

ECCO project: **E**uropean value **C**hain for **CO**₂

Storage Economics of the ECCO-tool

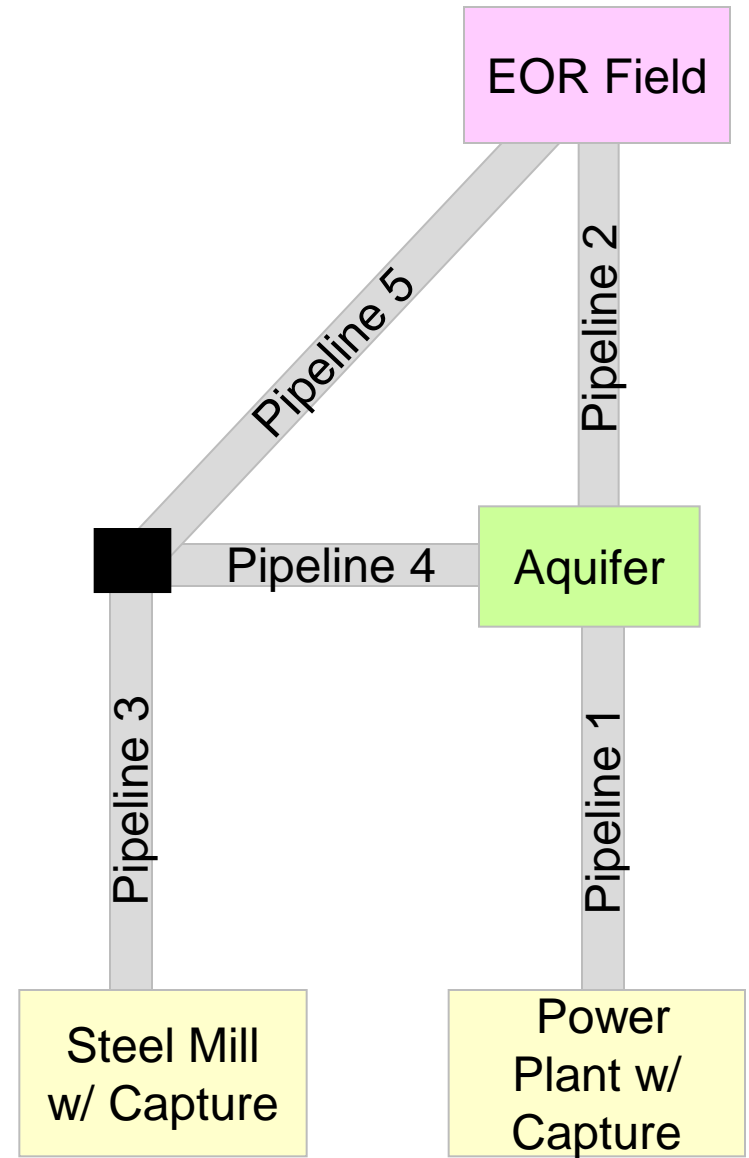
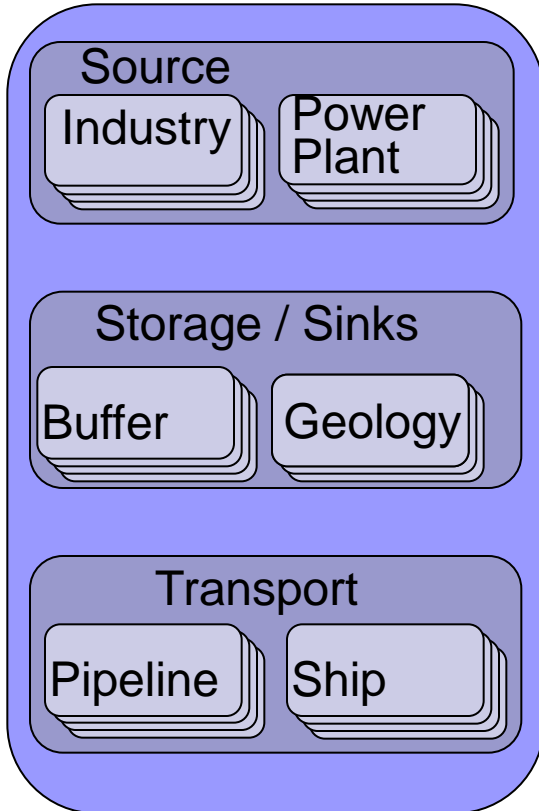
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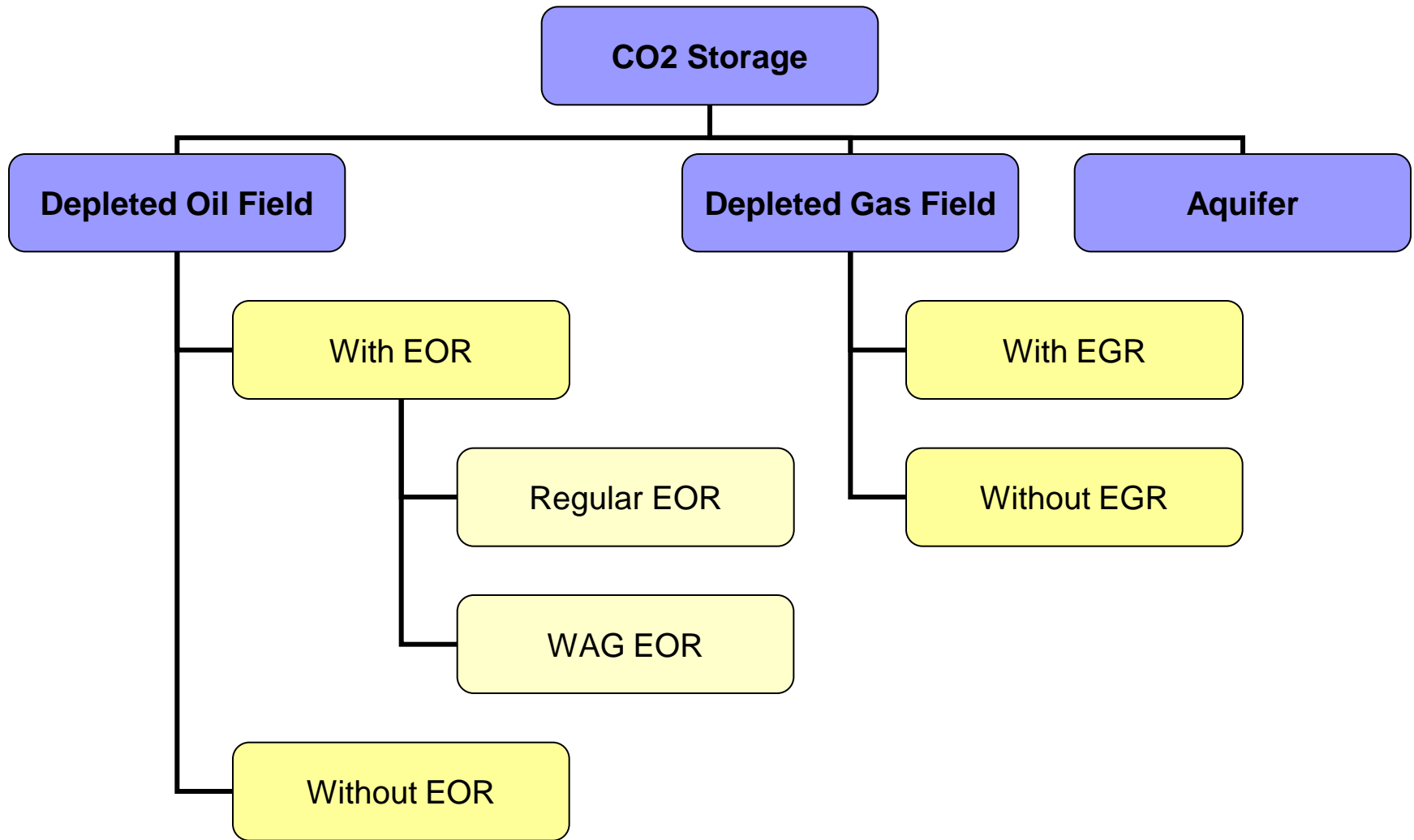
Overview

- **Introduction**
- **Storage module**
- **Automatic decisions in the storage module**
 - **Incremental investments**
 - **Abandonment criteria**
- **Example**
- **Conclusion**

Define Network / Components



Storage in ECCO tool



Automated decisions yield more realistic cashflow forecast

- Steady state conditions:
“no incremental investments during life cycle of their operations”
 - Capture plant operator
 - Transport system operator

- Unsteady state conditions
“in order to meet the contract incremental investments may be needed”
 - Storage operator

Decision algorithms in depleted gas field module

The CO_2 target rate is specified in contract

To meet the contract user can specify the following incremental investments:

- Drilling additional well(s) and construction additional platforms (max. number)
 - Decision trigger: current injection capacity < contractual injection value + a safety margin
 - At each time step ECCOtool will update new injection capacity taking into account changing reservoir physics and incremental investments (if any)

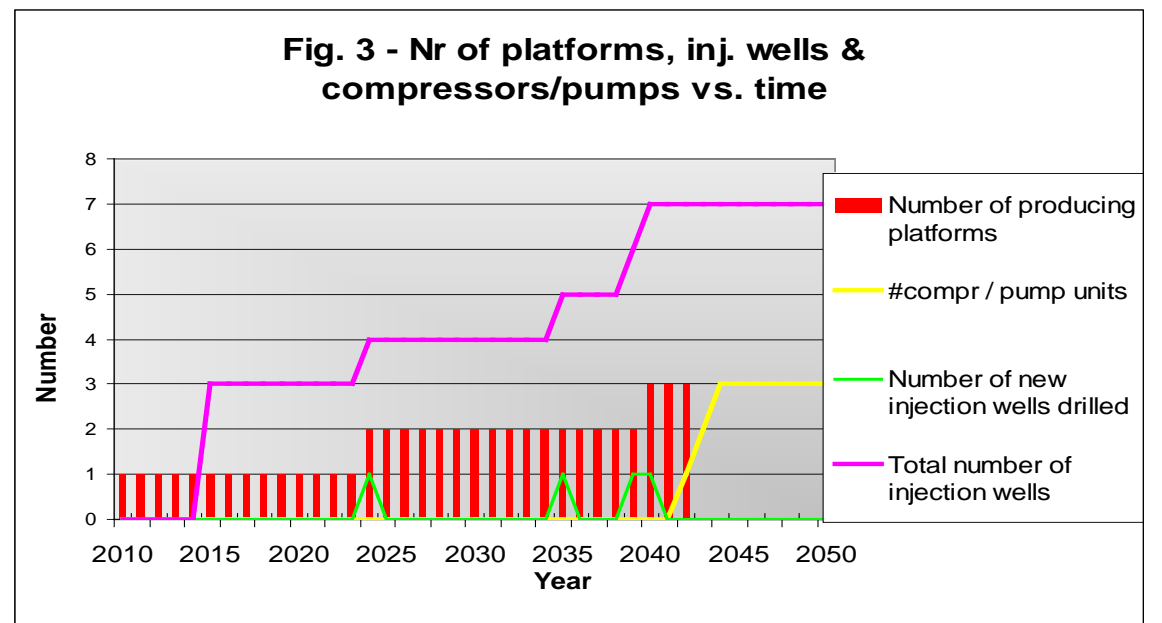
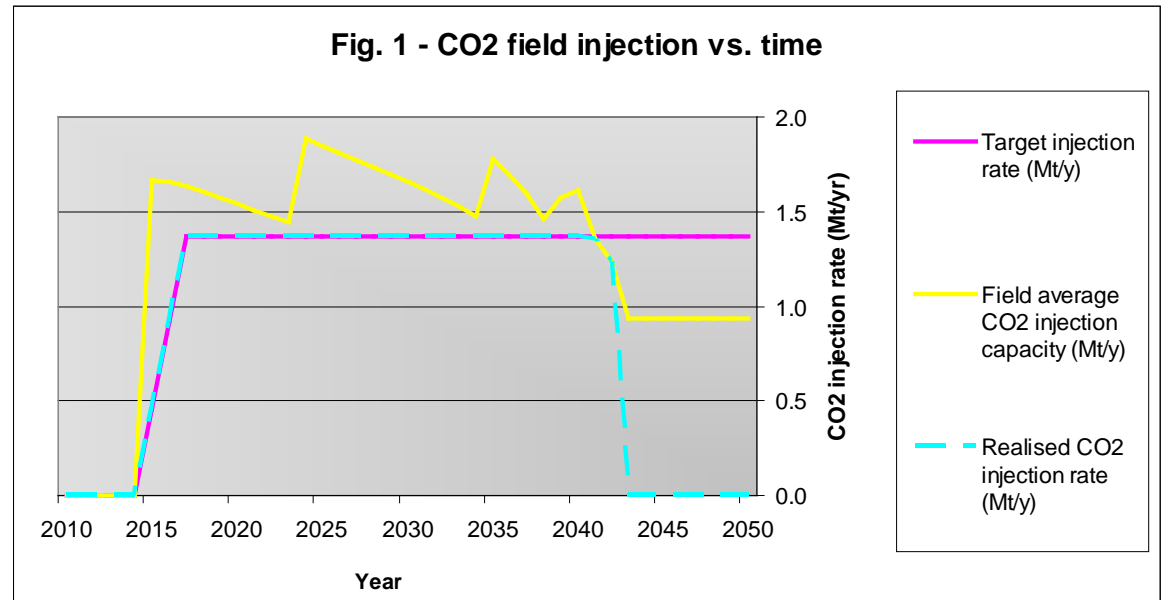
- Installing compressors
 - If all specified incremental wells have been drilled, compression can be installed (multiple stage)

Decision algorithms in depleted EOR field module

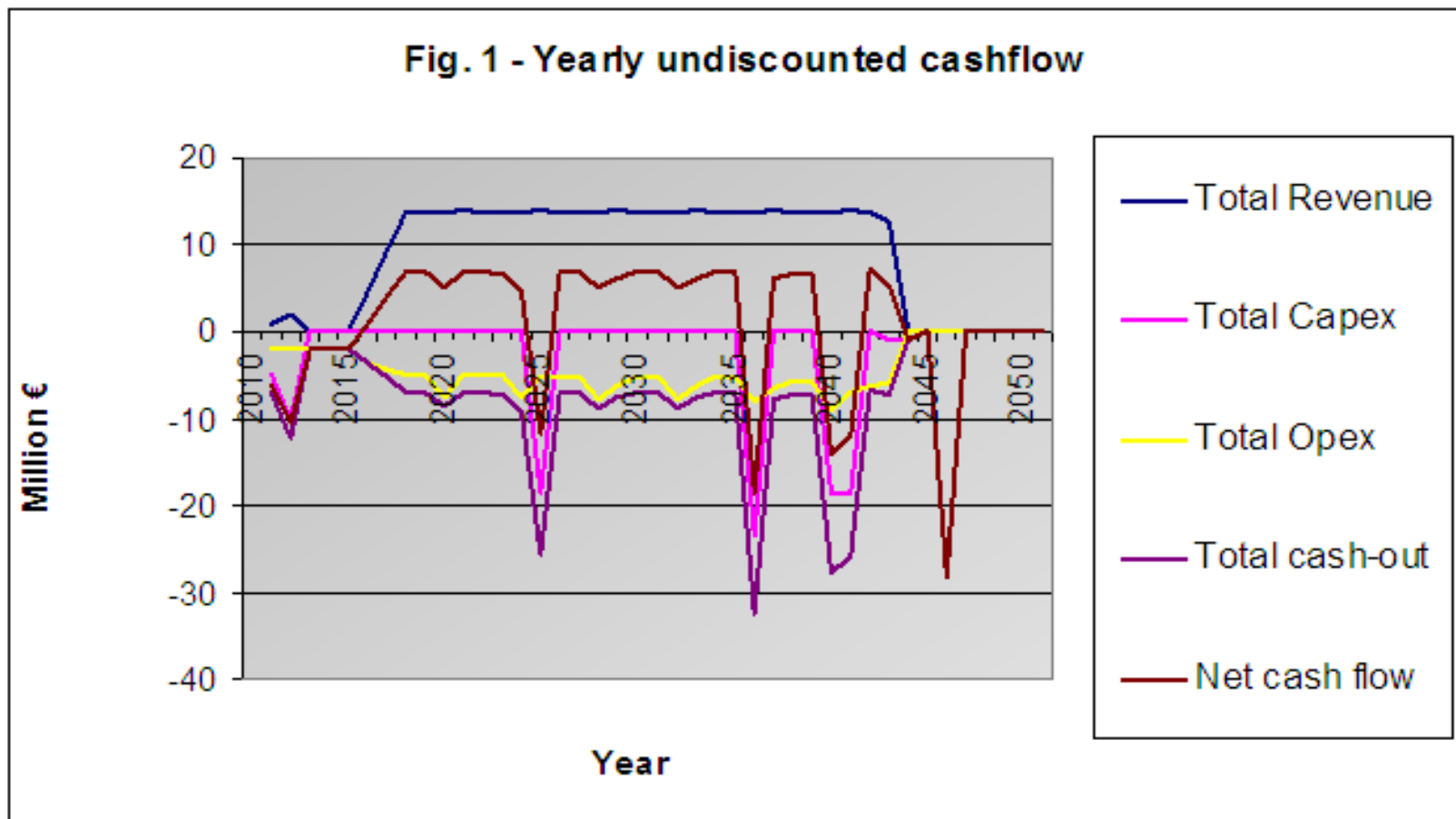
- EOR operations are steady state
 - CO₂ (and, if applicable, water) reservoir volumes injected are assumed to be equal to the reservoir volumes produced
- CO₂ injection capacity will stay therefore the same during the life cycle
- to meet the liquid production (oil + water) may be additional wells are needed and therefore incremental investment have to be made.

Example:

- Additional Wells (4)
- Additional platforms (2)
- Installing compressors (3)

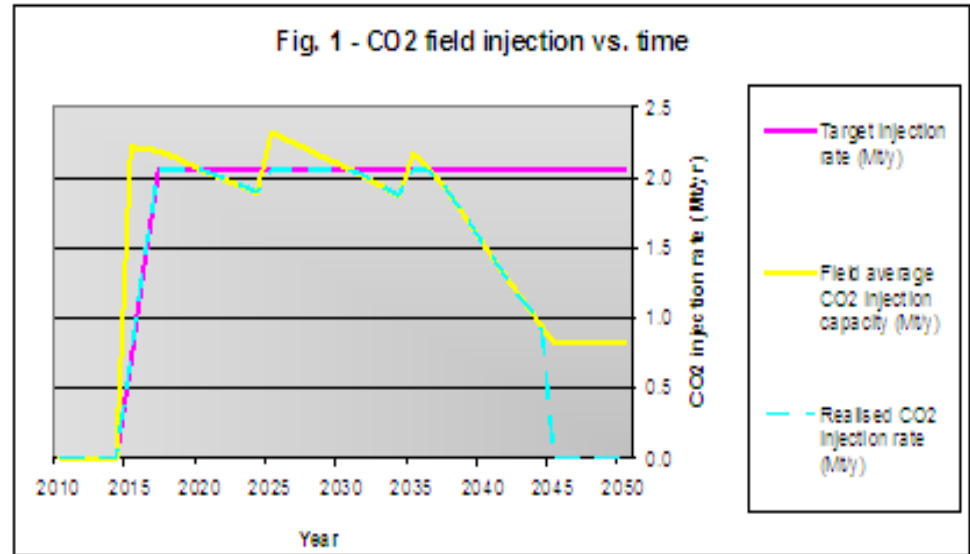


Example

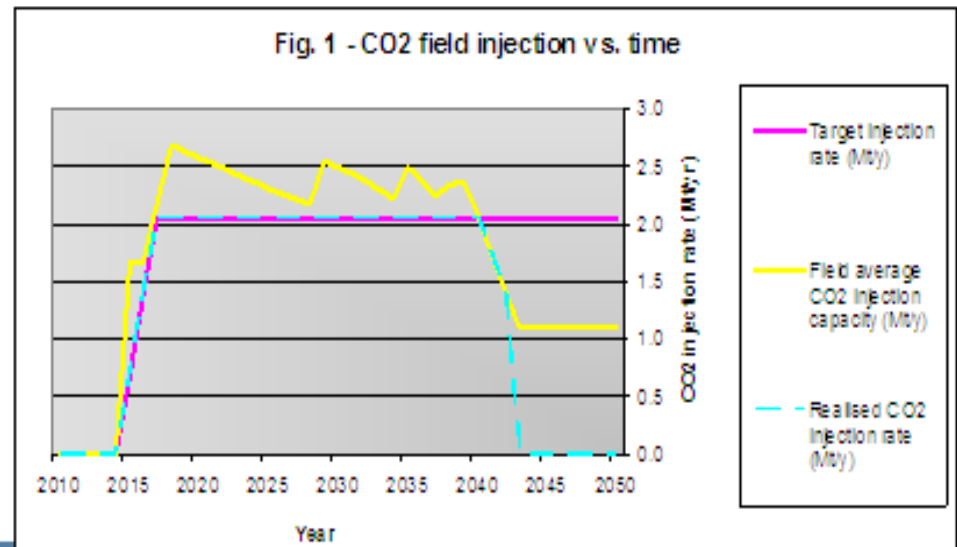


Advantage of automatic decisions

Non-automatic decisions:
Scenario:
Every 10 year drill a new well



Automatic decisions:
Based on previously explained
criteria



Automated decisions yield more realistic cashflow forecast

■ Stopping criteria

- User specified economic life time applies for (n years)
 - Capture plant operators
 - Transport operators

- Abandonment based on (a combination of) physics and economics
 - Storage operator

Automatic abandonment decisions

Storage units have lifetime that is governed by physics and economic performance

- Technical criteria:

- Maximum allowable average reservoir pressure (user specified)

- Economic criteria:

- Minimum economic CO₂ injection rate limit
- Maximum allowable number of consecutive years with a post-tax net cash flow (NCF) <0

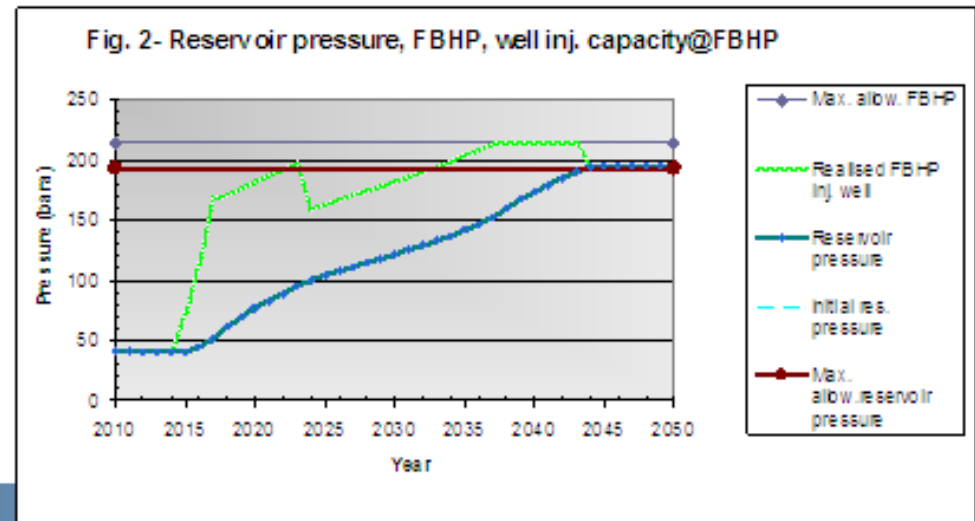
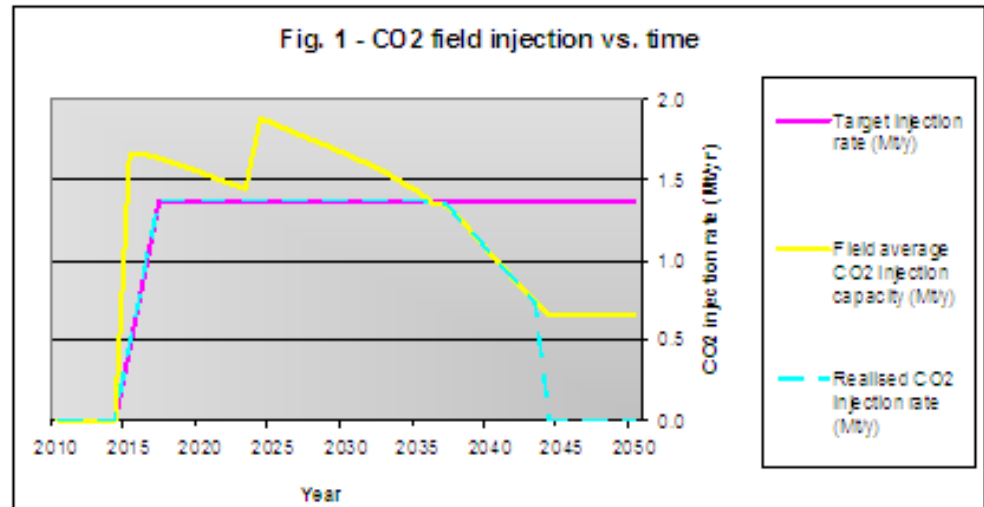
Additional condition: minimum number of injection years to prevent premature shutting-in

Both technical and economic abandonment criteria are active in the storage module

Stopping criteria

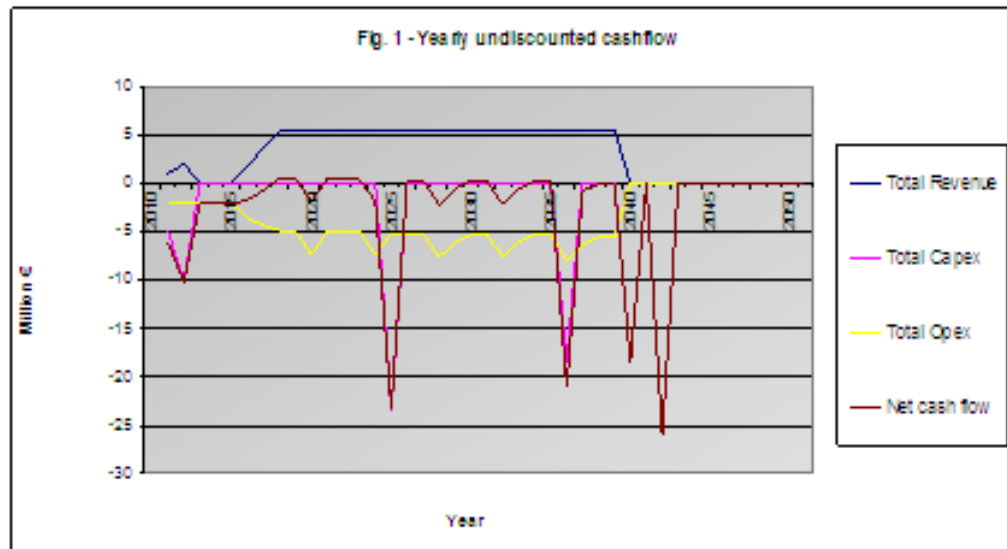
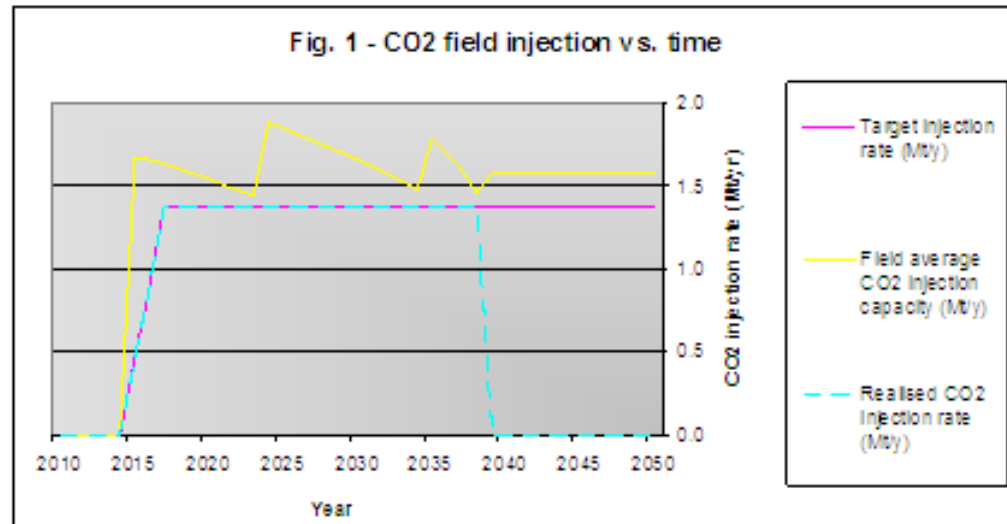
■ Technical

Reservoir pressure >
Maximum reservoir
during injection
pressure



Stopping criteria

- Economical
 - 4 yrs NCF<0



Post-injection phase of field

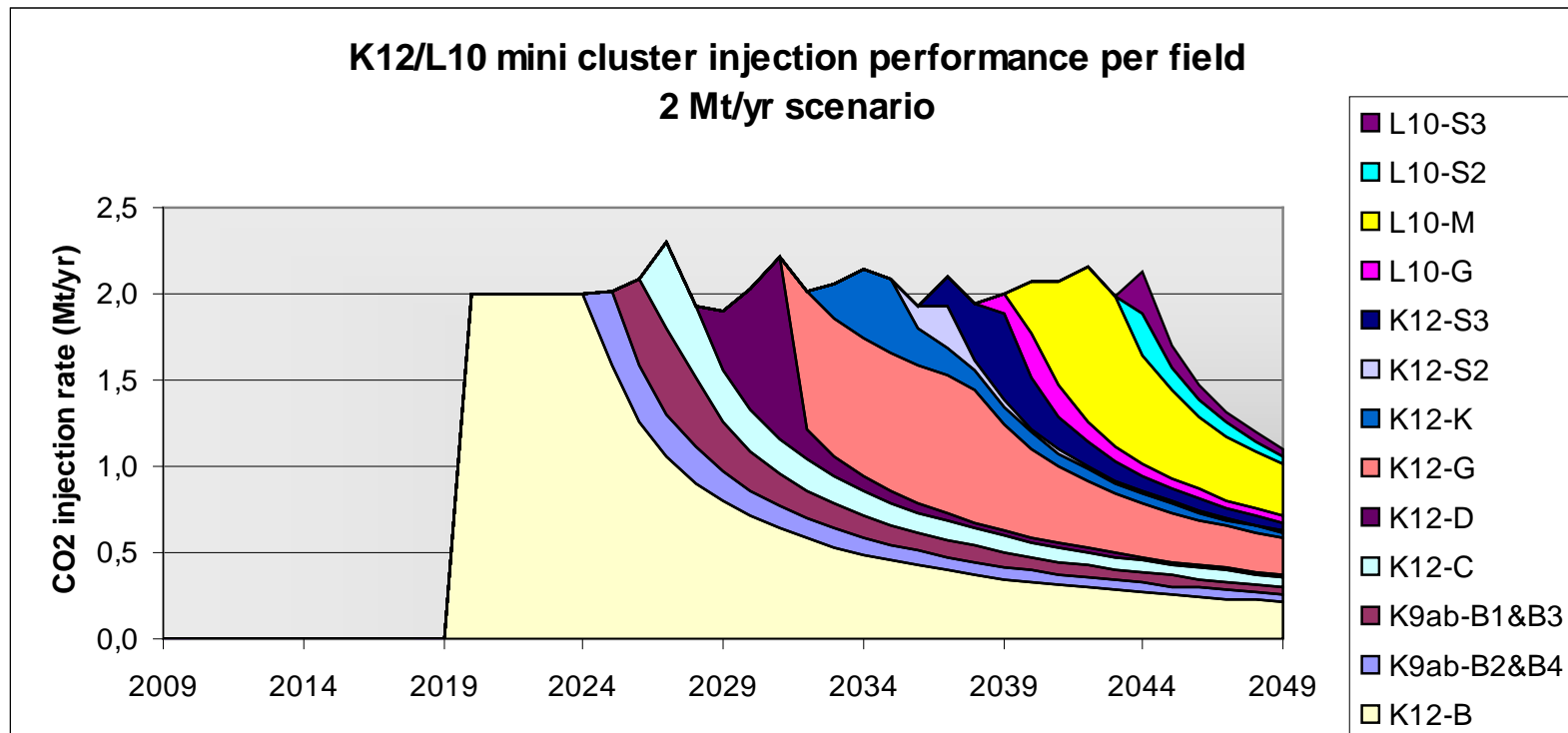
- After the field is shut-in monitoring period starts
 - User defines number of monitoring years and yearly monitoring opex.
 - Automatically included in cashflow

- After the monitoring period the field will be abandonment
 - Abandonment capex is included automatically in the cashflow
 - This last expenditure in the life of the storage unit.
Now the full life-cycle discounted cash flow analysis can be done

Conclusion

- The decision algorithms programmed in ECCOtool for the Storage Operator are aimed at fulfilling contractual obligations during the life-cycle of the storage chain unit, and consist of:
 - Drilling incremental wells (Depleted Gas Field, EOR and Aquifer modules)
 - Constructing incremental platforms (Depleted Gas Field, EOR and Aquifer modules)
 - Installing (additional) compression (Depleted Gas Field and Aquifer modules)
 - Closing-in the field, monitoring and abandonment

Portfolio of fields to meet contract



K12/L10 minicluster cashflow performance 2 Mt/yr scenario

