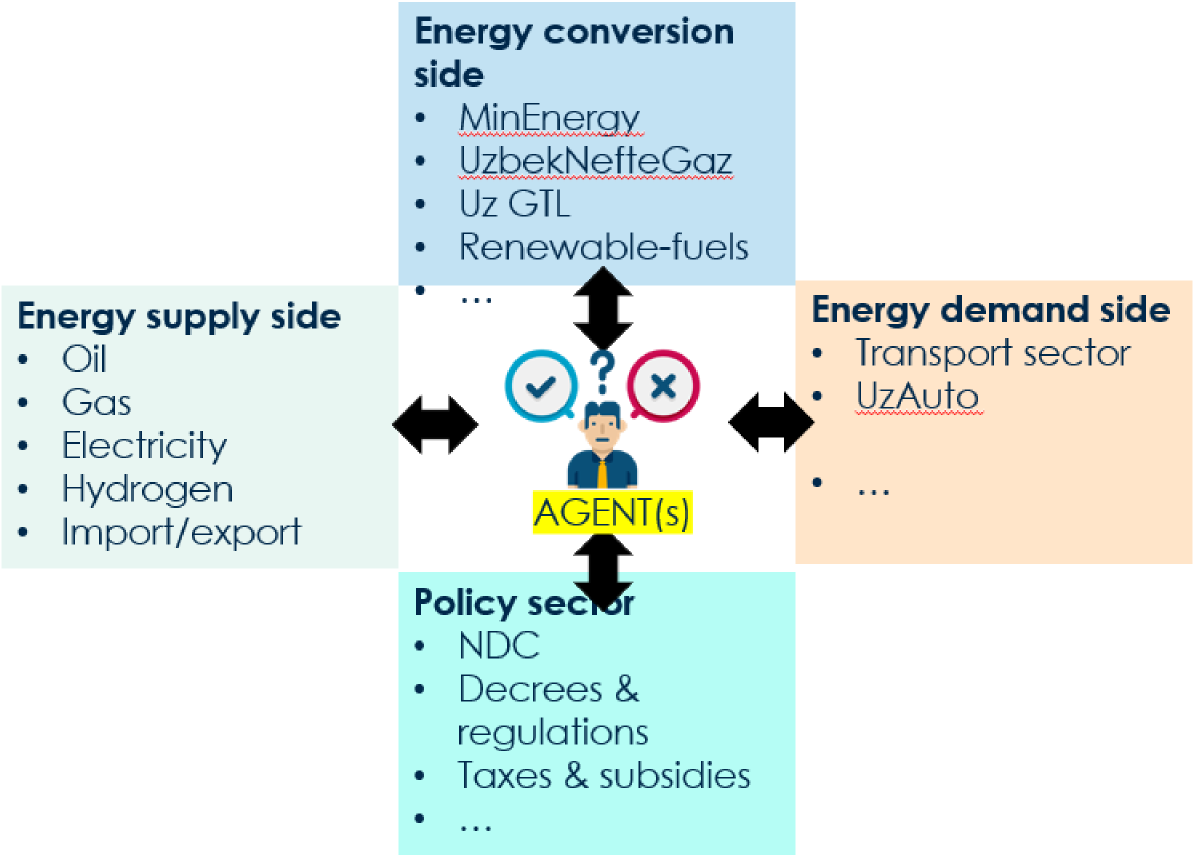
Agent



Energy conversion side
• MinEnergy
• UzbekNefteGaz
• Uz GTL
• Renewable-fuels
• …
Energy supply side
• Oil
• Gas
• Electricity
• Hydrogen
• Import/export
AGENT(s)
Energy demand side
• Transport sector
• UzAuto
• …
Policy sector
• NDC
• Decrees & regulations
• Taxes & subsidies
• …

- NPV (net present value)
- EAC (equivalent annual cost)
- LCOE (levelized cost of energy)

Fixed cost

Fixed costs associated with a technology.

Given a factor α and an exponent β, the fixed costs F are computed from the `capacity fulfilling the current demand` C as:

$$F = \alpha * C^\beta$$

α and β are “fix_par” and “fix_exp” in Techno-data, respectively.

capacity_to_service_demand(*technologies*, *demand*, **args*, ***kwargs*)

Minimum capacity required to fulfill the demand.

Emission cost

Emission cost for each technology when fulfilling whole demand.

Given the demand share D, the emissions per amount produced E, and the prices per emittant P, then emissions costs C are computed as:

$$C = \sum_s \left(\sum_c D\right) \left(\sum_c EP\right),$$

with s the timeslices and c the commodity.

NPV (Net present value)

Net present value (NPV) is the present value of all future cash flows of a project. Because the time-value of money dictates that money is worth more now than it is in the future, the value of a project is not simply the sum of all future cash flows. Those future cash flows must be discounted because the money earned in the future is worth less today. In order to calculate NPV, we must discount each future cash flow in order to get the present value of each cash flow, and then we sum those present values associated with each time period.

$$NPV = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$

Where:

- **C** = Cash Flow at time t
- **r** = discount rate expressed as a decimal
- **t** = time period

Equivalent annual cost

$$\mathrm{EAC} = \frac{NPV}{A_{t,r}}$$

EAC = equivalent annual cost
NPV = net present value
r = annual interest rate
t = number of years
A = capital recovery (amortization) factor

$$\mathrm{EAC} = -\frac{\mathrm{NPV}}{A_{t,r}}, \text{ where } A_{t,r} = \frac{1 - \frac{1}{(1+r)^t}}{r}$$

the equivalent annual cost (EAC) is the cost per year of owning and operating an asset over its entire lifespan. It is calculated by dividing the negative NPV of a project by the "present value of annuity factor"

LCOE

Agent invests based on LCOE (output based on levelized cost of energy):

- I – investment cost per bvkm @ t year (slide 12&13)
- M – fixed operating & maintance cost per bvkm @ t year, (set as 3% of I_t)
- F – fuel expenditures (including carbon price) per bvkm @ t year
- E – amount of energy @ t year
- r – discount rate (i = interest rate, set as 10%, T = technology maturity, set as 15 year)

$$LCOE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{\mathrm{E}_t}{(1+r)^t}}$$

$$r = \frac{1}{(1+i)^T}$$

Assignment 7

- Using the data from assignment from 5 and 6, define the optimal parameters for the given demand function:
- y=
- Considering that initial parameters as follows:
- p0=
- p1=
- It is suggested to use curve-fitting

Assignment 8

- Based on the collected data from assignments 5 – 7, fill out the model files (model.zip).
- You need to change objectives of the agent (LCOE, NPV, etc.)and compare the results.