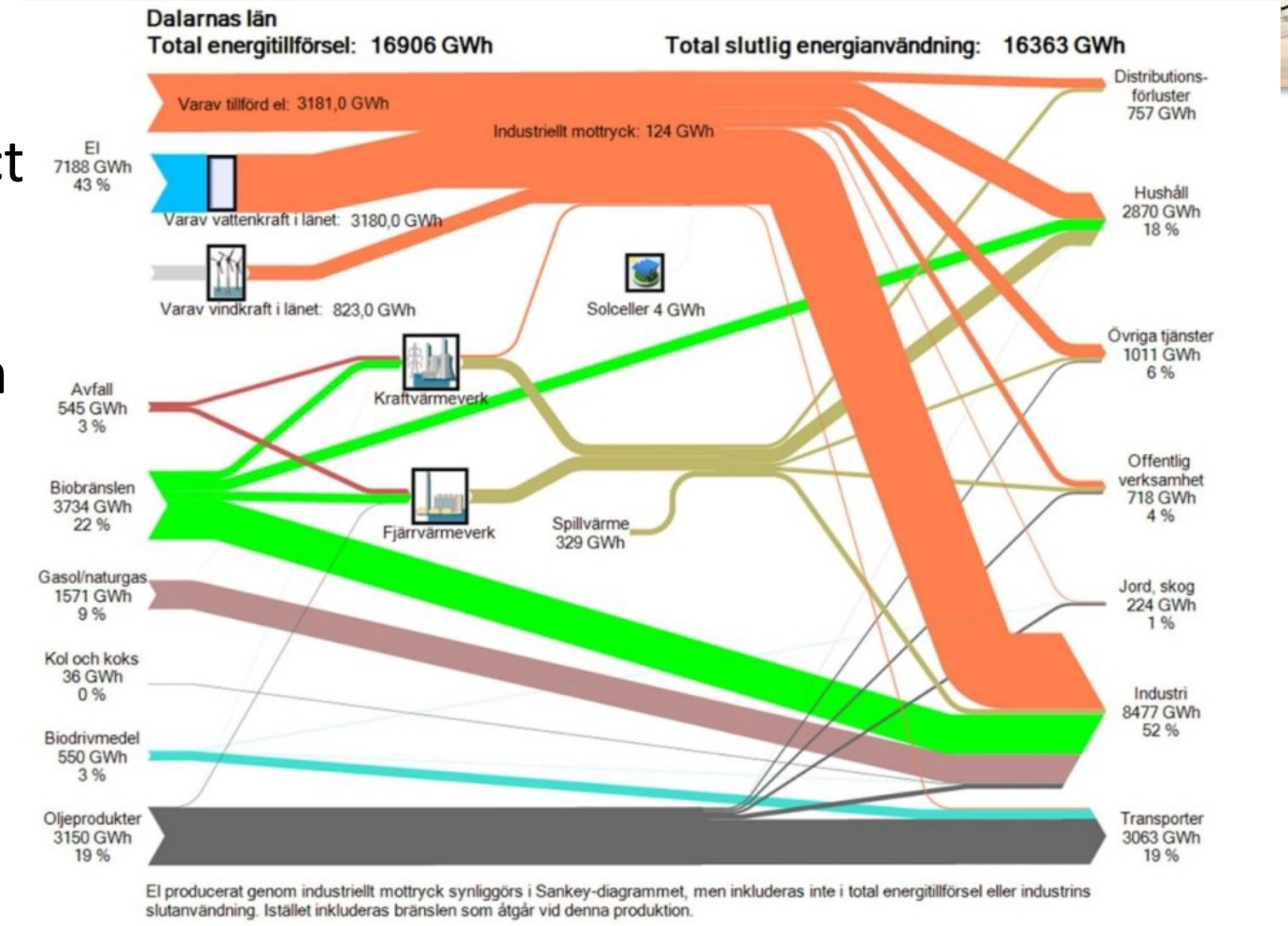
Switching the current as a serious game

- *Serious games* are primarily designed for more than just having fun
- The goal is …
  - Create an experience of transformation
  - That visualize relations, challenges and possibilities
  - And create arenas for creative encounters
- Make perspectives and interests visible
- Therefore *mega-game*
- Therefore a region

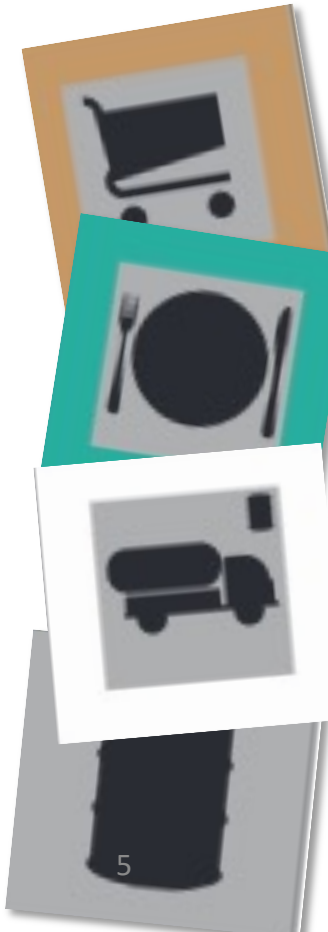


Understanding the scale

- Making sustainable decisions means understanding the impact of our choices on a large scale
- The simulation is built on the data collected from the game as well as region specific data
- The simulation is also built on theoritic scenarios from academia on future trends



El producerat genom industriellt mottryck synliggörs i Sankey-diagrammet, men inkluderas inte i total energitillförsel eller industrins slutanvändning. Istället inkluderas bränslen som åtgår vid denna produktion.



Our goal: reduce CO2 emissions

•The Swedish parliament has decided that Sweden shall be carbon neutral by 2045

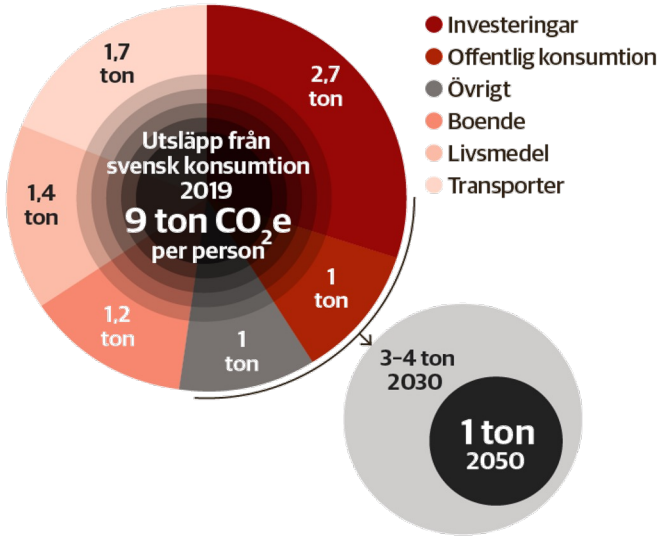


Bild från DN [211203]

-13,5 %/år

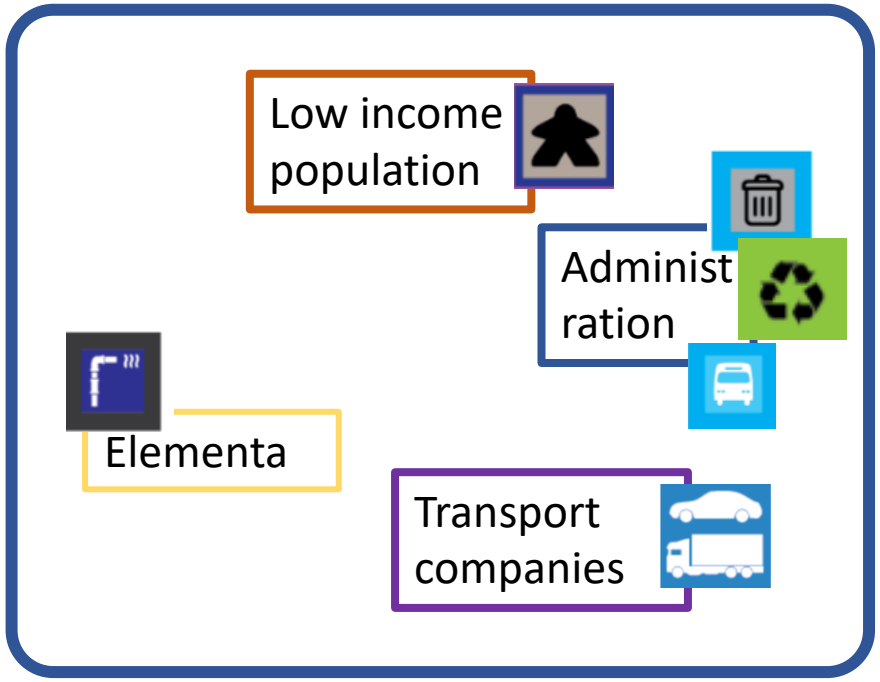
Climate budget trend for Östergötland

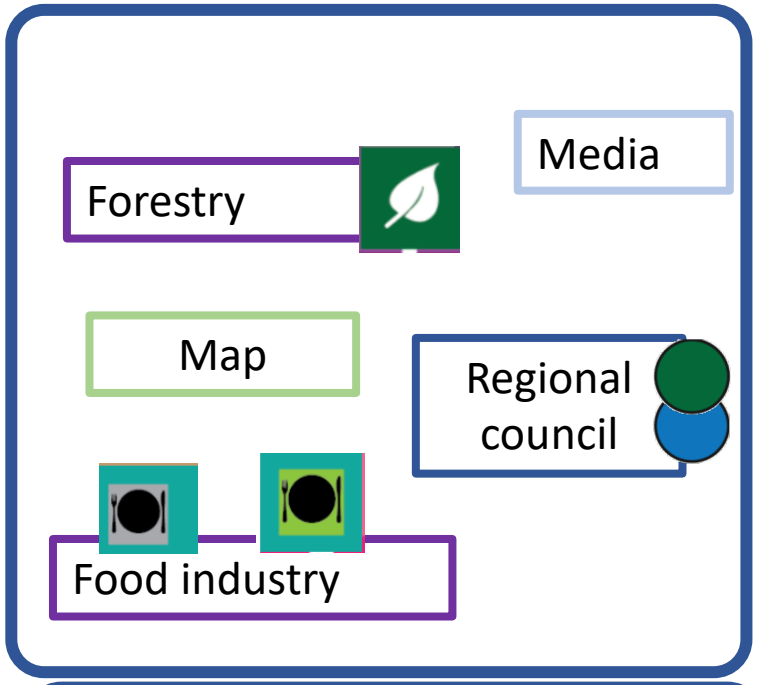
https://www.climatevisualizer.com/

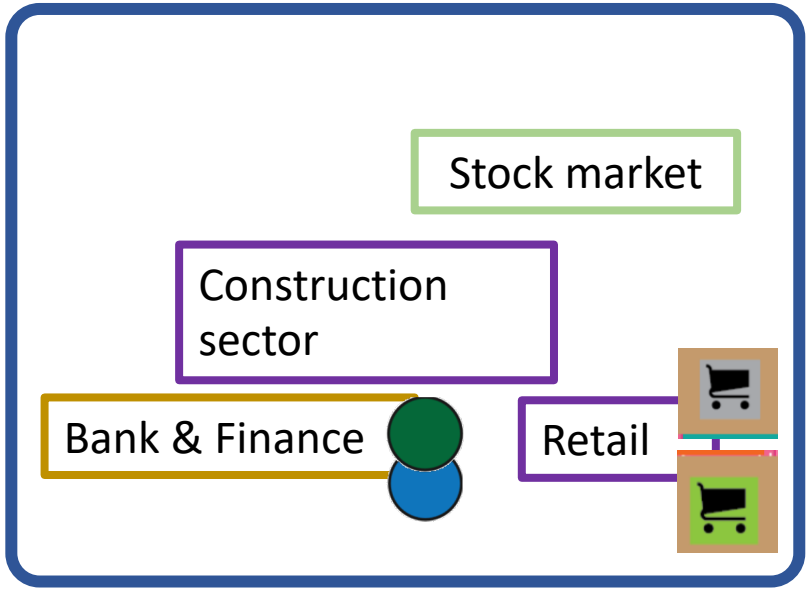
Game structure

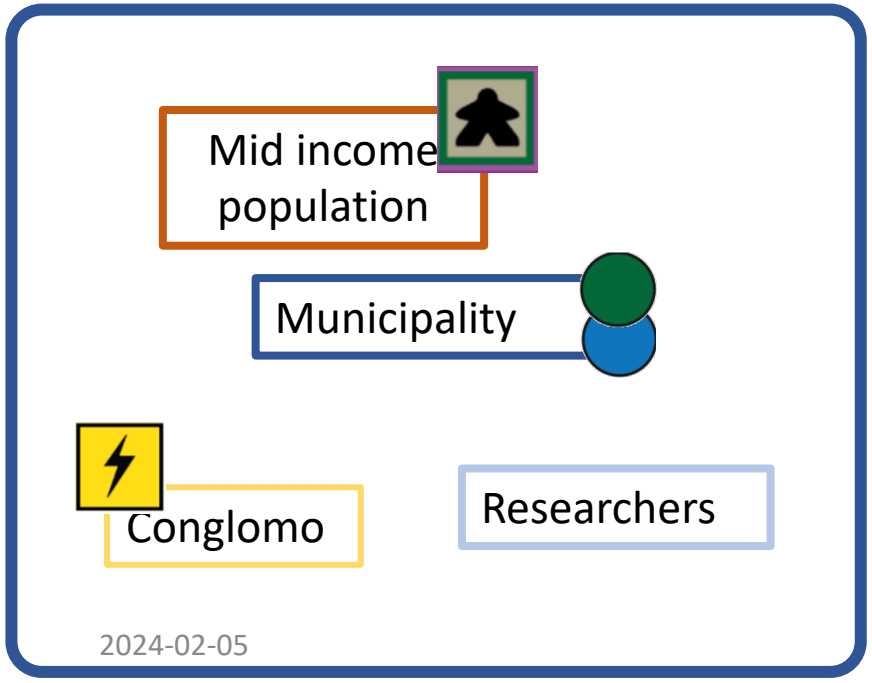
A full day activity (9-16):

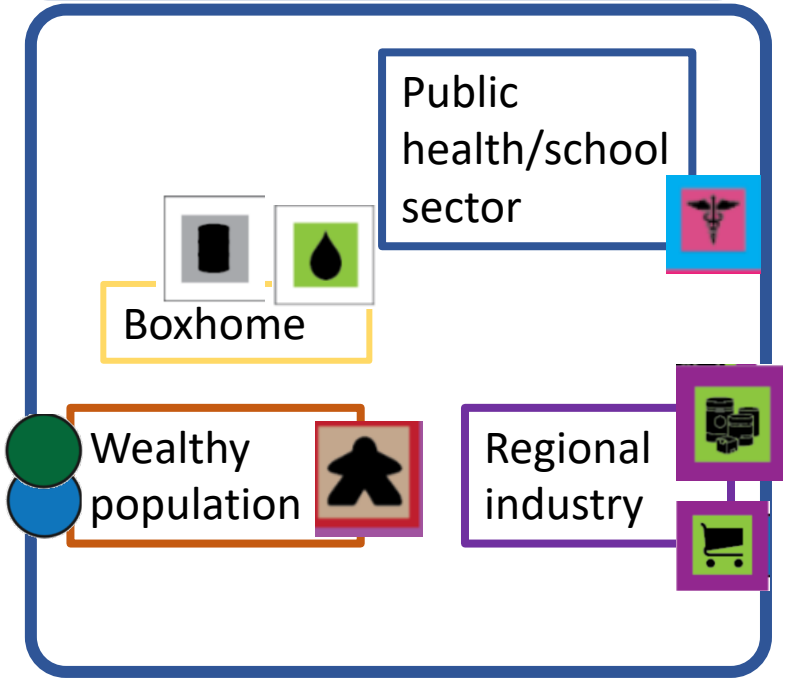
- An introductory round
- 3-5 Rounds of 45-60 minutes
- Debriefing after each round
- Summary and result presentation at the end





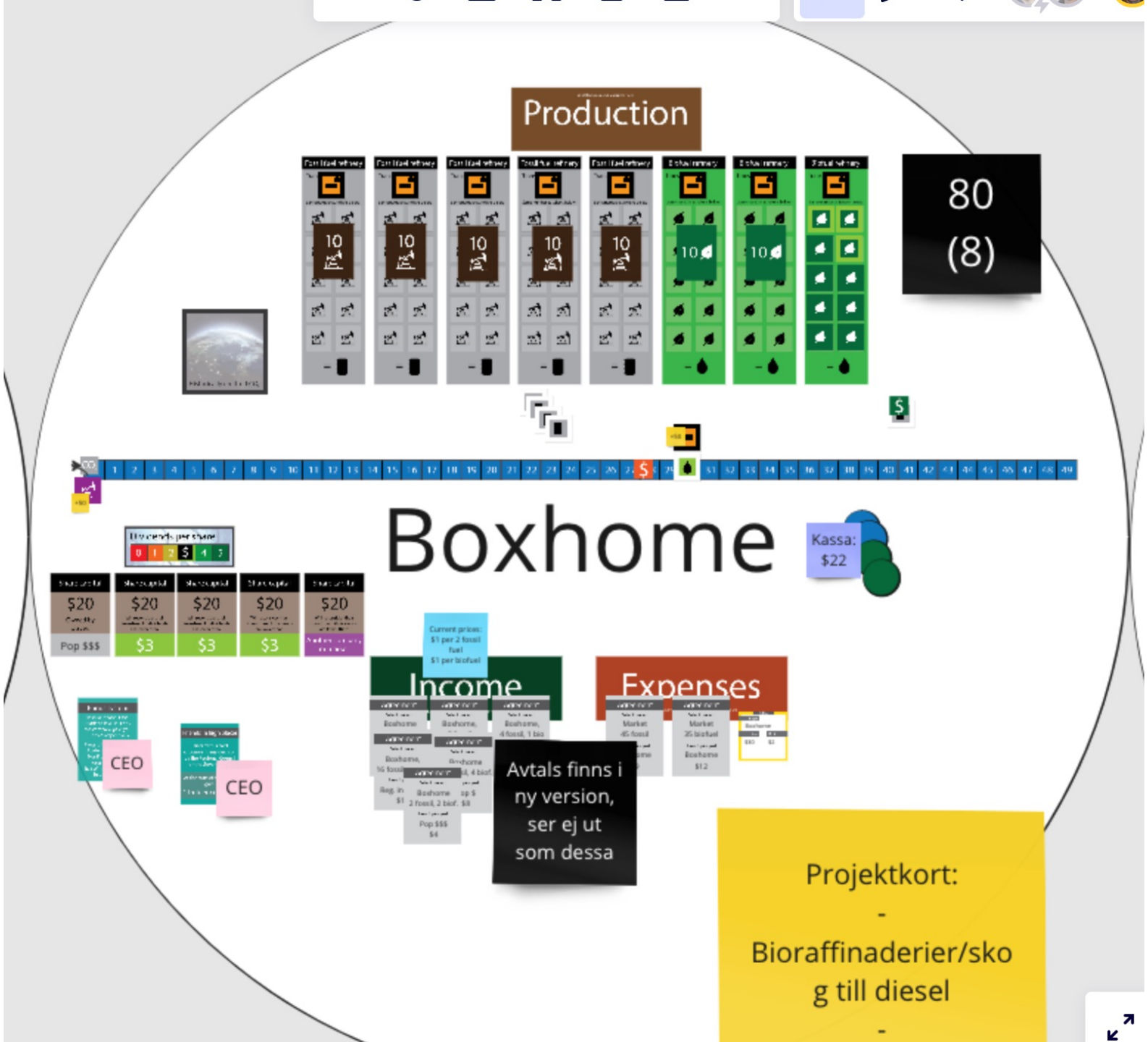




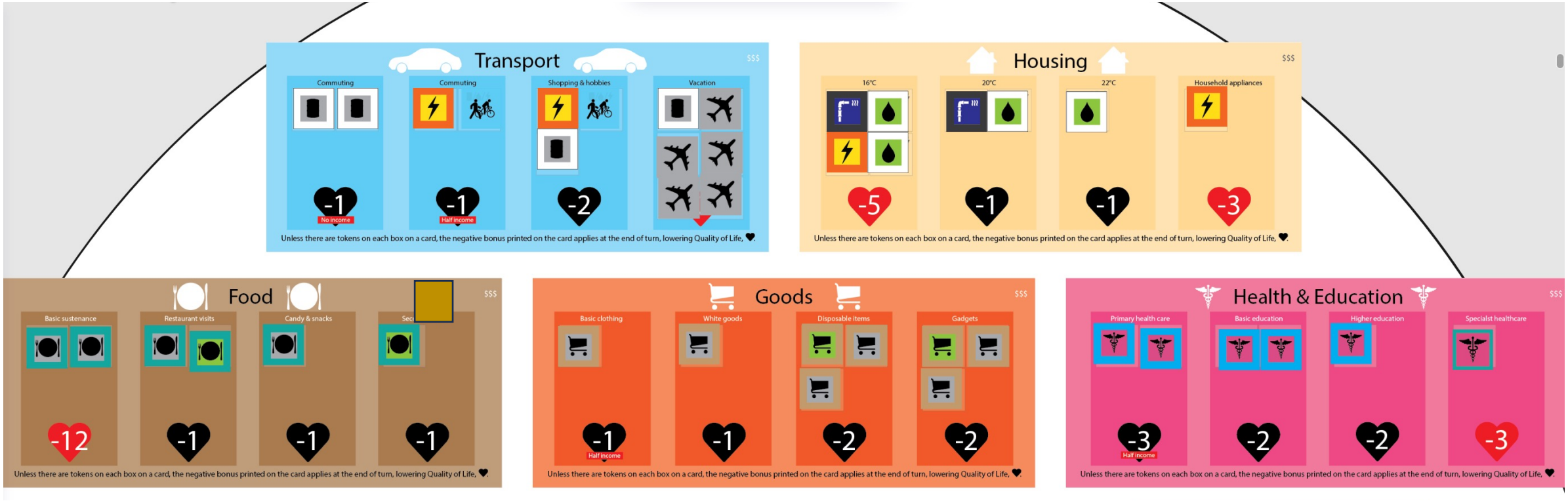


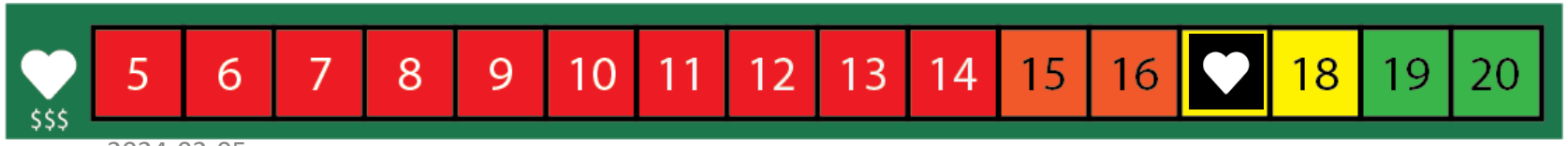
Game layout for last event 70+ high school students in Uddevalla

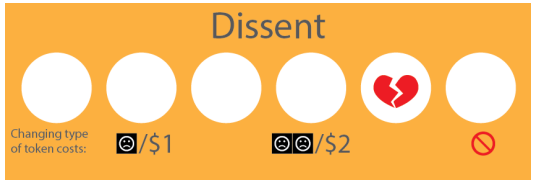
Game boards


Production
80
(8)
Boxhome
Kassa:
$22
$20
$20
$20
$20
$20
Pop $$$
$3
$3
$3
Income
Expenses
CEO
CEO
Avtals finns i ny version, ser ej ut som dessa
Projektkort:
-
Bioraffinaderier/sko g till diesel
-

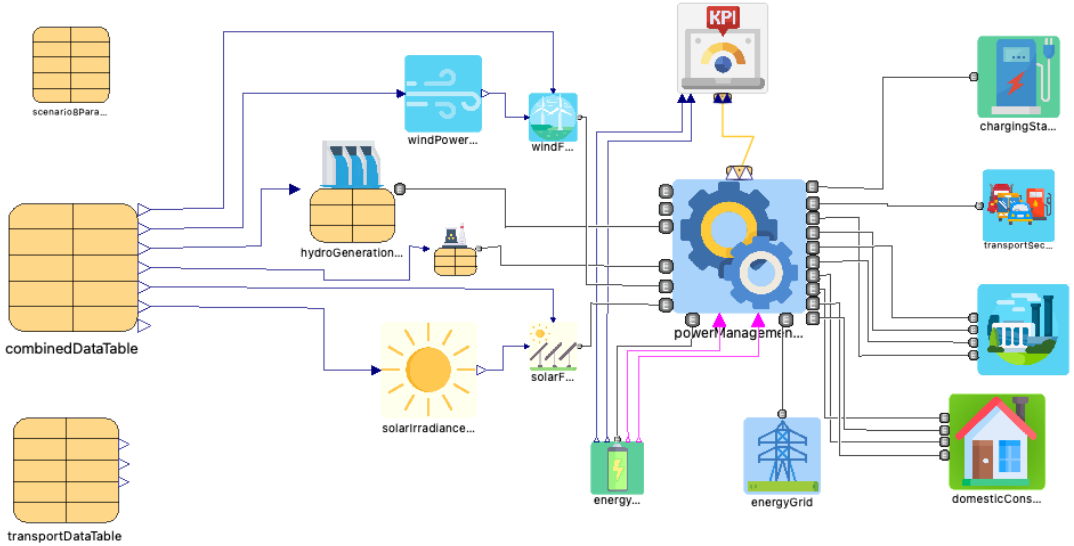
Population board



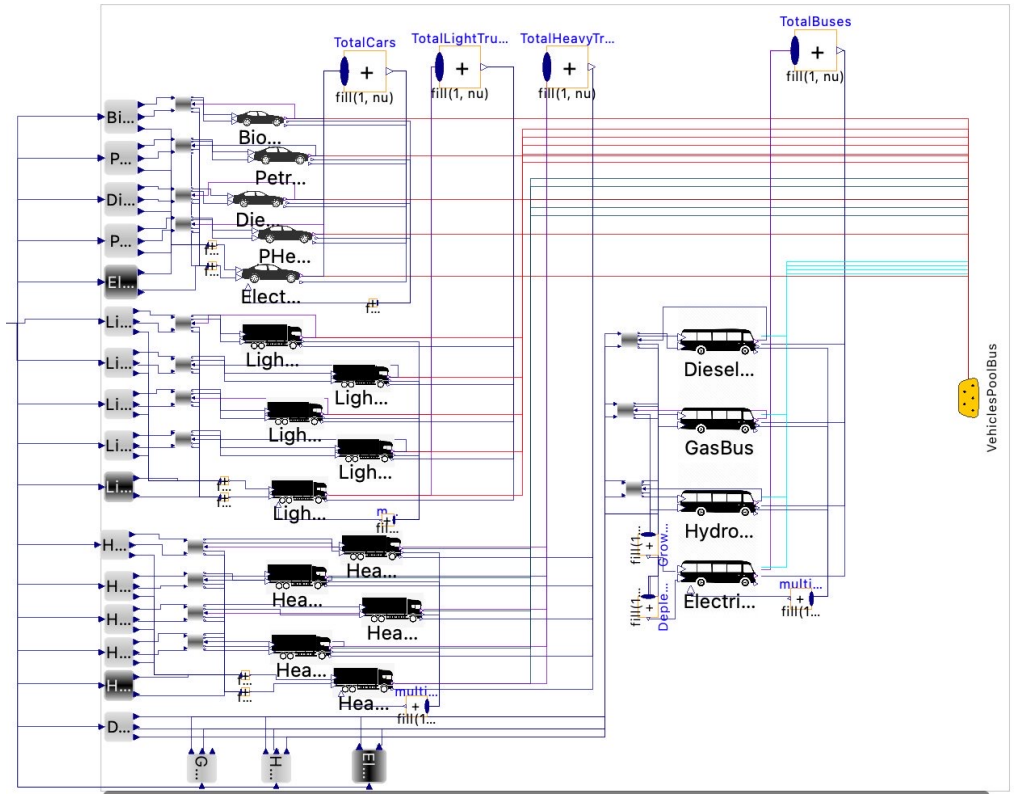


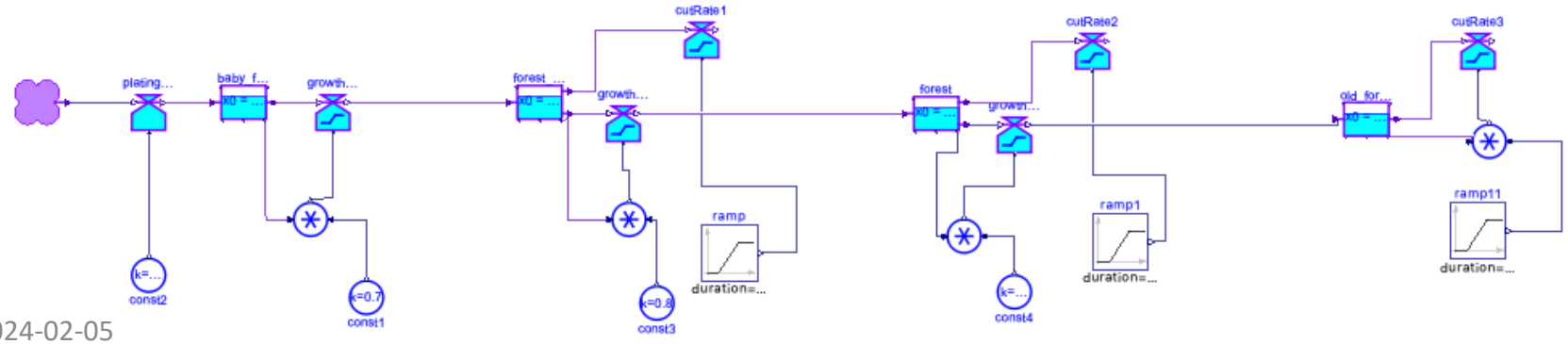


The simulation models



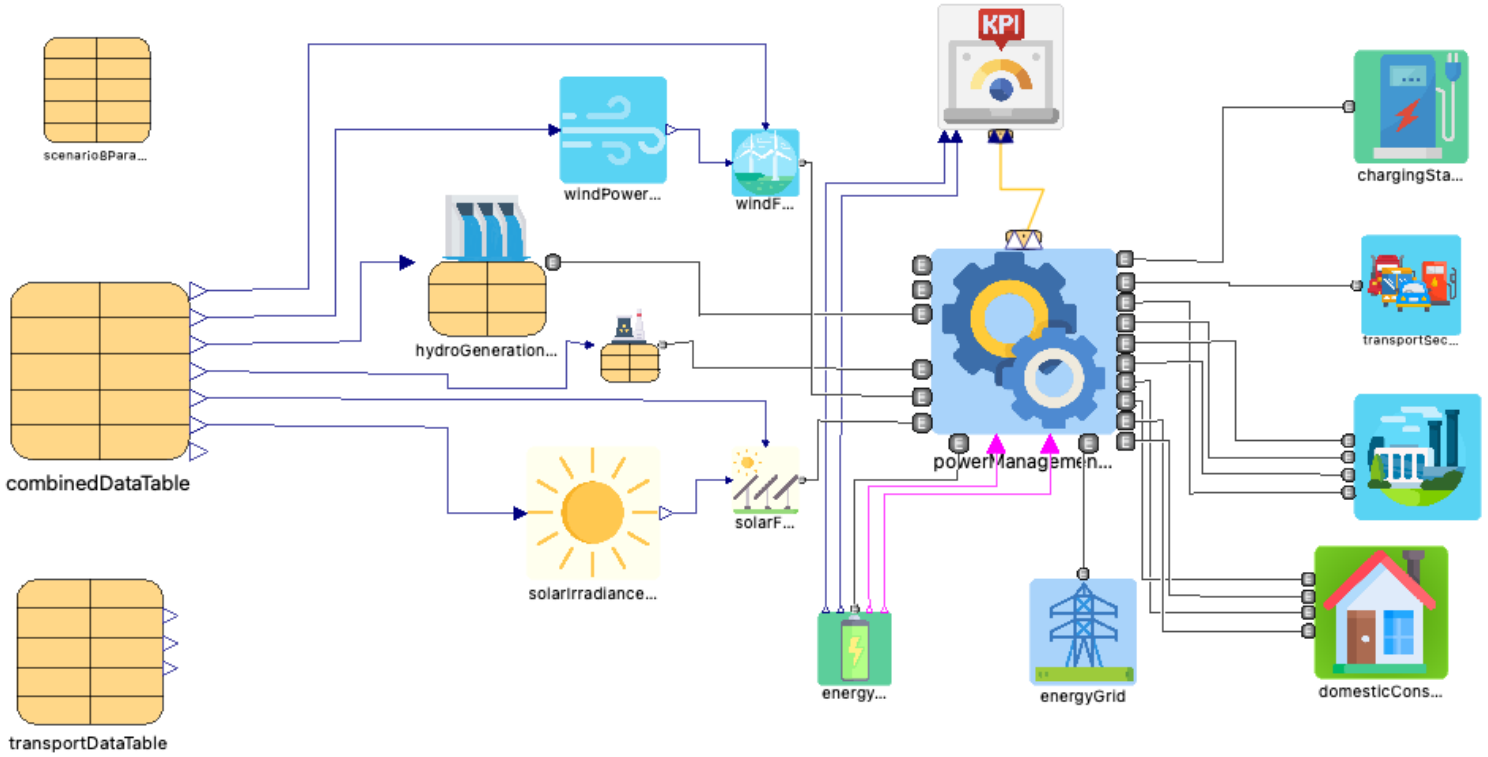
Regional Scenario



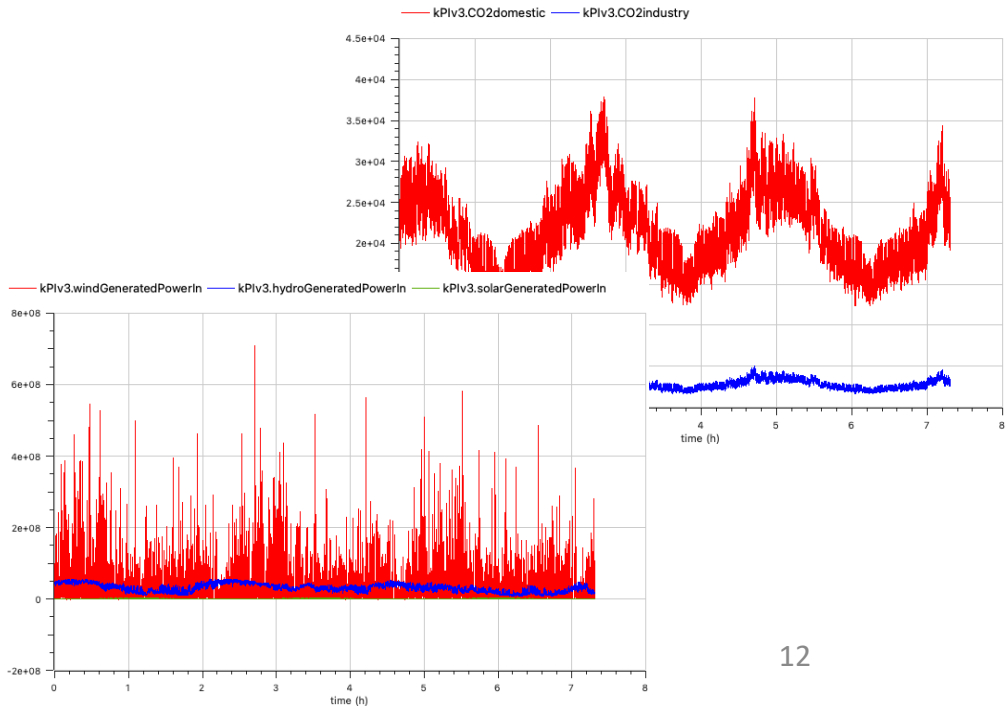


Energy grid model

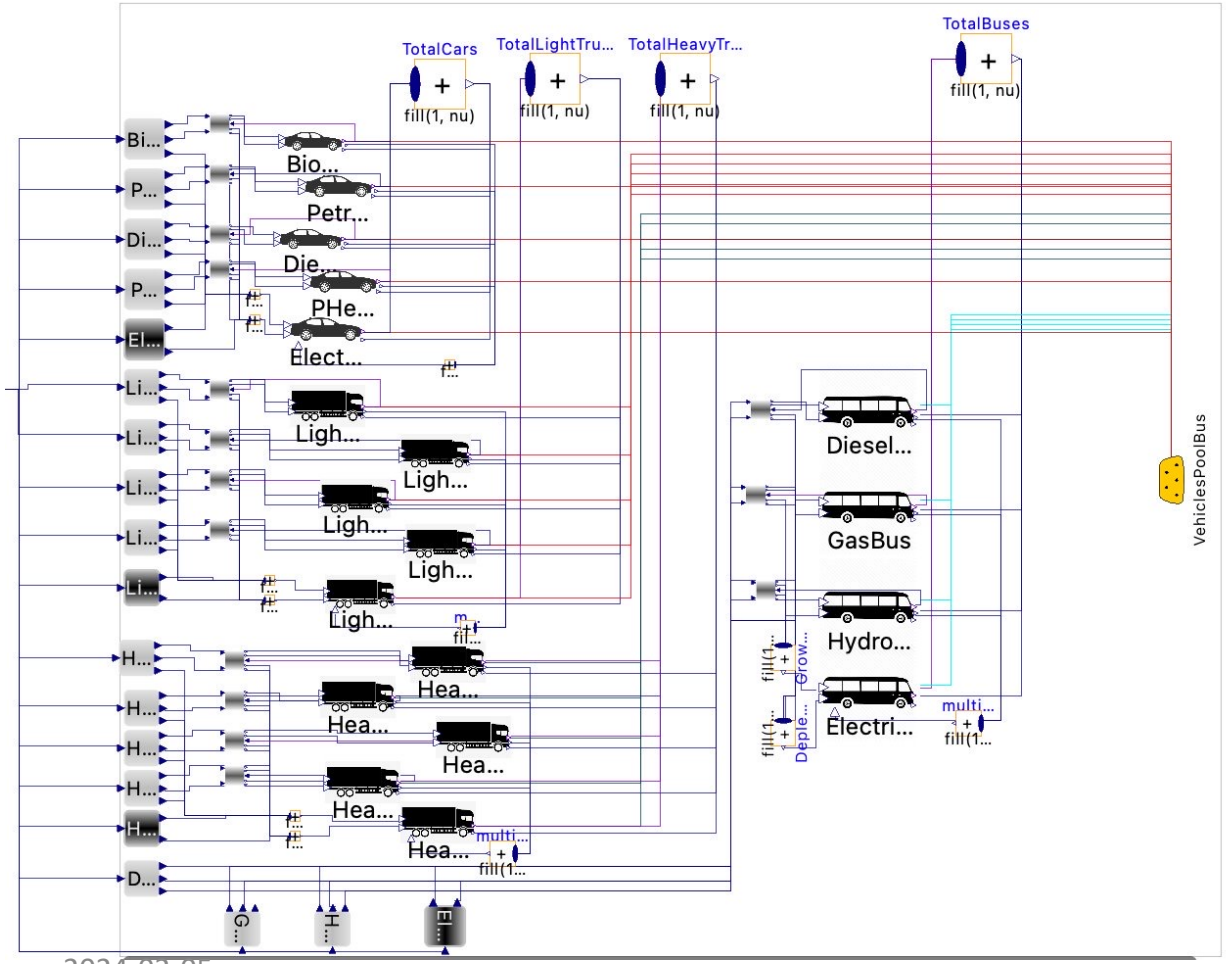
Parametrized using regional data (irradiation, wind speed, energy demand, # of vehicles…)



Regional Scenario



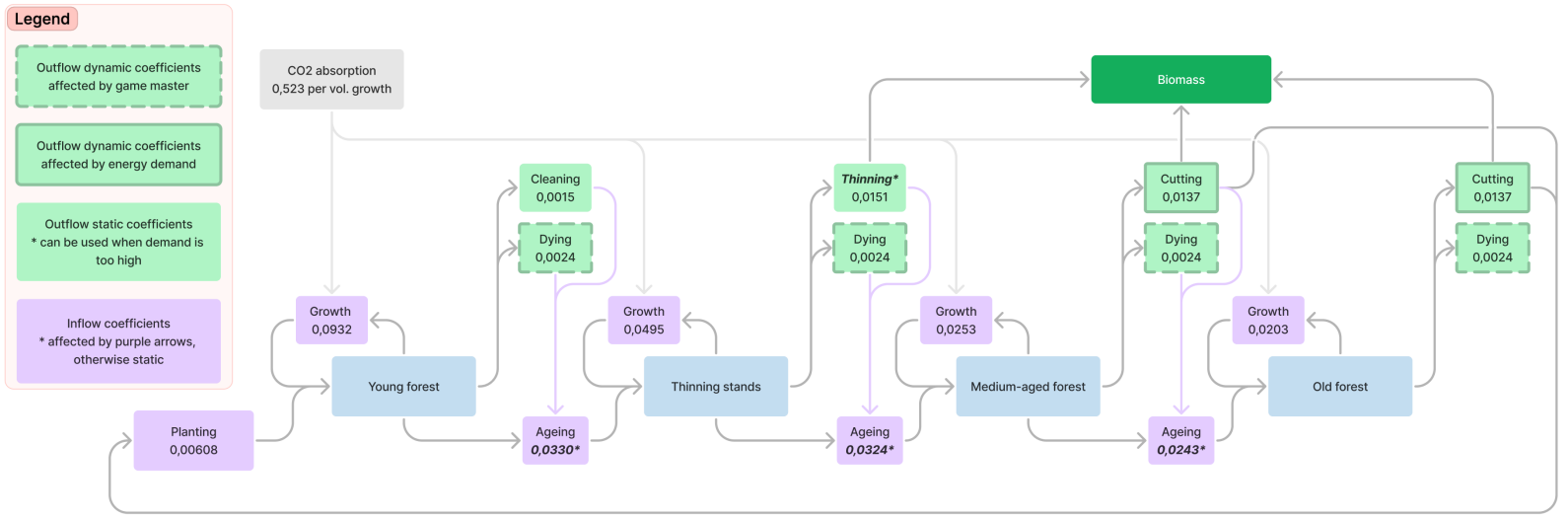
Transportation model

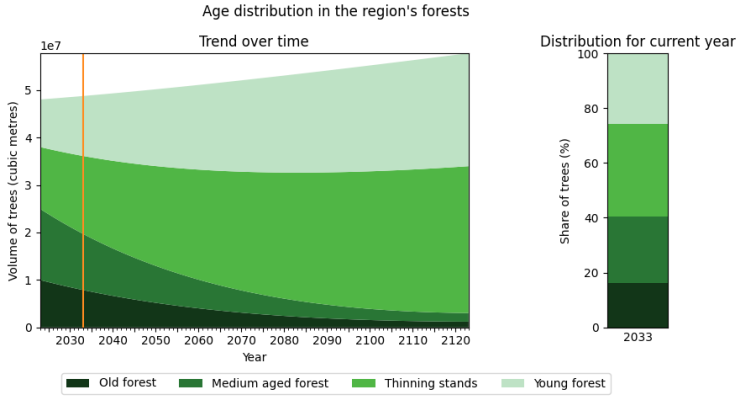


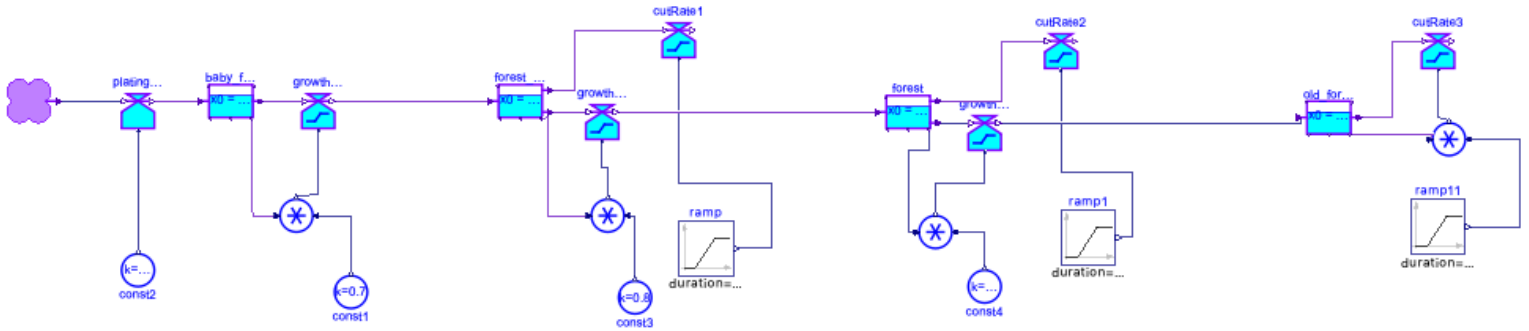
- used to calculate CO2 emissions
- parametrised with regional numbers and then based on later decisions

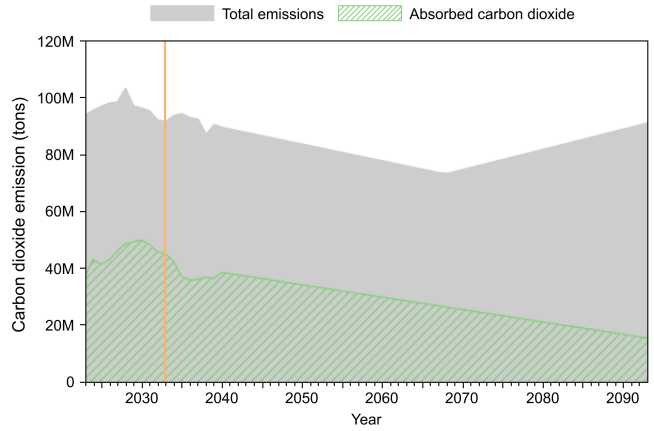
[Work by LiU, Modelicon and Politecnico di Milano]

Biomass model



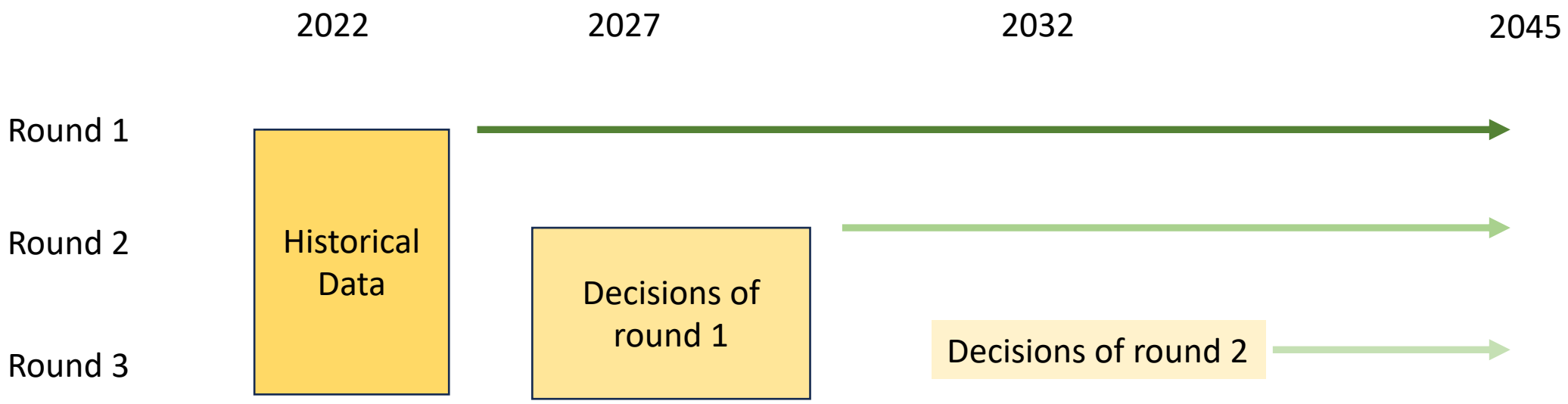




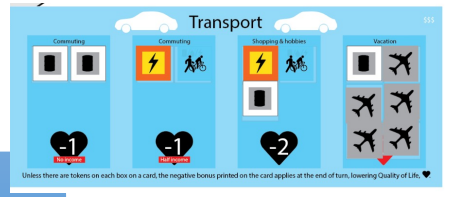


Simulation

- Input data generated in iterations after each round
- Simulations cannot change the past
- Historical data + time series + trends in decisions + delays
  → generated data

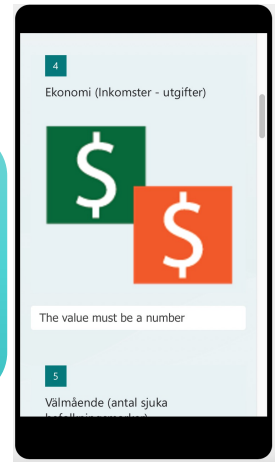


Current work flow



Play round and make decisions

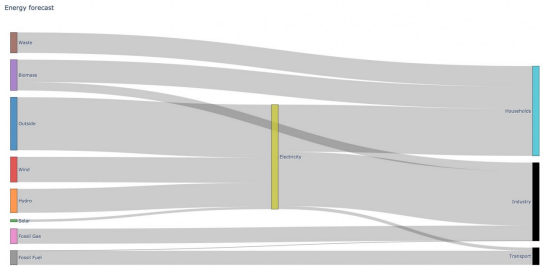
Count cards and Collect data through MSforms

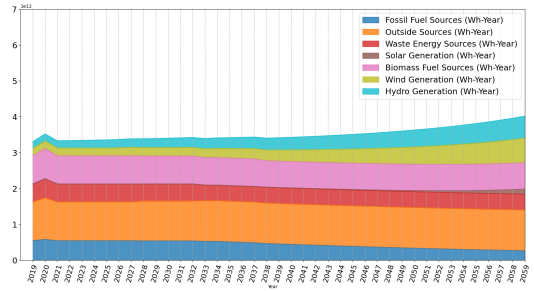


Export Excel and extrapolate data to generate input for OM

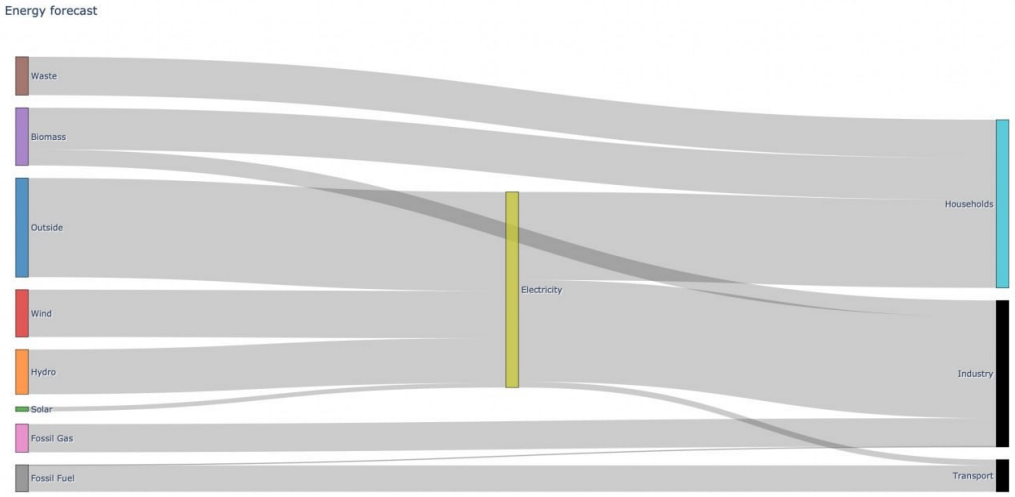
Simulate the models

Generate graphs and present results

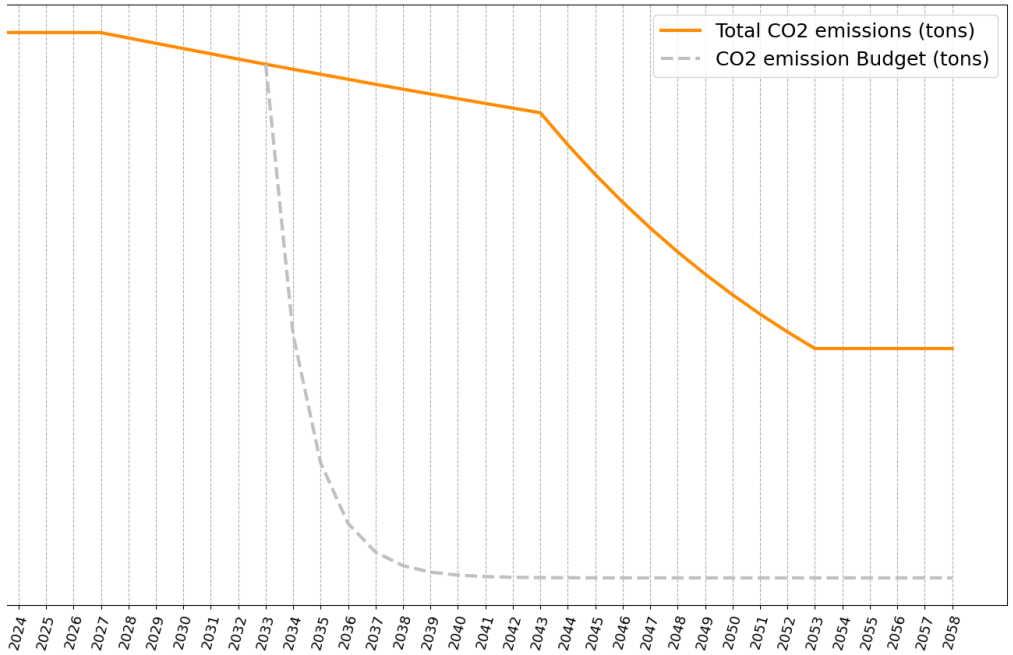




Visualisation of results

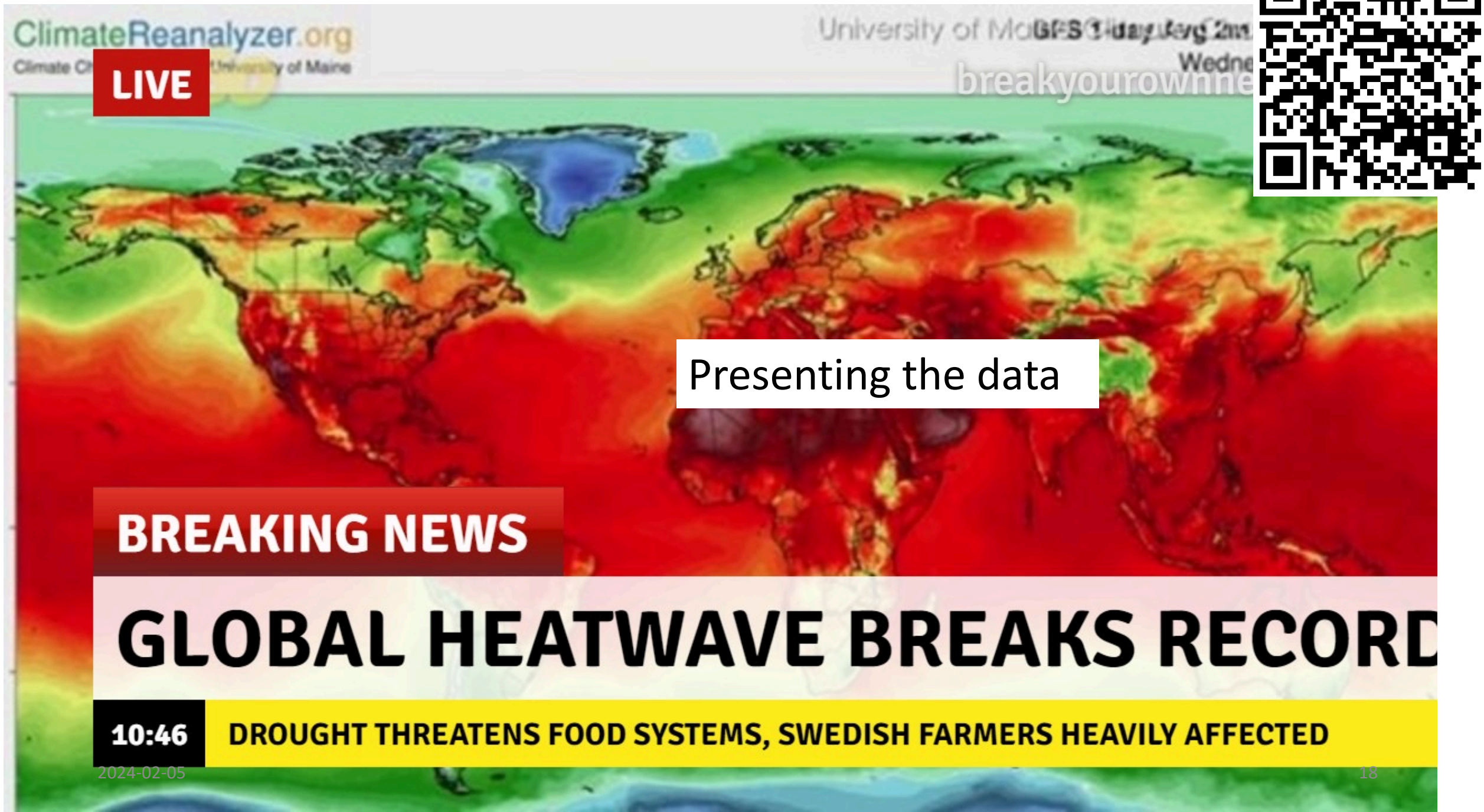


Energy flow Sankey diagram for 2030, based on game decisions



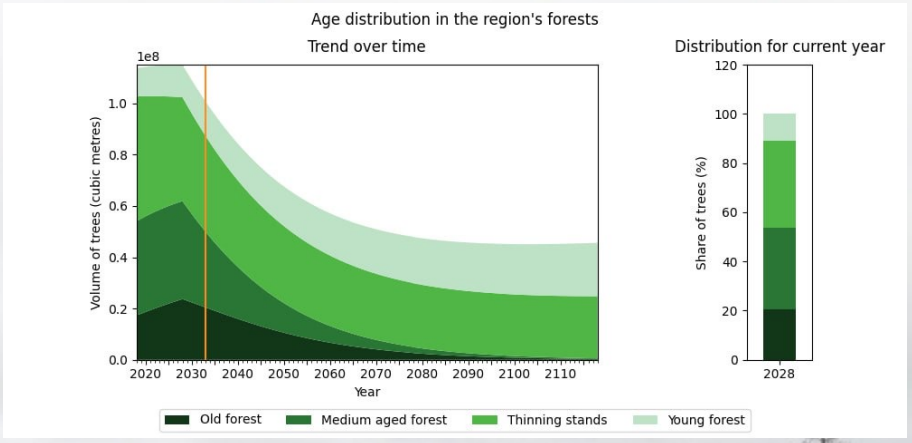
CO2 budget

Accessible via QR code



Presenting the data

LIVE

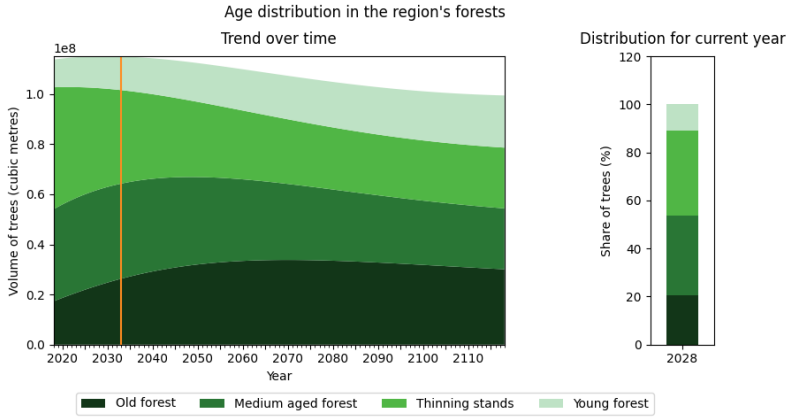


BREAKING NEWS

KRITISKT LÄGE FÖR SKOGEN

9:44 SLU: "HUNDRATALS RÖDLISTADE ARTER PÅVERKAS AV SKOGSAVVERKNINGEN"

Example scenario



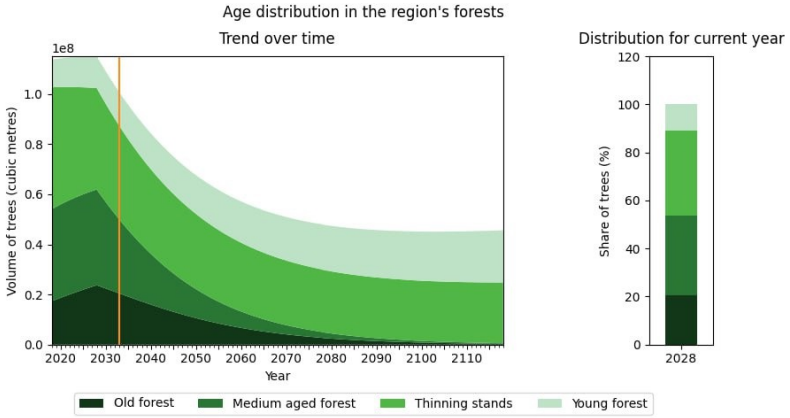
1

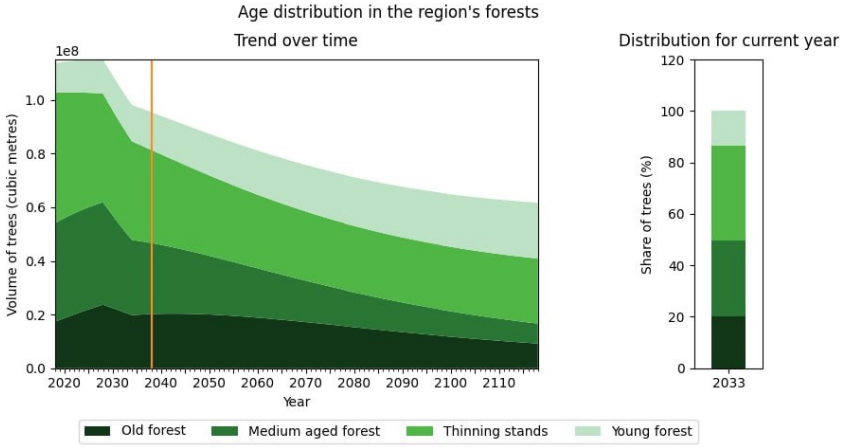
Based on historical data
> 3% biomass volume
can be harvested yearly

Lets GO GREEN!

…. OOPS?

2



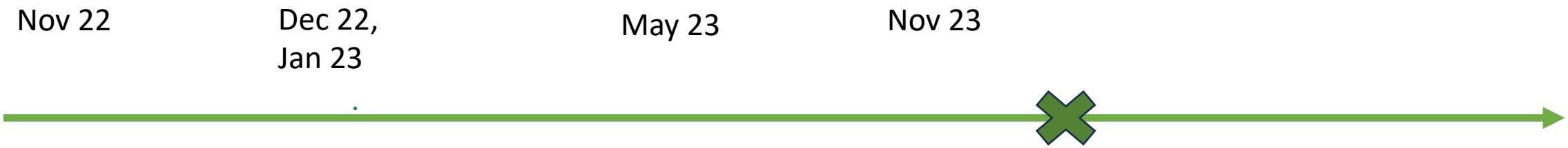


3

Ok, let’s go less green,
but we have a business to run

Certified wood from “Brazil”

Evolution of the simulation



First game, about 20 peole,
1 person data collection, model crashes because of unexpected parameters

Second and third games 20-40 people, more detailed simulation parametrisation, script-based data generation based on round results, some graphs can be generated, but by the time the can be shown the round is over

Developed biomass Modelica model as a master thesis

Increased step size, much faster simulation, forms used to speed up data collection, tested on 70 players

What's next?

- Calculate more indicators (wellbeing or happiness for example)
- Integrate with a climate/environment model (Earth3?)
- More interactive visualisation (nicer graphs, better handling of scaling)
- Close the loop (control the imports better)

Thank you!