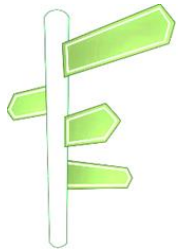


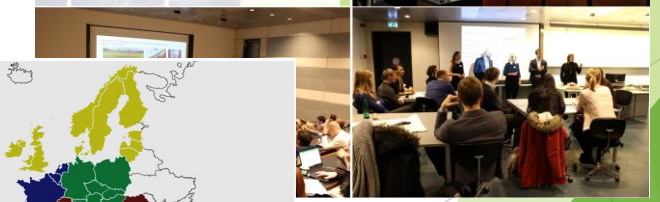
ENERGY CROSSROADS

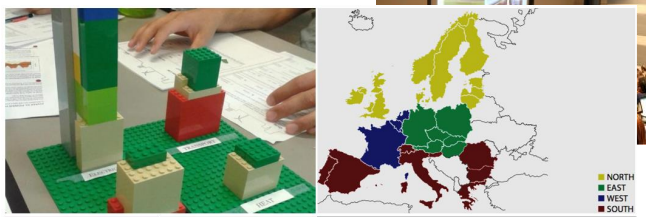
the global coalition for a clean, prosperous and secure energy future

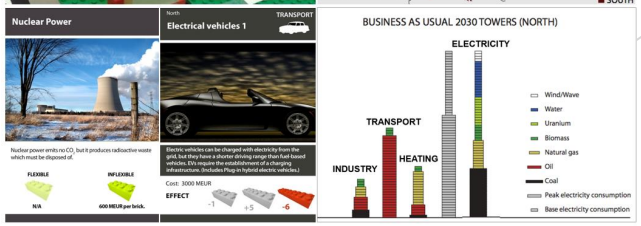
SUSTAINABLE DEVELOPMENT
SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

Our Activities

- Young professionals network
- Green energy system
- Sustainable society
- Several diverse projects & events:
  - Electricity Markets 2.0
  - Energy Mondays
  - Energy Tours
  - Greenspiration conference
  - Changing the Game
  - (Changing the City)
  - ….



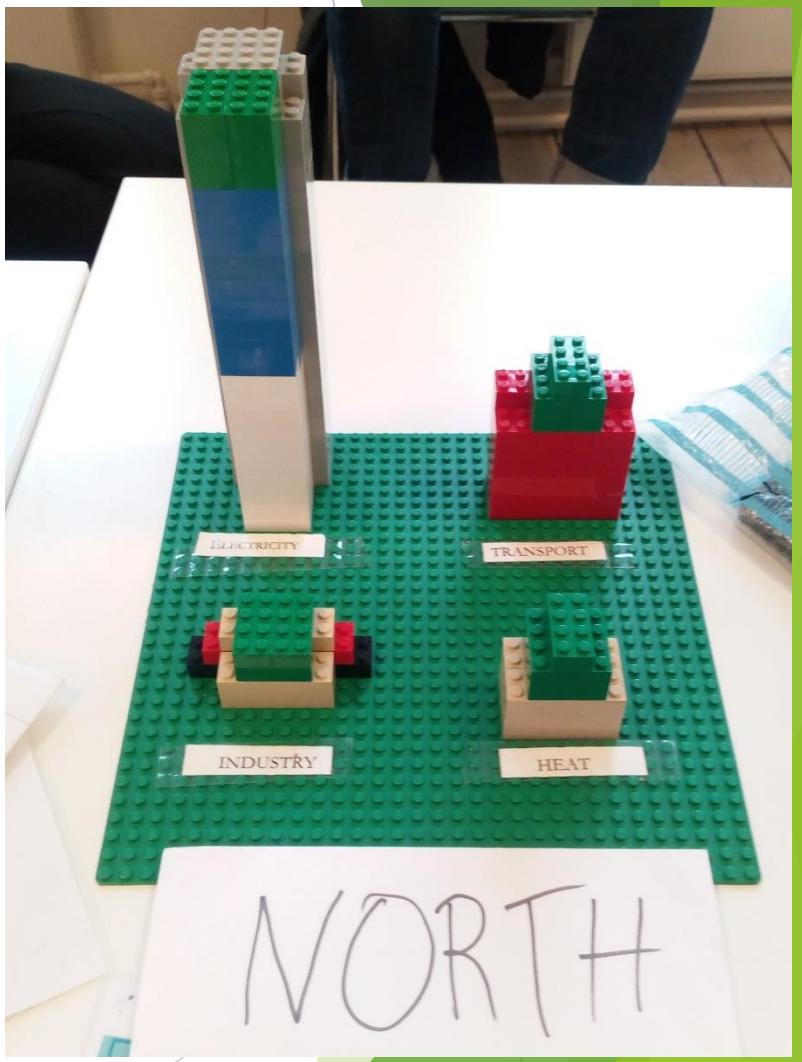




”Changing the Game”

Create your own energy scenario for Europe in year 2035!

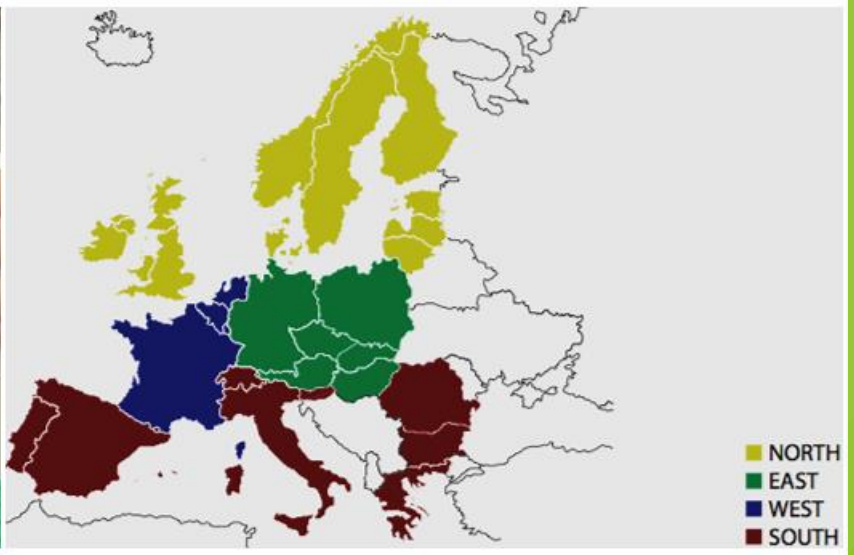
- CO_2 Emissions
- Share of Renewables
- Security of Supply
- Energy Consumption

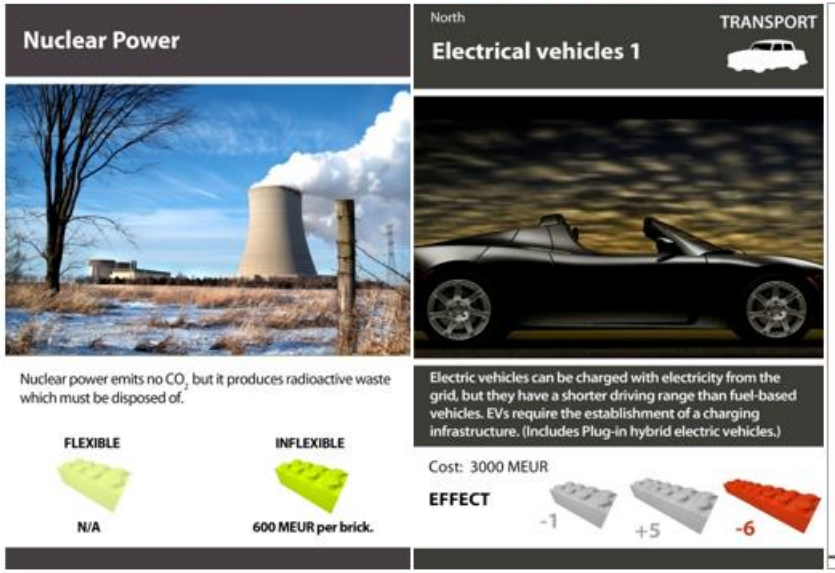


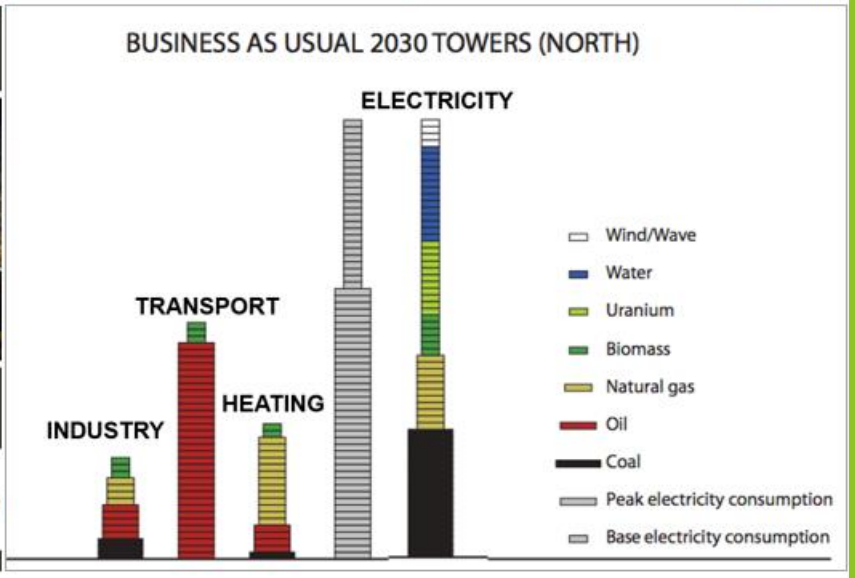
SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

What you will be doing?

- Understand how European energy system works.
- Energy system planning (Educational Lego Game)
- Open discussion among an interdisciplinary audience.
- Opportunity to create your own energy scenario for Europe in 2035.





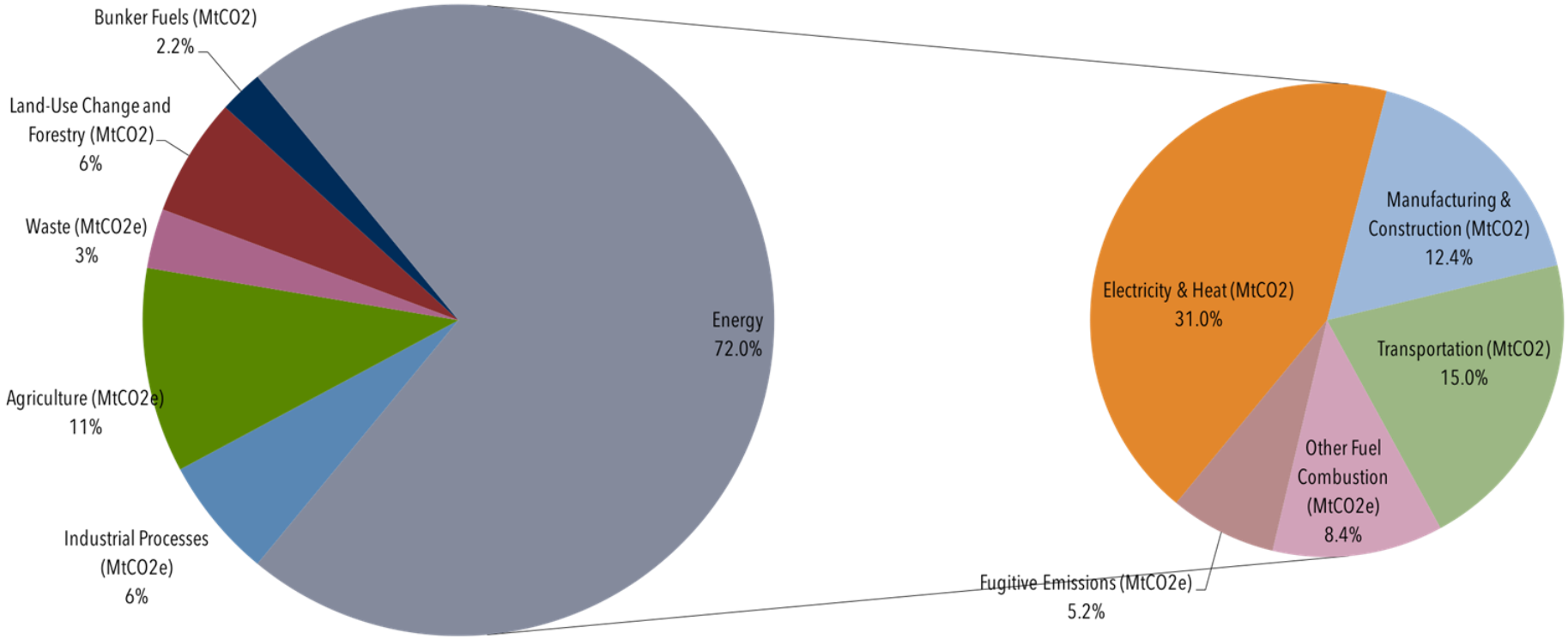


”WHY ARE ENERGY SYSTEMS SO IMPORTANT”

SUSTAINABLE DEVELOPMENT
SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

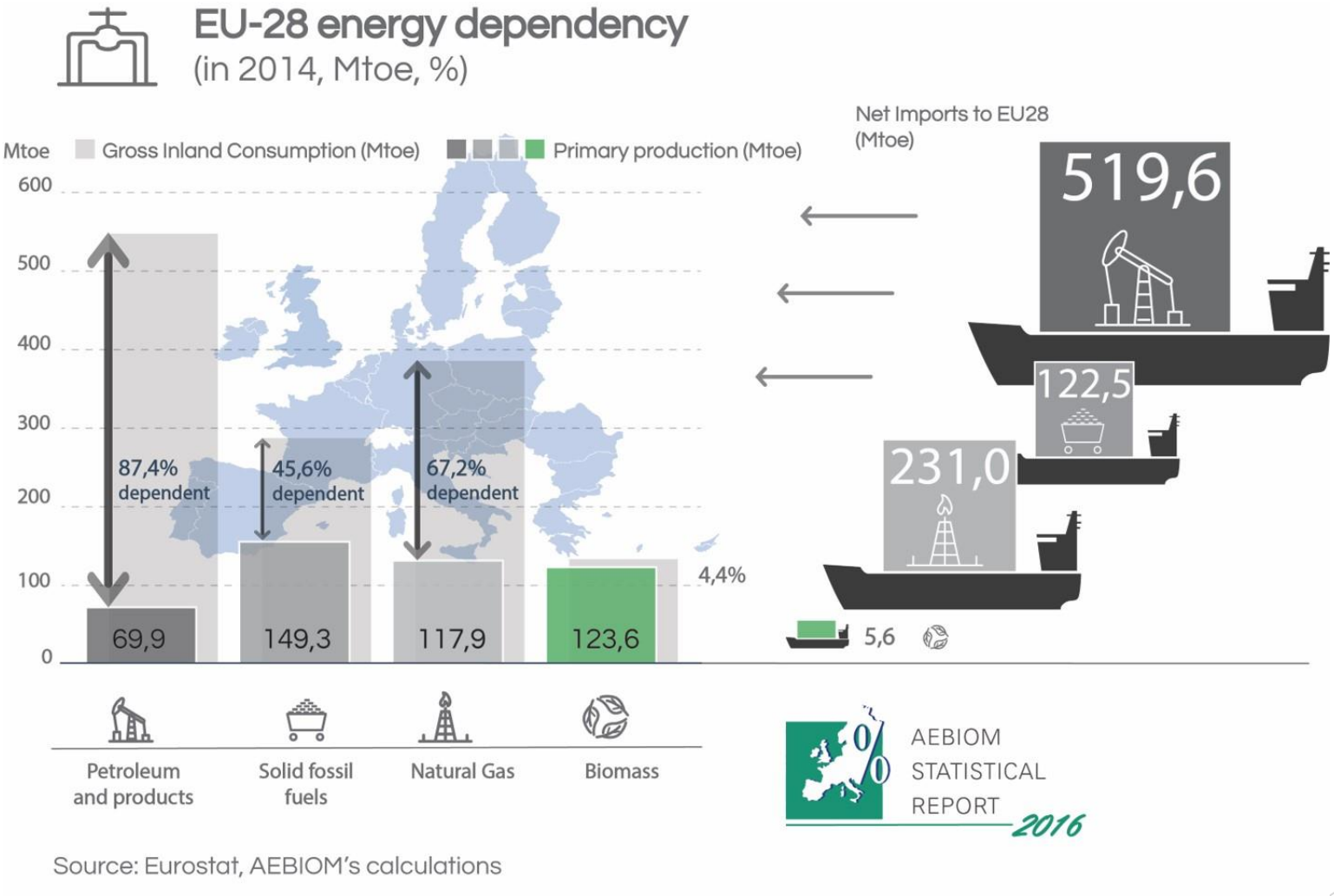
Climate change impacts

Global GHG emissions by sector

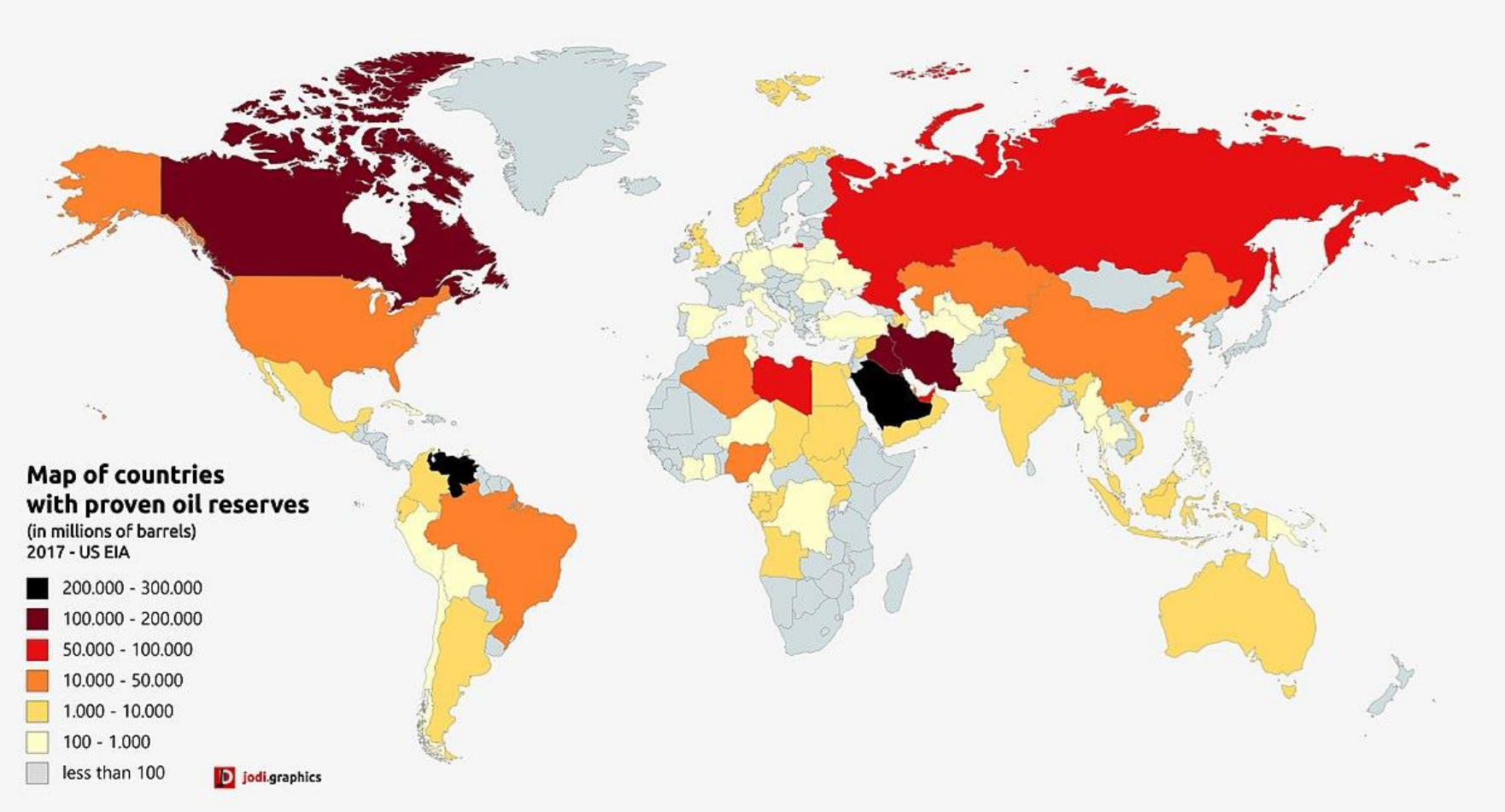


Source: (World Resources Institute, 2017).

Our energy dependency

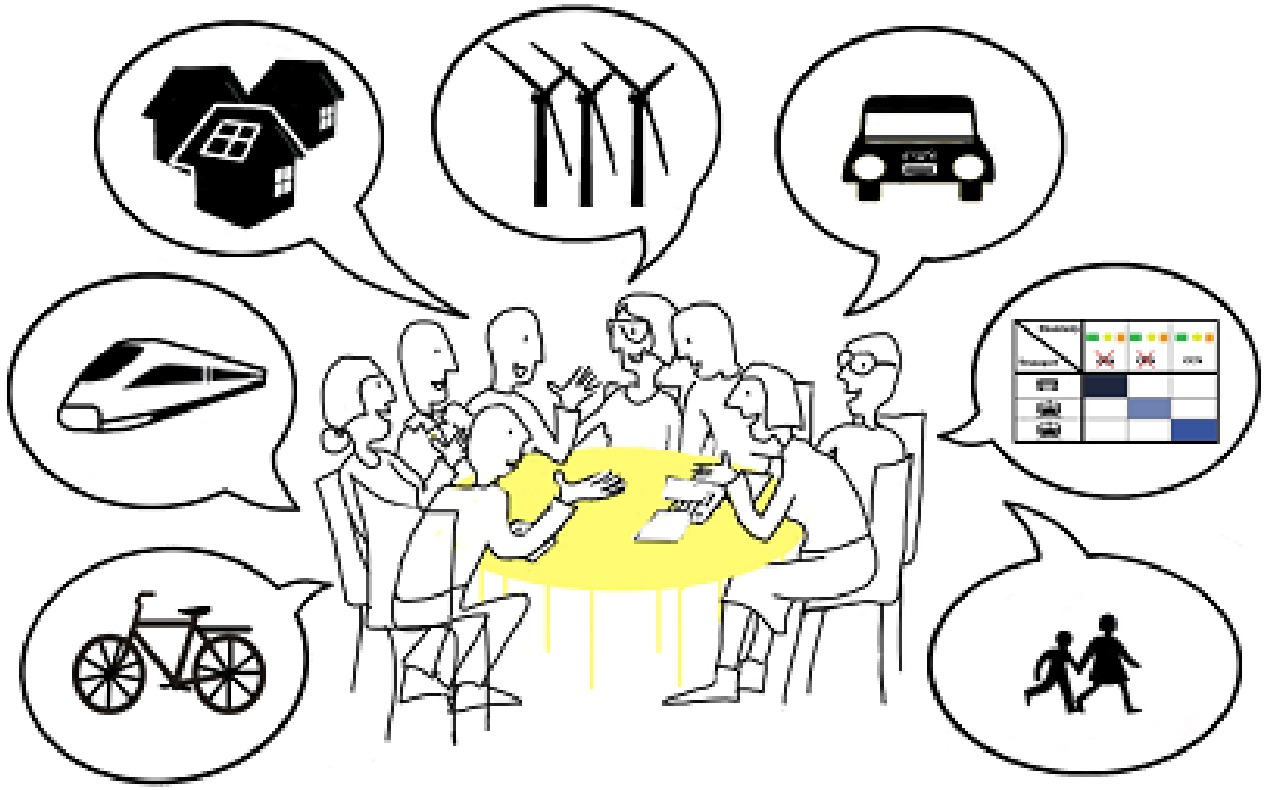


Oil reserves



Source: U.S Energy Information Administration (2017)

The goal of playing ”Changing the Game” (CtG)



Please discuss the climate impacts of your decisions!

”LET`S INTRODUCE CHANGING THE GAME”

SUSTAINABLE DEVELOPMENT
SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

CtG-Lego Bricks

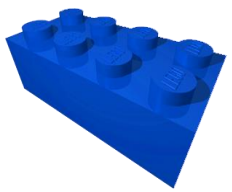
1 LEGO BRICK

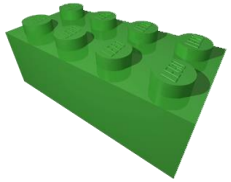
=

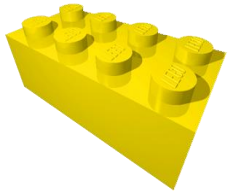
125 PJ of primary energy used per year.

ENERGY SOURCES

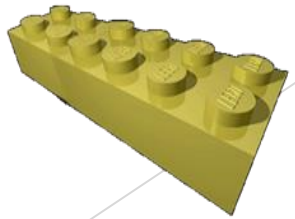
CO_2 NEUTRAL







CO_2 EMISSIONS



Peak & Base electricity consumption

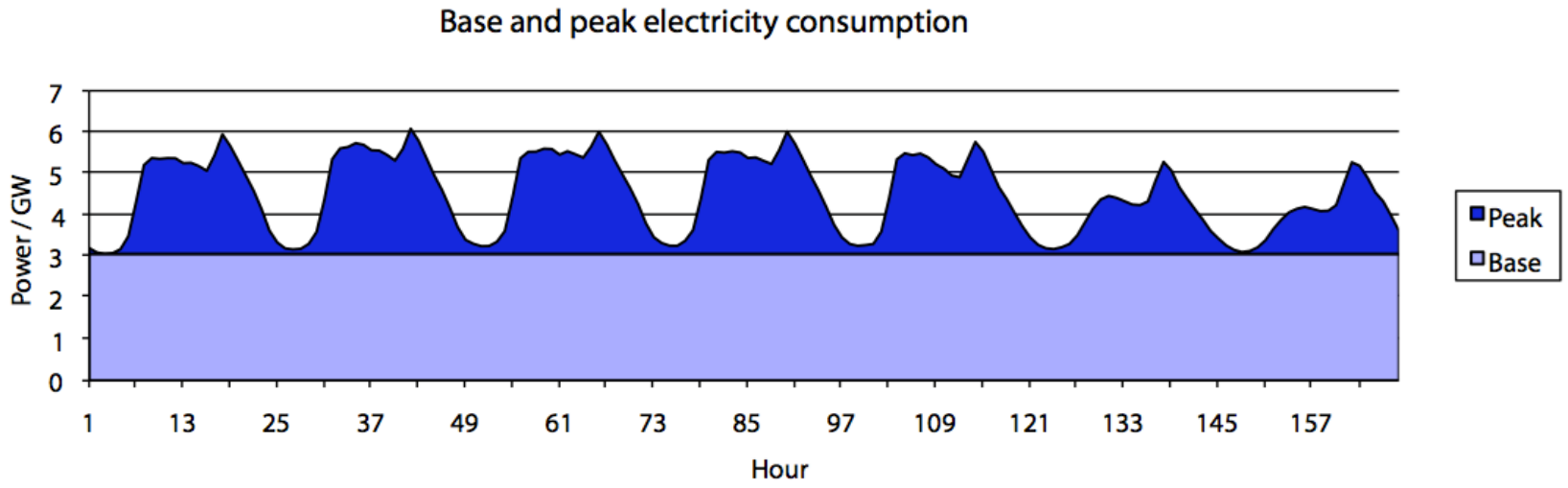
1 **ELECTRICITY LEGO BRICK**

=

An electric output of 17.5 TWh.

Base electricity consumption

Peak electricity consumption



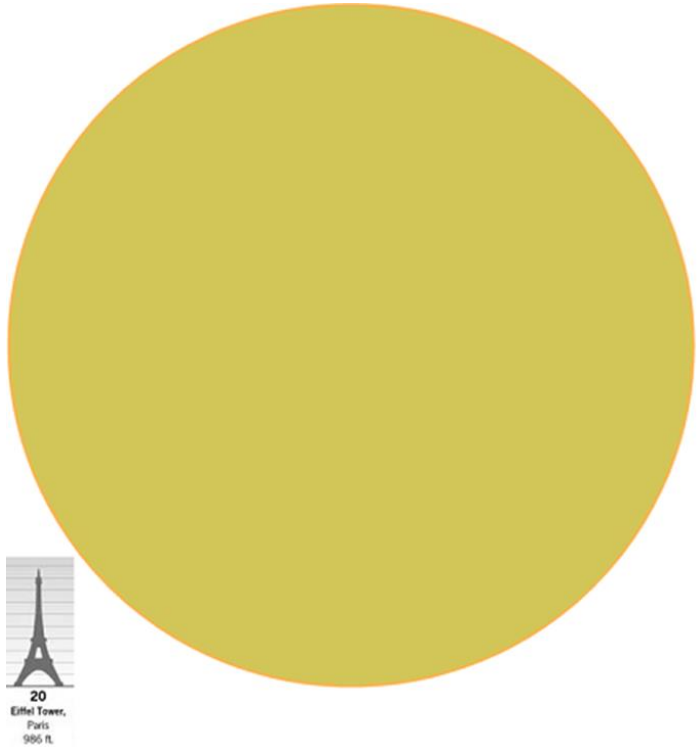
Energy dimensions

COAL

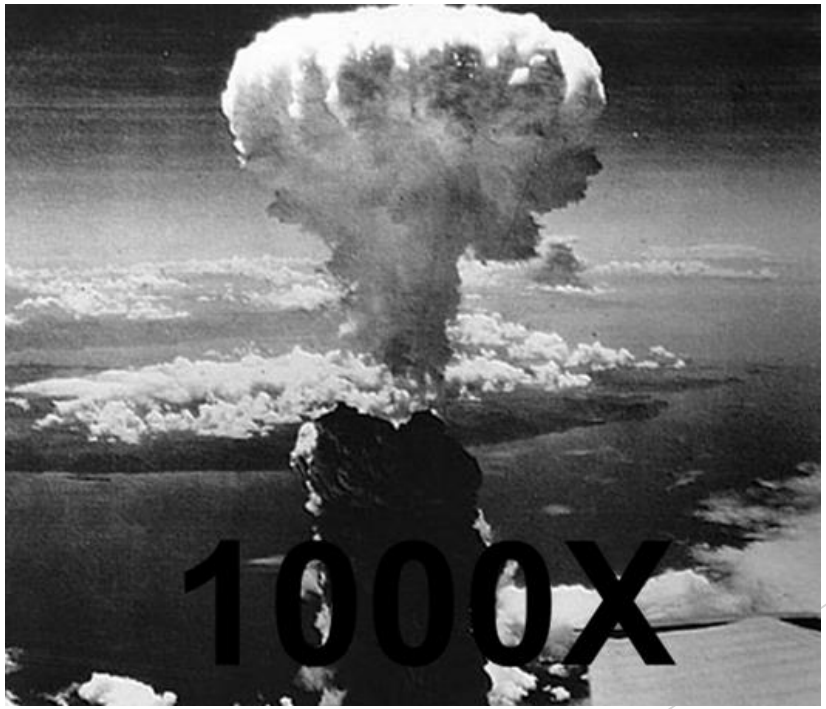
OIL

Energy dimensions

NATURAL GAS



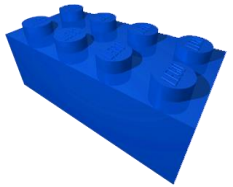
NUCLEAR



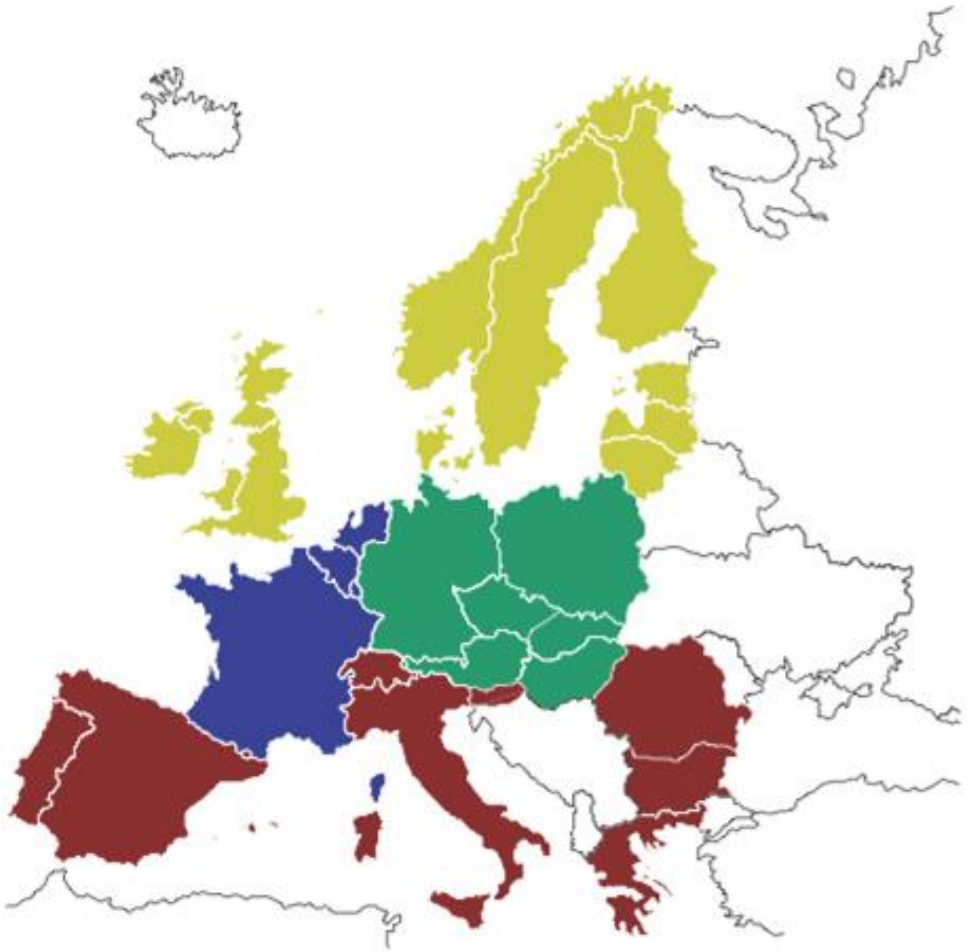
Energy dimensions

BIOMASS

HYDRO

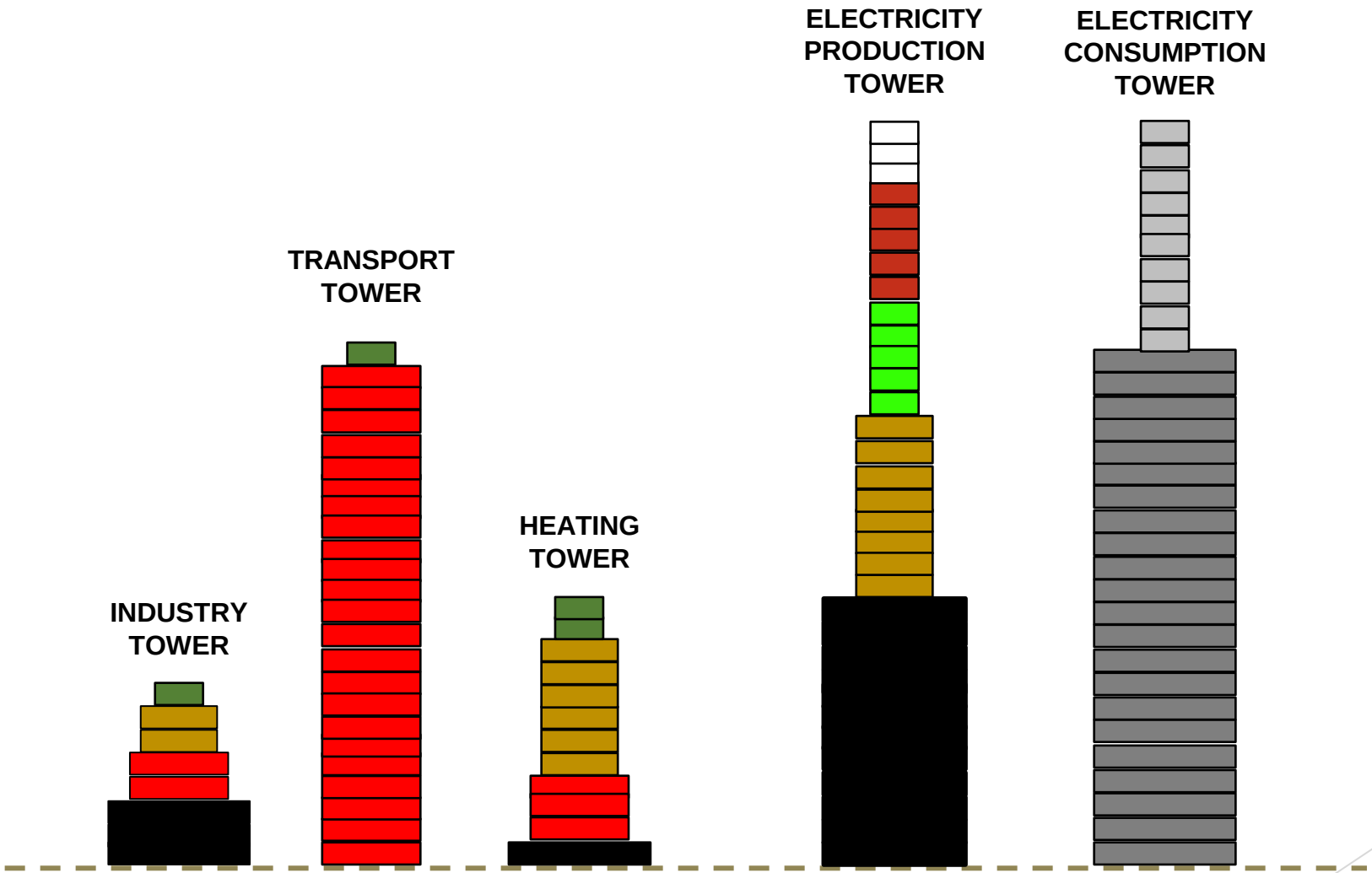


Europe’s regions in the game



NORTH	WEST	EAST	SOUTH
Norway Sweden Finland Denmark Estland Lettland Lithuania UK Ireland	Belgium Netherlands France	Poland Germany Austria Czech Republic Slovakia Slovenia	Portugal Spain Italy Romania Greece Bulgaria Switzerland

CtG-2035 BAU tower region set



How to play “Changing the Game”?

STAGE 1

TARGET SETTING:
- Understand your region
- Agree on your 2035 Region Targets:

30 min

STAGE 2

APPLY CHANGE CARDS TO BAU 2035:
- Select the technological and social change cards to transform the transport, heating, industry and electricity consumption tower.

90 min

STAGE 3

CONSTRUCT YOUR ELECTRICIY PRODUCTION TOWER:
- Sell to the facilitator your BAU 2035 Electricity production tower.
- Select the capacity cards or power plants technology to build your new tower.

60 min

STAGE 4

EVALUATE YOUR NEW SCENARIO:
- Calculate your results and evaluate if your region targets has been achieved
- Make a short presentation of your new scenario.

30 min

CtG – Stage 1: Set targets

Target setting + focus areas

- Understand your region
- Agree on your 2035 targets

Use extra information material:

- Regions
- Background posters

TARGETS & RESULTS NORTH REGION

TEAMPLAYER NAME	2010	2035 BAU	2035 TARGETS	2035 RESULTS
ENERGY RELATED CO_2 EMISSIONS (tones per capita per year)	7.6 t	8.4 t		
TOTAL ENERGY CONSUMPTION:	114 bricks	131 bricks		
SHARE OF RENEWABLES	19 %	25 %		
CONSUMPTION OF OIL & GAS	67 bricks	69 bricks		
OTHER TARGETS				

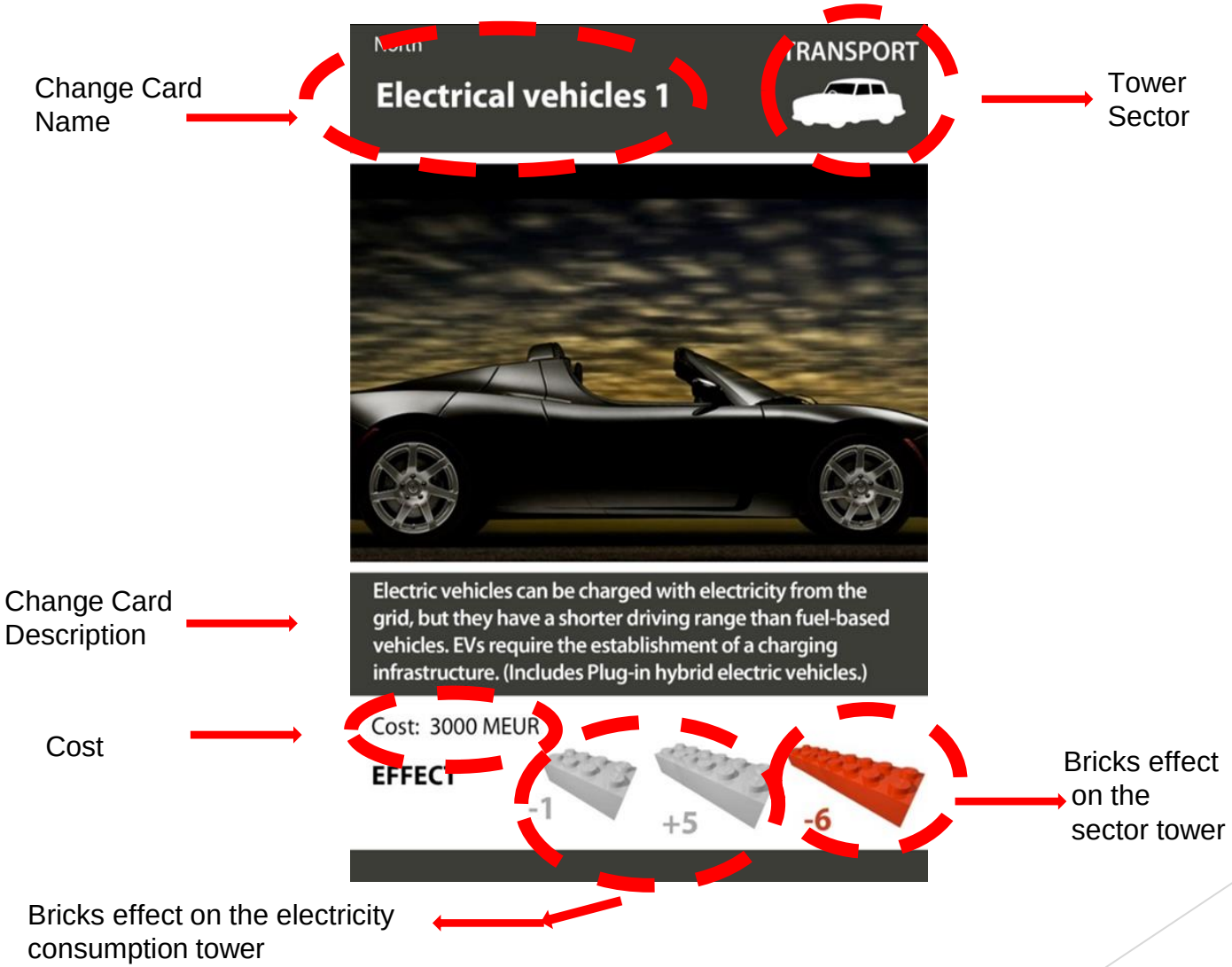
CtG – Stage 2:Apply Change Cards To BAU 2035

- Transform the TRANSPORT, HEATING, INDUSTRY and ELECTRICITY CONSUMPTION tower based on your 2035 regional targets.

- Use the CHANGE CARDS
  - Available technology and social change behavior that can be implemented in each sector.
  - Sort the CHANGE CARDS:
    - YES: Changes you want to implement
    - MAYBE: Changes you might want to implement
    - NO: Change you do not want to implement

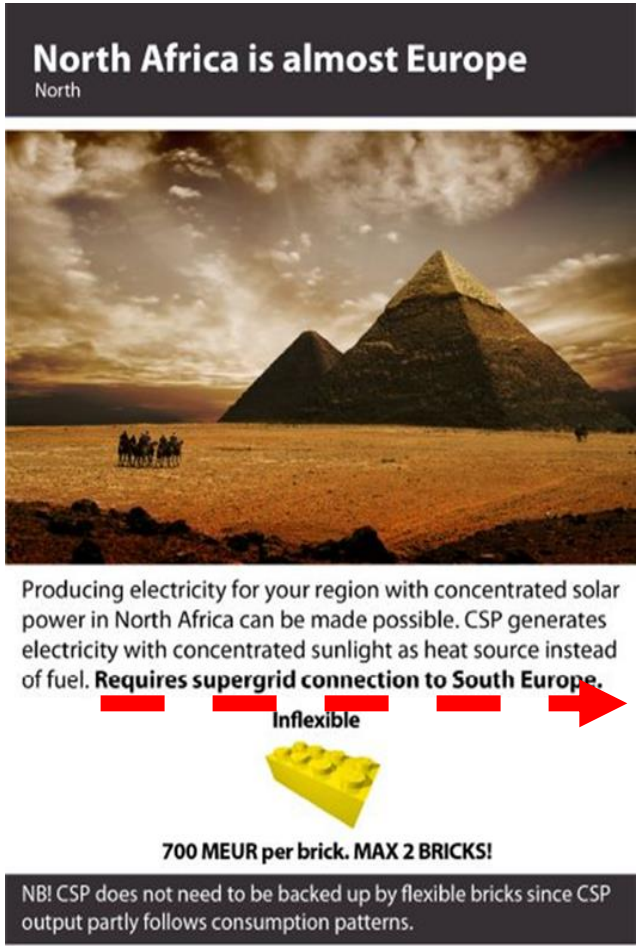
- Pick up a BRICK BANK MANAGER and ACCOUNTANT
  - Brick Bank Manager: Applies the changes to the towers
  - Accountant: Keeps track of expenses (implementation cost) and savings (removed fuel bricks).

CtG – Stage 2: Change Cards



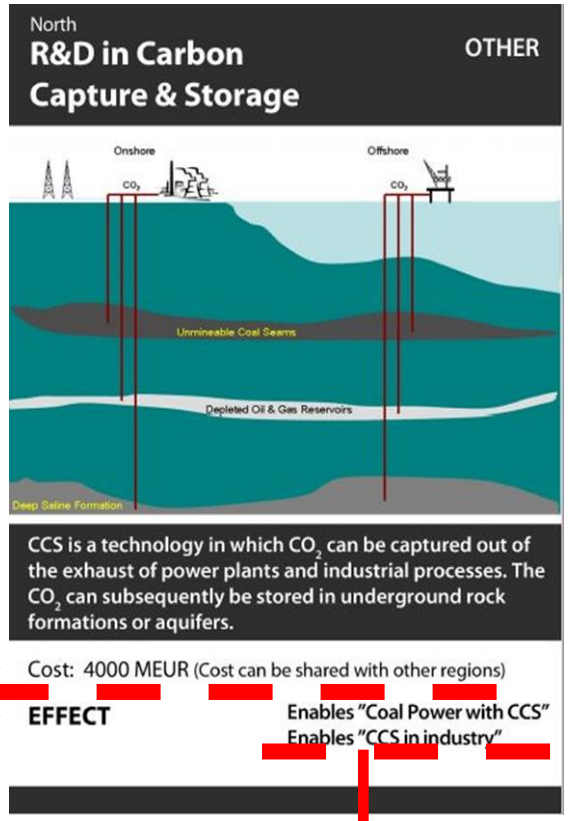
CtG – Stage 2: Change Cards

Effect proportional to the number of regions that play it



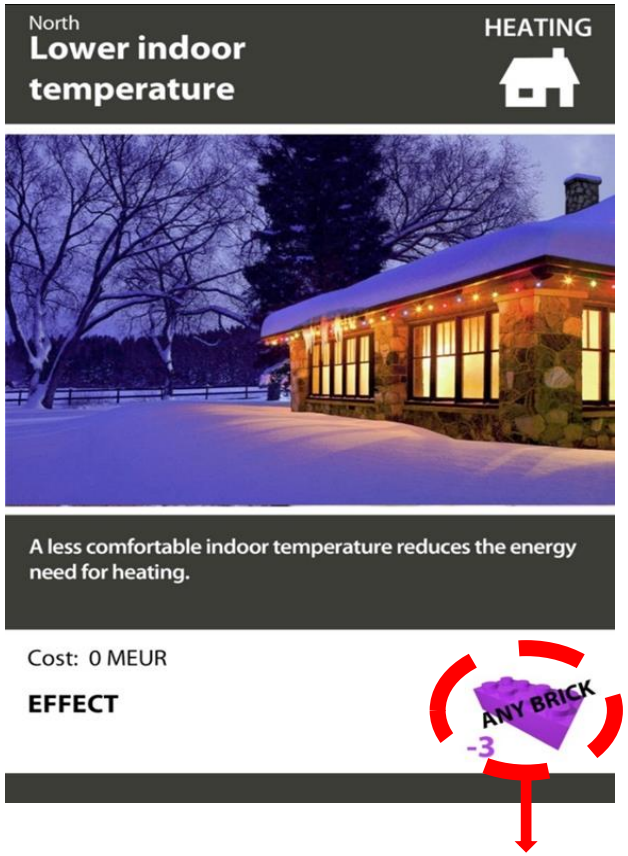
Requires supergrid connection card

CtG – Stage 2: Change Cards



Shared costs with other regions

Enables the CCS changes cards in the game



Option to use any available energy source

CtG-Implement selected change cards

ACCOUNTANT

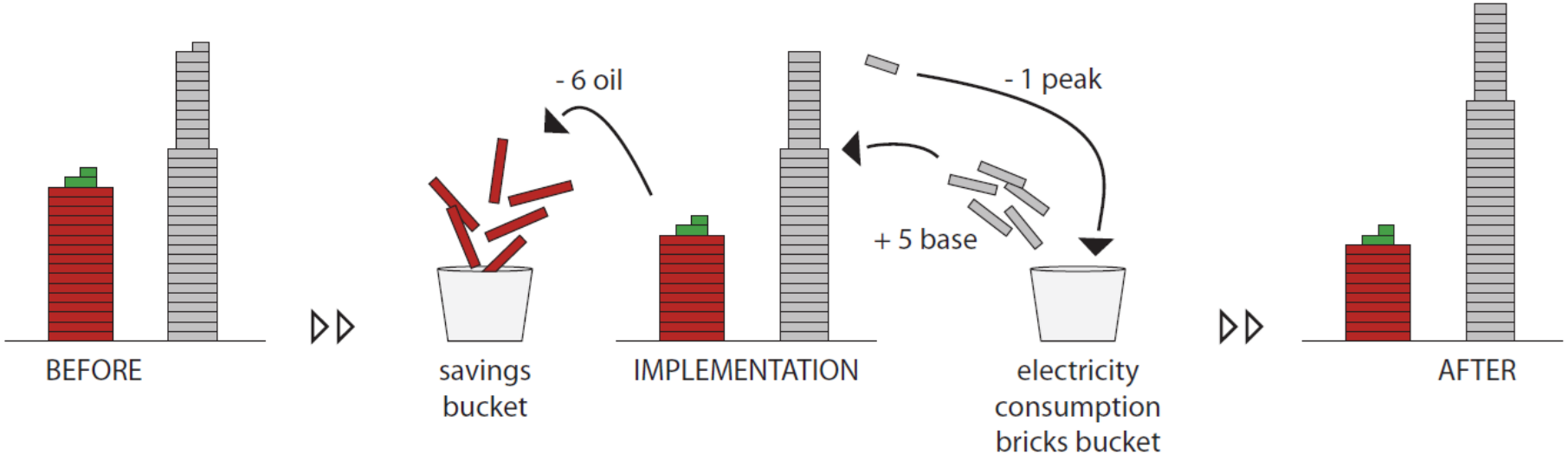
- Note all the YES cards, Cost & Savings (the removed or added fuel bricks).
- NB: If you use bricks from the “Bank” (region available sources), you have to pay for them!

ACCOUNTING SHEET		
CHANGE CARDS NAME	COST MEUR	SAVINGS EFFECT ON THE BRICKS Number & Color of brick
ELECTRIC VEHICLES 1	3000	- 6 RED/OIL

CtG-Implement selected change cards

BRICK BANK MANAGER

- Remove or add the Lego bricks based on the YES cards to the saving bucket

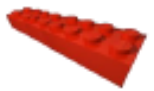
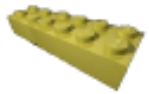
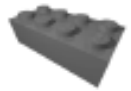
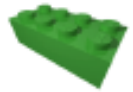


CtG – Stage 2:Economic balance calculation

- Calculate the SAVINGS:
  - Count all removed fuel bricks in the saving buckets.
    Nr. of bricks removed for each fuel type **X** its cost (fuel price)
  - Minus all the added fuel bricks taken from the bank.
    Nr. of fuel brick added **X** its cost (fuel price)

SAVINGS : EFFECT ON THE BRICKS			
TYPE OF FUEL BRICK	**NUMBER**	**FUEL PRICE MEUR/BRICK**	**SAVINGS**
RED / OIL	**-6**	**1200**	**7200**

Fuel Price List

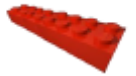
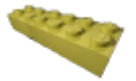
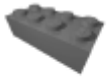
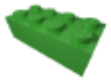
Fuel LEGO®	Fuel Type	Fuel price (MEUR/brick)
	Coal	300
	Oil	1200
	Natural Gas	800
	Coal with CCS*	400
	Biomass	700

*Using CCS does not require different coal, but it does require more coal (since energy is needed to remove CO_2). The price increase of 50 % is a bit too extreme.

CtG – Stage 2: Economic balance calculation

- Calculate the economic **balance**
  - **BALANCE = SAVINGS – COST**
  - COST:
    - Calculate the total cost of implementing all the YES cards, using the accounting sheet
  - SAVINGS:
    - Calculate the total savings arising from the changes, using the accounting sheet and fuel price sheet (multiply amount of removed fuels with their unit price).
    - Exp: - 6 red bricks x oil price = 6 x 1200 MEUR = 7200 MEUR

Fuel Price List

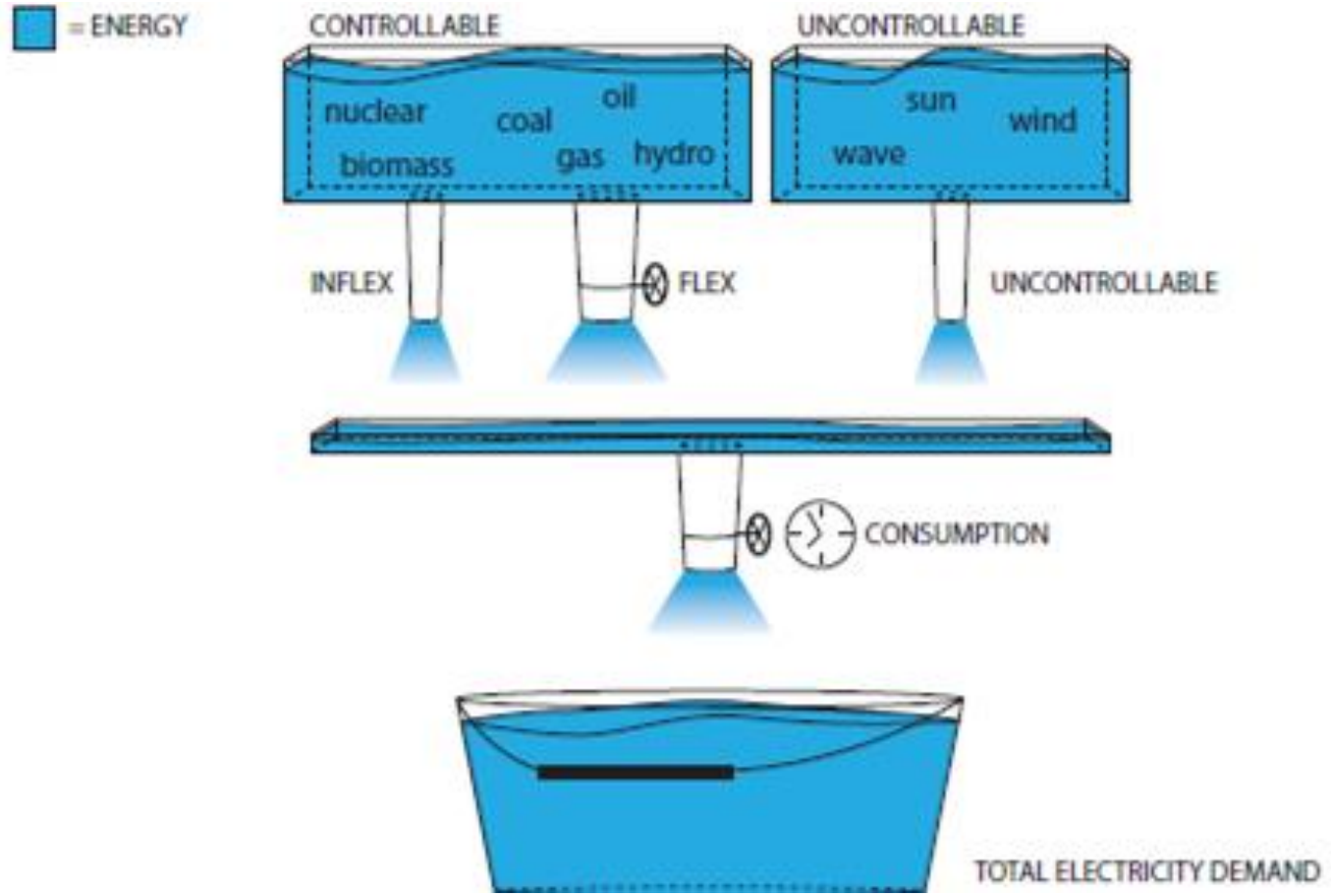
Fuel LEGO®	Fuel Type	Fuel price (MEUR/brick)
	Coal	300
	Oil	1200
	Natural Gas	800
	Coal with CCS*	400
	Biomass	700

*Using CCS does not require different coal, but it does require more coal (since energy is needed to remove CO_2). The price increase of 50 % is a bit too extreme.

CtG – Stage 3: Power your future

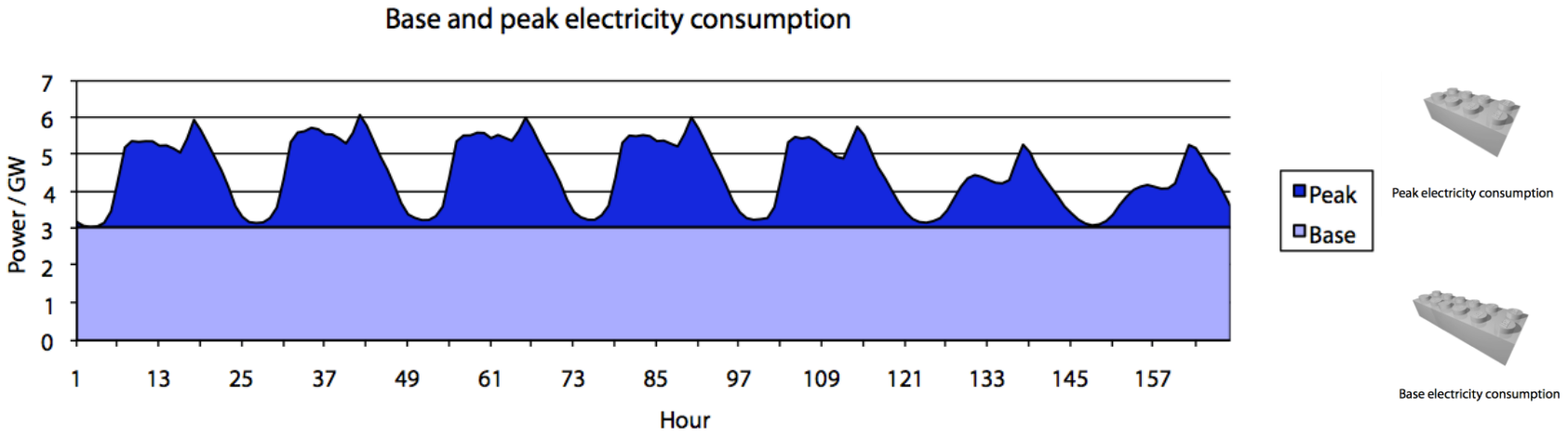
- Opportunity to transform your BAU 2035 electricity production tower to fit your dream vision! Construct the NEW future power supply tower
  - Sell to the facilitator (“bank”) your BAU 2035 electricity production tower
  - **BALANCE + “BAU2035 ELECTRICITY PRODUCTION TOWER REVENUE” = BUDGET**
  - The BUDGET can be spent on building your future electricity production tower

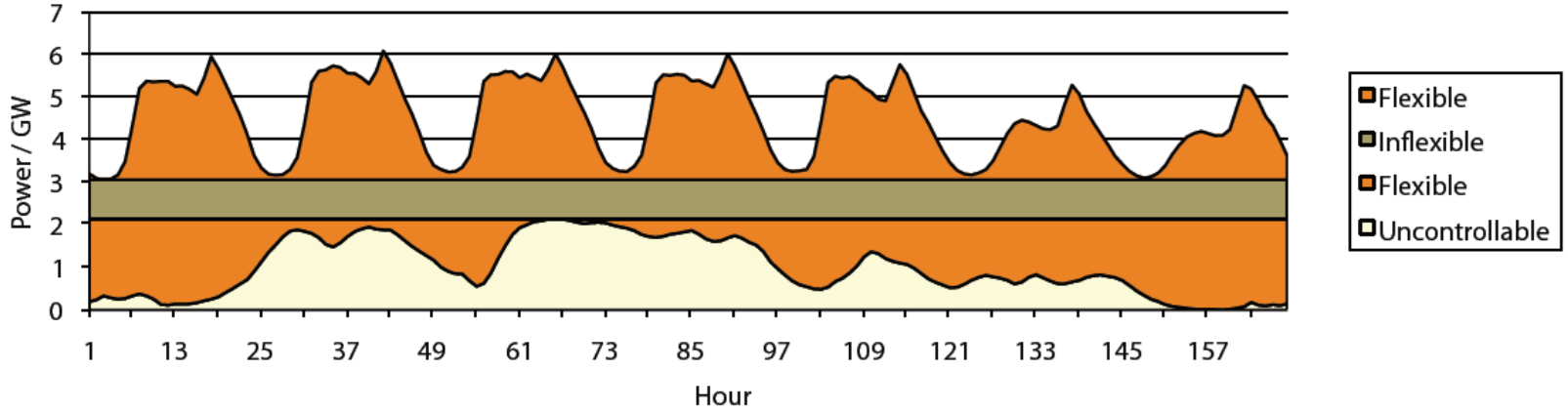
CtG – Stage 3: Energy production technologies and electricity system



CtG – Stage 3: Understand the electricity system

- Physical constrains on the electricity system
- Rules for satisfying the base and peak electricity consumption:

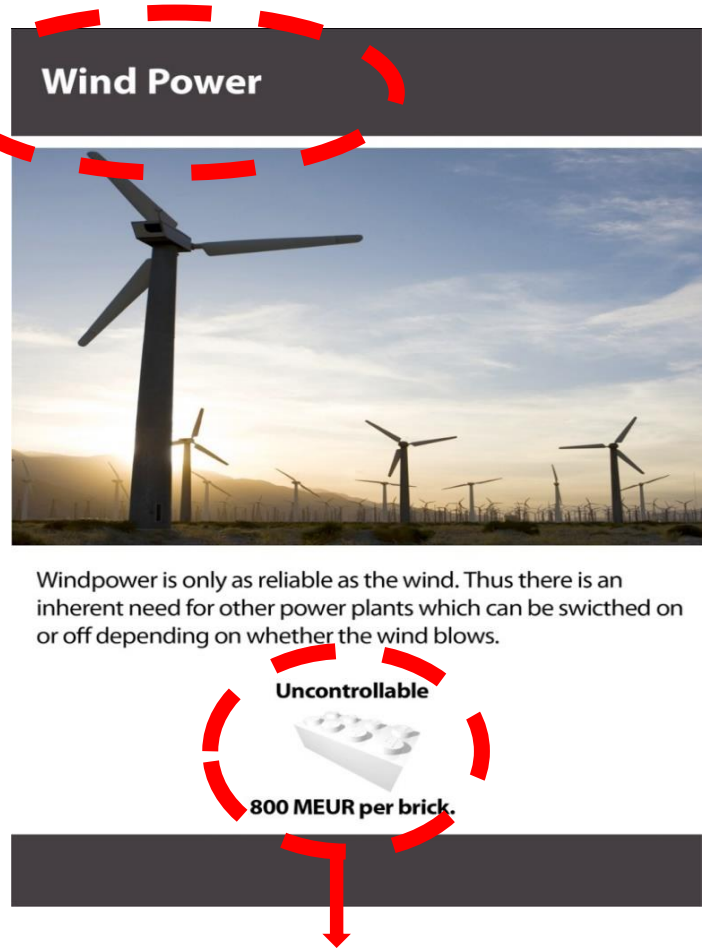


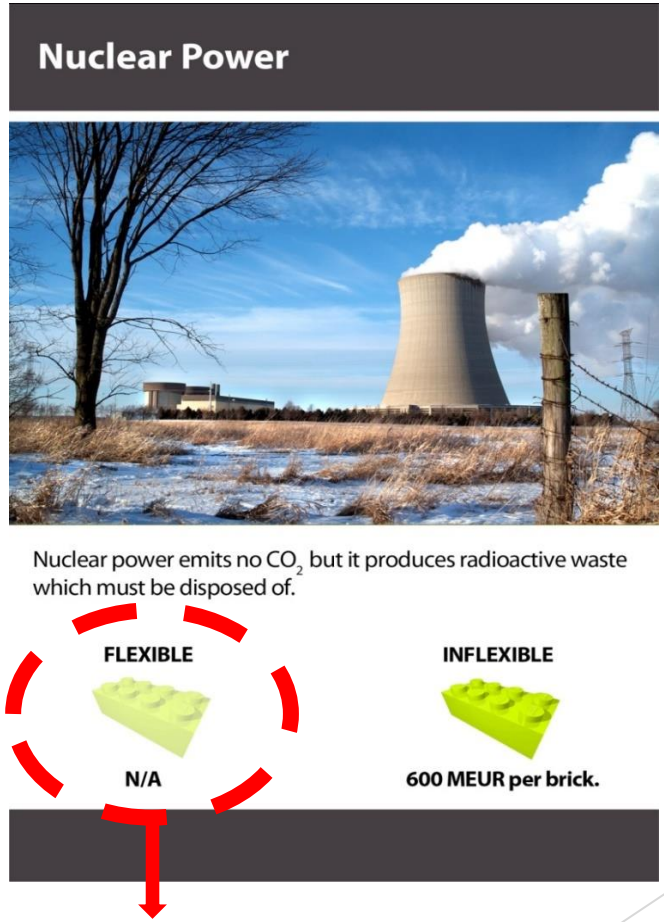


CtG – Stage 3: Capacity cards

Capacity card name

Capacity card description





Wind and solar power plants are uncontrollable due to fluctuating weather

It is not possible to have flexible nuclear power due to high risks etc.

CtG – Stage 3: Implement selected capacity cards

- Select the capacity cards to build your new electricity production tower for your dream 2035:
  - Based your decisions on your stakeholder roles, on your 2035 regional targets and budget.

- Satisfy the new electricity demand represented by the electricity consumption tower.
  - Base electricity demand.
    - Inflexible capacity power plants
    - Uncontrollable + Flexible capacity power plants
  - Peak electricity demand.
    - Flexible capacity power plants

- NB: The “Bank” limits the available resources to the particular region.

CtG – Stage 3: Register expenses of all implemented capacity cards

CONTROLABLE TOTAL EXPENSES

+

UNCONTROLABLE TOTAL EXPENSES

=

TOTAL EXPENSES

CONTROLABLE RESOURCES

TECHNOLOGY	INFLEXIBLE CAPACITY		FLEXIBLE CAPACITY		TOTAL EXPENSES (CI*AI)+(CF*AF)
	COST (CI)	AMOUNT (AI)	COST (CF)	AMOUNT (AF)	
COAL					
COAL WITH CCS					
OIL					
GAS					
BIOMASS					
HYDRO					
NUCLEAR					

UNCONTROLABLE RESOURCES

TECHNOLOGY	UNCONTROLABLE CAPACITY		TOTAL EXPENSES
	COST	AMOUNT	
WIND			
CSV (CONCENTRATED SOLAR PANELS)			
SOLAR PV			

CtG – Stage 3: Financial balance calculation

BUDGET

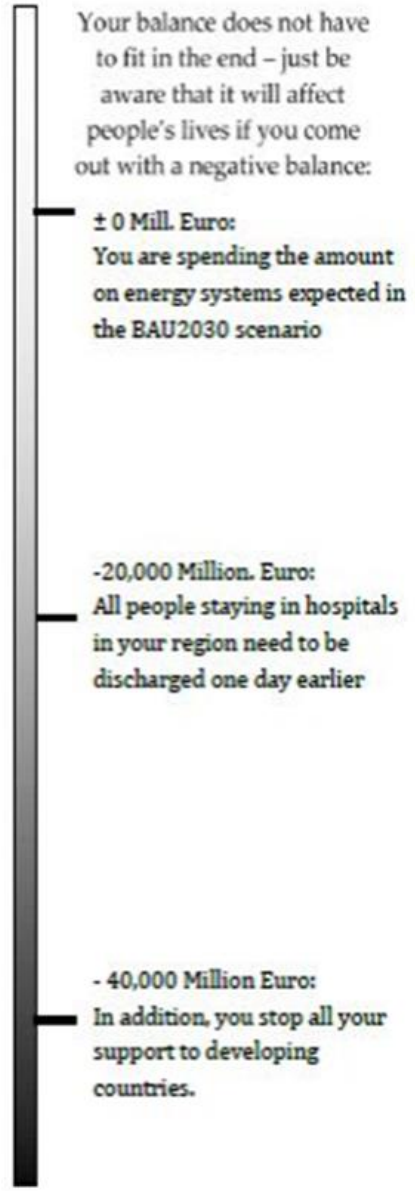
–

TOTAL EXPENSES

=

FINANCIAL BALANCE

- Check the consequences of your financial balance in the welfare services.

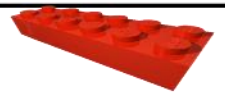
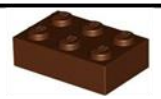
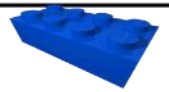


CtG – Stage 4: Evaluate your new scenario

- Calculate Total Energy Consumption:
  Count total nr. of bricks (T)
- Calculate Total nr. renewable bricks (R)
- Calculate the share of renewable sources %

TOTAL NR. RENEWABLE BRICKS (R)
/
TOTAL NR. BRICKS (T)
=
SHARE RENEWABLES %

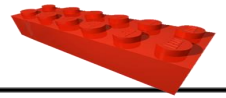
- Calculate consumption of Oil & Gas:
  Total nr. of Oil & Gas bricks.

FUEL LEGO	ENERGY RESOURCE	NUMBER OF BRICKS
	COAL	
	OIL	
	NATURAL GAS	
	COAL WITH CCS	
	NUCLEAR	
	BIOMASS	
	HYDRO9	
	WIND	
	SUN	

TOTAL ENERGY CONSUMPTION
Total nº of bricks (T)

CtG – Stage 4: Evaluate your CO2 emissions

- Calculate Total CO_2 emissions:
- Estimated region population in 2035
- Calculate CO2 emissions per capita (tons/capita)

FUEL LEGO	ENERGY RESOURCE	NUMBER OF BRICKS	CO2 EMISSIONS (dots units)
	COAL		X 20 dots =
	OIL		X 16 dots =
	GAS		X 12 dots =
		TOTAL dots	

Conversion factor 0.6 (millions tons/dots) **X** CO_2 **emissions** Total dots (dots) **/** **Region Population (million)** **=** CO_2 **emissions per capita** (Tons/capita)

CtG – Stage 4: Short presentation of your NEW scenario

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