|  |  |  |
| --- | --- | --- |
| Capture – Capex | 200 | M EUR/Mt CO2/yr |
| Capture – Opex Electricty | 130 | MWh / t CO2 |
| Connection to Pipeline | 1 | M EUR/company |
|  |  |  |
| Electricity (NL 2018) **DECREASE 5%** | 75 | EUR/MWh |
| Governments yearly total subsidy amount | 15 | MEUR /year |
|  |  |  |
| Capture technology and price |  | **INCREASE 10%/YEAR** |
| Maximum capture technology initial | 5 | MT/year |

1. **CAPEX AND COSTS FOR THE DIFFERENT ASPECTS OF THE SYSTEM**

|  |  |  |
| --- | --- | --- |
| No of Companies | 25 | Companies |
| Min Oil Demand | 1 | Mt/yr |
| Max Oil Demand | 10 | Mt/yr |
| CO2 emissions / ton Oil | 3,2 | t CO2 / t Oil |
| OPEX Industry | CALCULATION | Price storage emit electricity oil |
| Specific Capture technolog |  | Year they build it |
| Payback period |  |  |

1. **ASPECTS OF THE INDUSTRIES**
2. **ASPECTC OF THE GOVERNMENT**

|  |  |  |
| --- | --- | --- |
| Governments yearly total subsidy amount | 15 | MEUR /year |
| Current CO2 price | INCREASE  PER YEAR | **PROVIDED IN EXCEL** |
| Distribtion of subsidy | FRACTION TO ROT AND INDUSTRY | **SLIDER IN NETLOGO** |
|  |  |  |

1. **ASPECTS OF PORT OF ROTTERDAM**

|  |  |  |
| --- | --- | --- |
| CO2 Storage price | 0.3 | MEUR /year |
|  |  |  |

1. **ASPECTS OF INFRA/STORAGE POINTS**

|  |  |  |
| --- | --- | --- |
| PRICE OF INFRA: |  |  |
| ON-SHORE or OFF-SHORE | Calculation per storage point | **PROVIDED IN EXCEL** |
| Fixed price pipeline | 70% Of price extensible pipeline price | **PRICE EXTENSIBLE IS CALCULATION** |

|  |  |  |
| --- | --- | --- |
| Pipe capacity | MT CO2/ Year | **PROVIDED IN EXCEL** |
|  |  |  |

**Calculation pipeline extensible= (Onshore km \* CapExonshore + Offshore km \* CapEx Oofshore)**

**Calculation pipeline fixed = Calculation pipeline extensible \* 0.7**

Agent: Government

State:

•Fixed yearly budget for subsidies – 15 MEUR

•Planned locations for storage, unknown to other agents

•(capacity, distance, on/off shore)

– **EXCEL**

•Current CO2 price

•Continually increasing, how is unknown to others

- **EXCEL**

•Distribution of subsidy

•fraction to Industries and Port (Slider in netlogo

•Actions

•Decide on how to split annual subsidy amount

•Dispatch subsidy for capture tech to companies

•Dispatch subsidy for PoRA for pipeline development

•Increase CO2 price

Agent: Port of Rotterdam

States

•CO2 price of storing in CCS

•type of CCS infra

•On-shore / off-shore

•Extensible yes/no

•But future risk that it will be unused, and will thus waste

CAPEX

Agent: Industry

•Decide to join a CCS infra or not, based on:

•CAPEX of capture technology, OPEX with or without capture

and their internal ROI

•Payback Period

•random, unique to company, 1-20 years

•OPEX

•price of CO2 storage

•Price of CO2 emitted

•Price of electricity

•Price of oil

•Have a specific capture technology

•Have X amount of heat/cold required, fixed

•Provided either by oil or electricity

•Oil and energy requirement

- **Excel**

Object: Capture technology

•Has maximum capture capacity in Ton/year

•CAPEX and electricity use based on capacity

•Can be built in 1 year

•Every year a 10% larger unit becomes available, for 10 %

lower cost

•Initial capacity and price **EXCEL**

Environment

•Electricity price EUR/MW

•Decreasing with 5% per year, decrease unknown to agents

•Initial price - **Excel**

KPIs

•Total CO2 emitted to air

•Total CO2 stored

•Total costs to industry to store CO2

•Total amount of subsidy dispatched by government

•To infrastructure

•To industry

•Total amount of electricity used

Evaluation criteria

•Does it run?

•Does it break? Easily?

•Does it generate some phenomena you can identify?

•How complex are the mechanisms you included?

•Did you perform verification steps?

•How did you set the experiments up?

•How did you do the analysis? - how well are you

interpreting the data?

•Coding – how well are using the NetLogo language / did

you read the manual

•Reporting – structured and clear report

If this is too simple or you are

bored...

•Industry:

•Agents have expectation about the future changes in CO2 price and CCS costs, based data they have seen and consider that in decision making

•Government

•Considers the distance to 2050 emissions targets, based on estimated building speed and joining rate changes total subsidy available and distribution

•PoR

•Attempts to predict which CO2 storage price is more likely to increase industry participation