ECCO Tool
Tool for the Analysis of CCS Value Chains

ECCO European value Chain for CO_2

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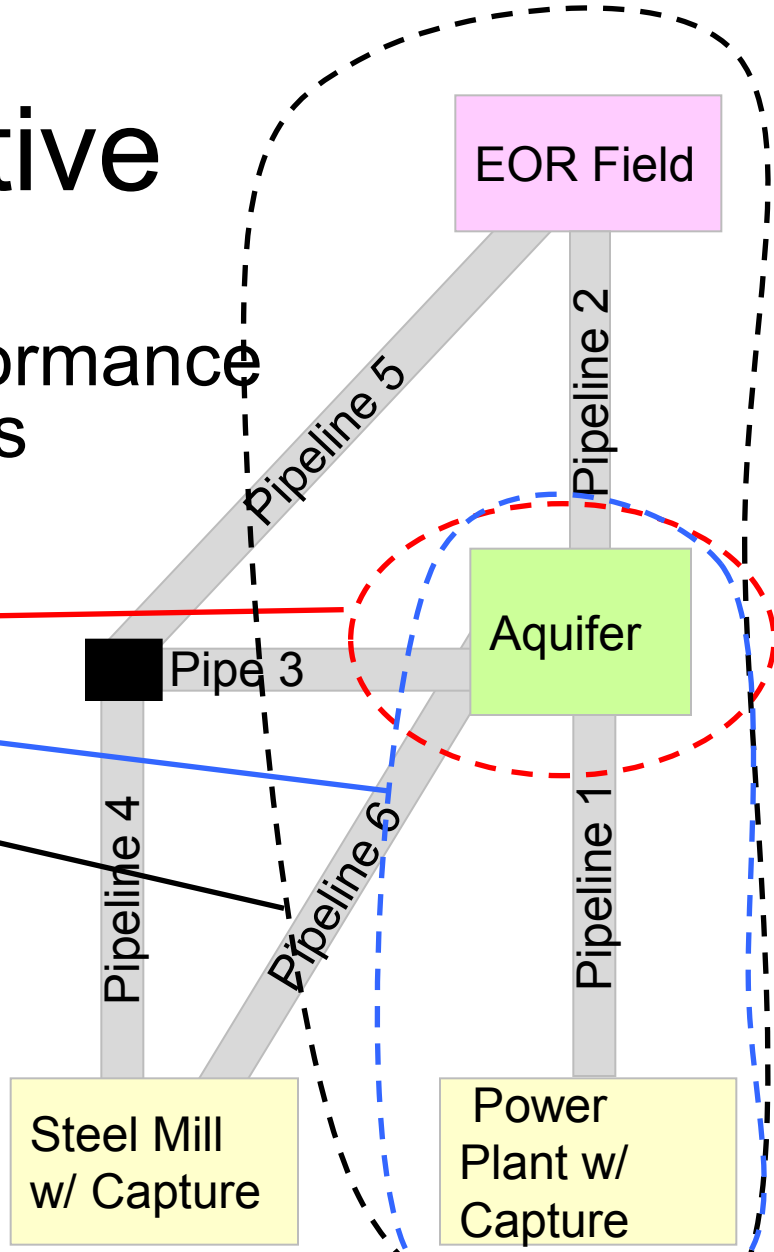
Outline

- ECCO Tool Objective
- Case Elements
- Implementation
- User Interface and Specifications
- Output

ECCO Tool - Objective

- Case study tool
- Calculation of economic performance indicators of CO_2 value chains
- Perspective:
  - Chain Units
  - Actor
  - System / Case wide
- Supporting
  - Multiple Assets
  - Network
  - Changes along timeline
- Should model dependencies



Case: Defining Elements

- Macro-economic data
  - Quantification of scenarios
  - Regional: All chain units and actors belong to a region
- Value chain network definition
  - Chain units and their locations and interconnections
- Properties of chain units
- Contracts
- Actors / Ownership / Taxes

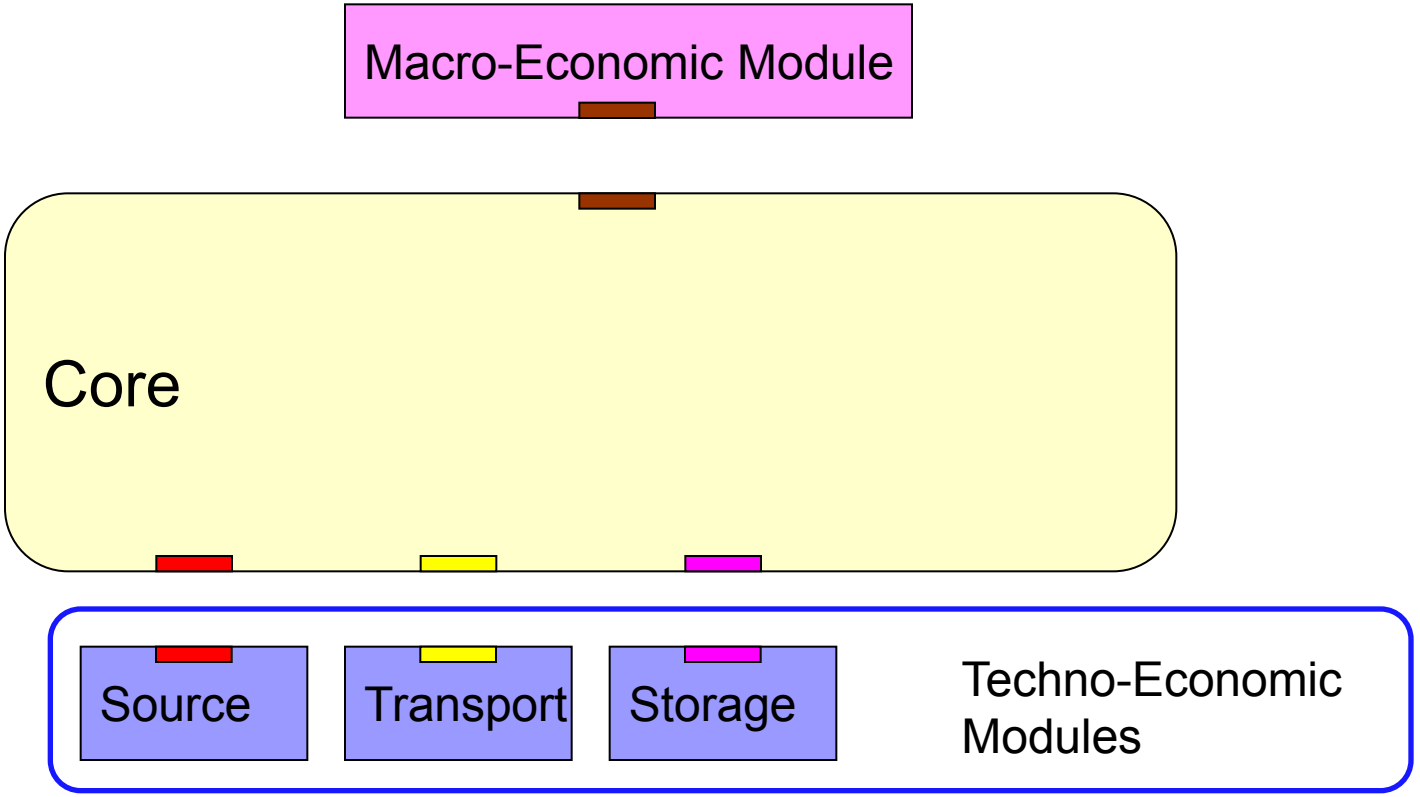
Relations Between Chain Units: Contracts

- Contracts specifies relations between chain units:
  - Physical CO_2 flows
  - Payments
- No competition / no automated decisions
  - It is assumed that contractual flows and payments are enforced
- Tool performs consistency check

Actors

- Controls a single or multiple value chain units
  - 1 → many relationship
- Ownership can vary with time
- Taxes and discount rates are actor specific

Implementation: Modularization



Macro-Economic Module

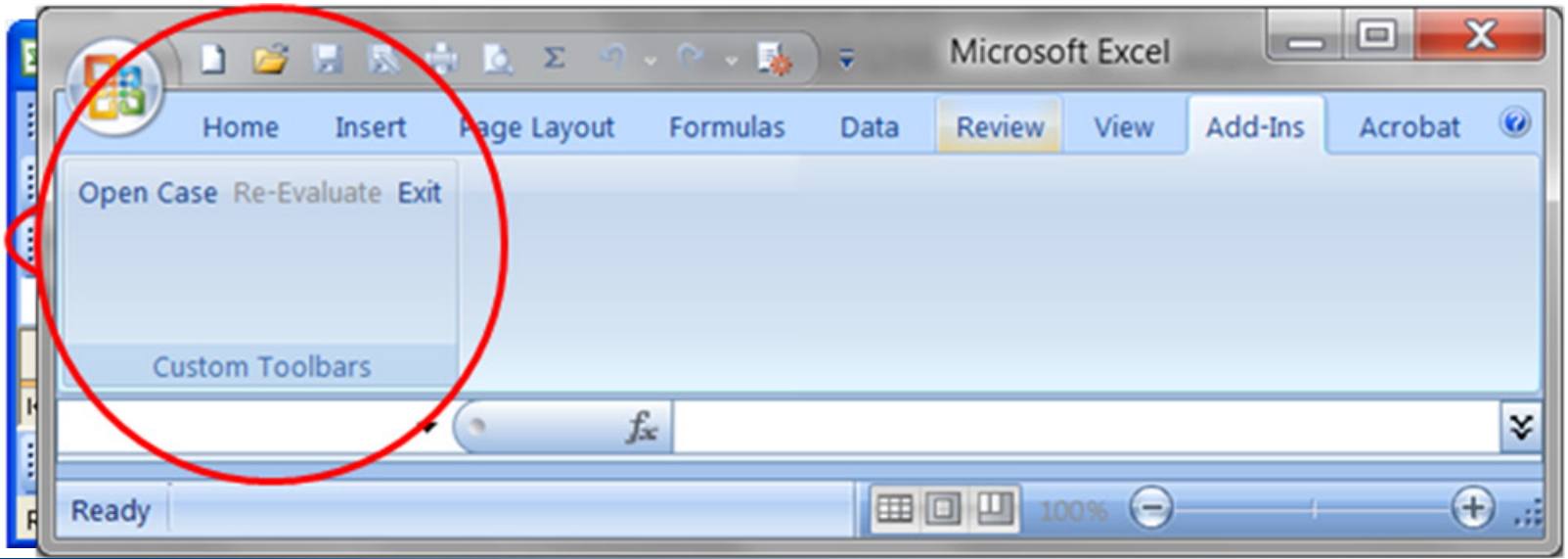
- Defines all prices and indices needed for calculation of key performance indicators, e.g:
  - Oil price
  - Interest rate
  - CO_2 Quota Price

Techno-Economic Modules

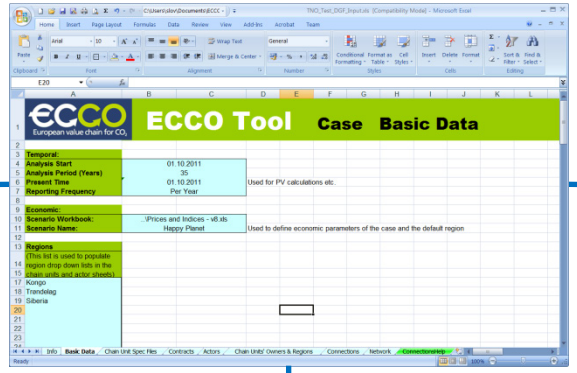
- Used to create chain units
- Types:
  - Source (PEL / IFPEN): The same module used for multiple types of sources
  - Transport (PEL / IFPEN)
    - Pipeline
    - Shipping
  - Storage (TNO)
    - EOR
    - DGF / AQF

Implementation: C# code and Excel Interface

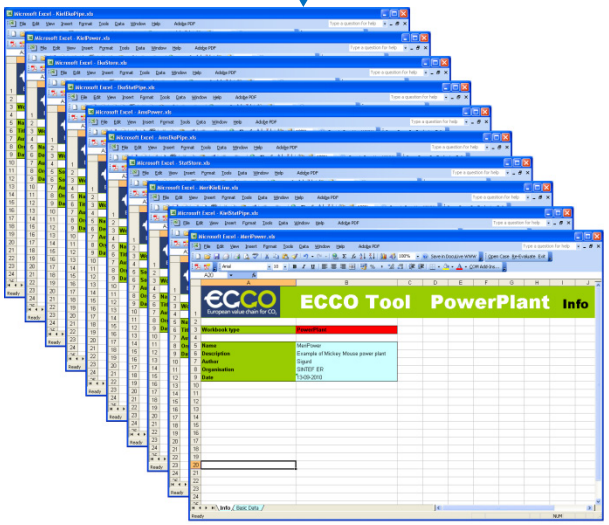
- Excel Add-In for
  - Excel 2003
  - Excel 2007



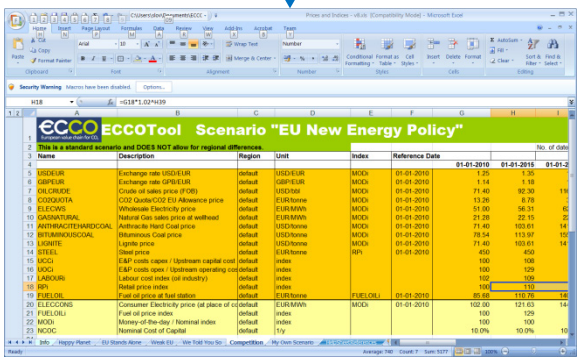
Specifications



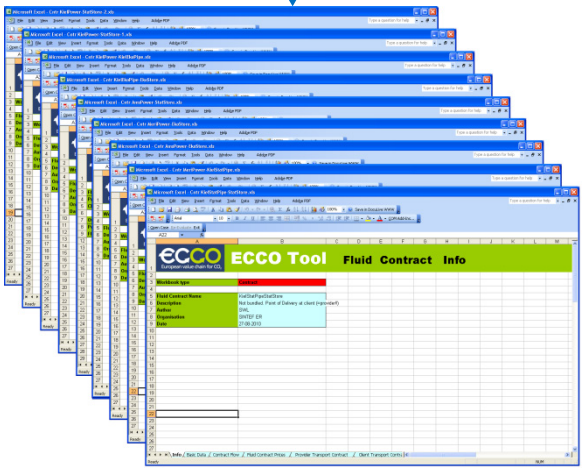
Case Workbook



Chain Unit Workbooks



Prices and Indices



Contracts Workbooks

European value chain for CO2
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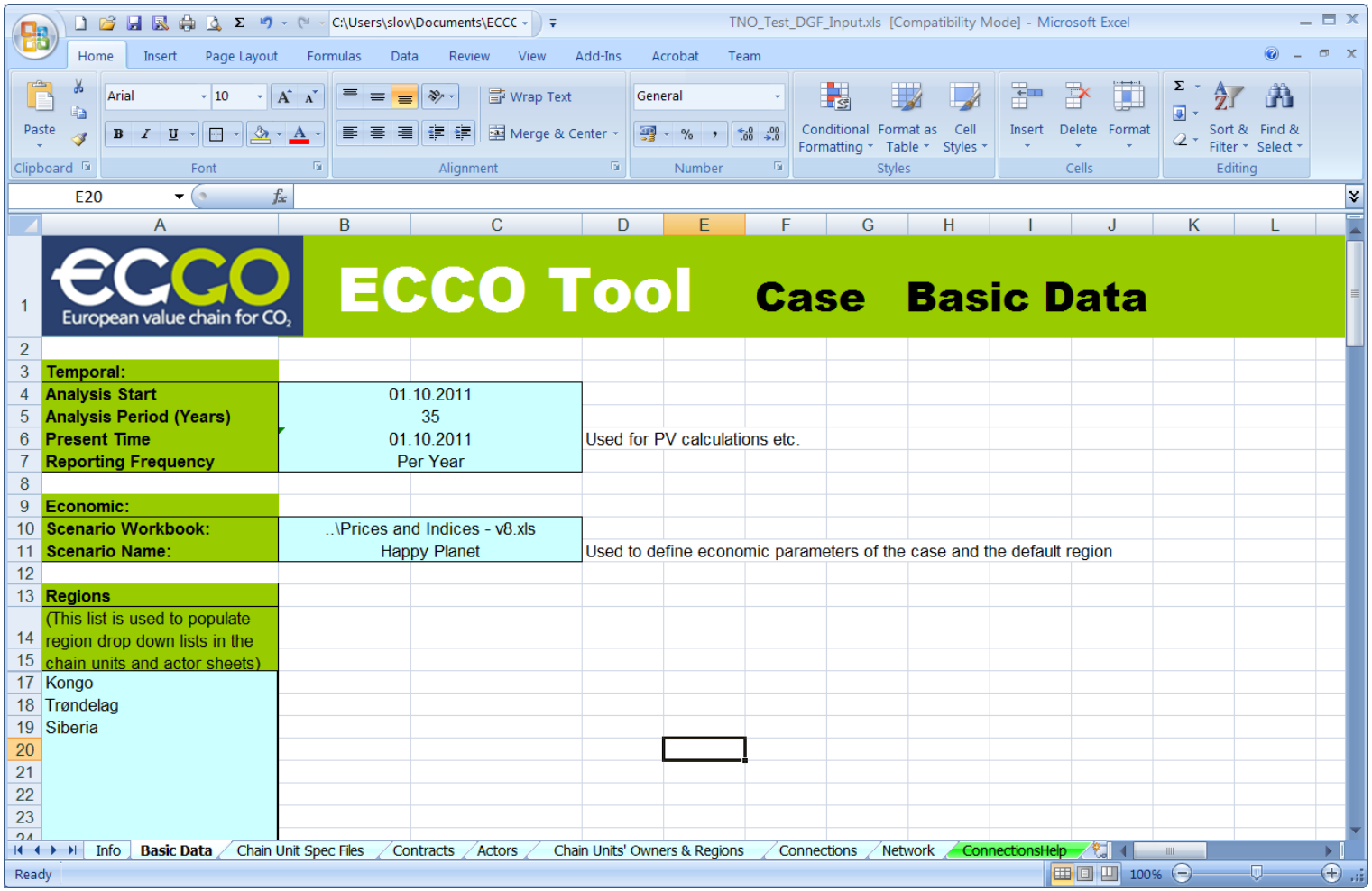
SEVENTH FRAMEWORK PROGRAMME

Case Workbook



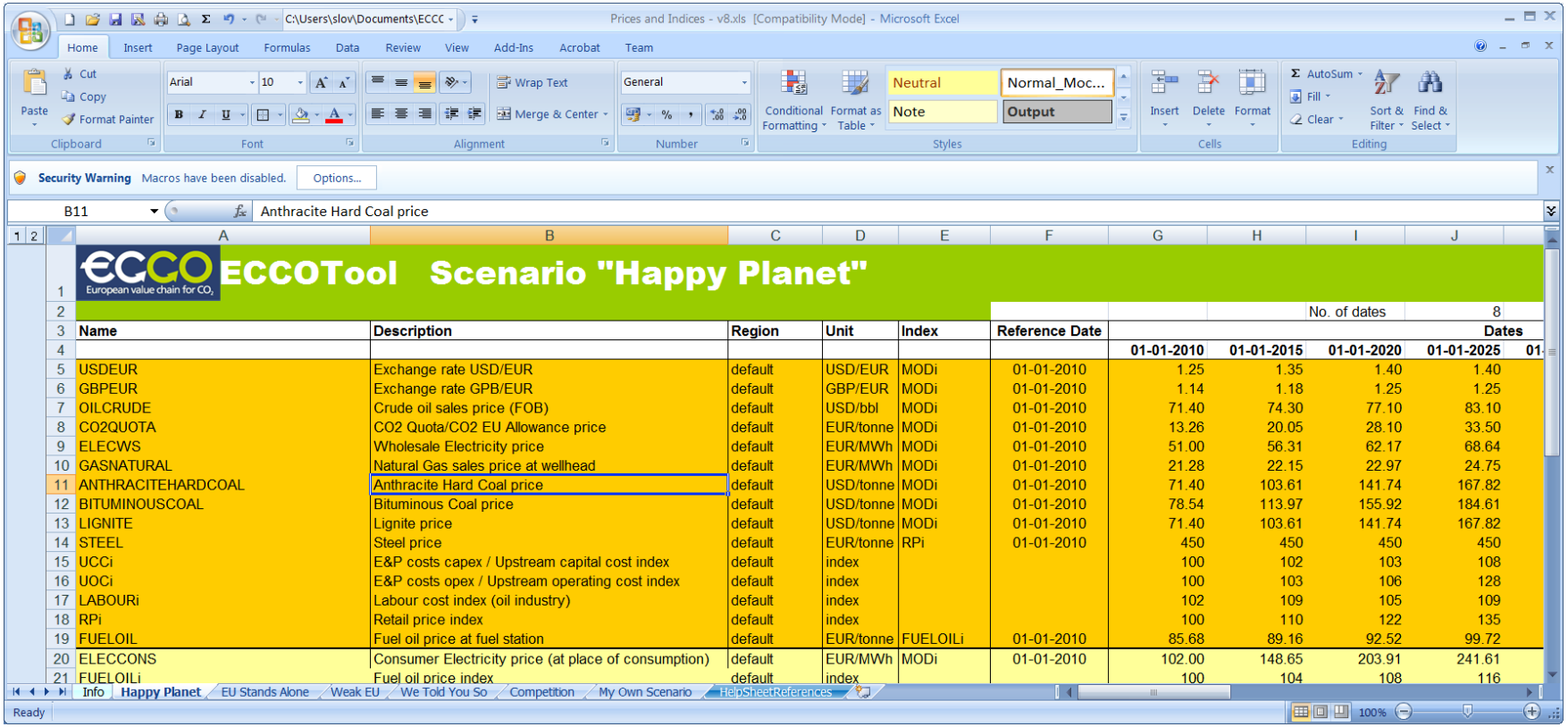
ECCO Tool Case Basic Data

Temporal:			
Analysis Start	01.10.2011		
Analysis Period (Years)	35		
Present Time	01.10.2011	Used for PV calculations etc.	
Reporting Frequency	Per Year		
Economic:			
Scenario Workbook:	..\Prices and Indices - v8.xls		
Scenario Name:	Happy Planet	Used to define economic parameters of the case and the default region	
Regions			
(This list is used to populate region drop down lists in the chain units and actor sheets)			
Kongo			
Trøndelag			
Siberia			

Case Workbook Specifications

- Basic Data:
  - Temporal data, e.g. analysis period
  - Reference to macro-economic data (work book)
- Reference to chain unit workbooks
- Reference to contract workbooks
- Define actors
  - Tax Parameters
  - Discount Rates
- Define network and connections

Prices and Indices Workbook



ECCOTool Scenario "Happy Planet"

	Name	Description	Region	Unit	Index	Reference Date	01-01-2010	01-01-2015	01-01-2020	01-01-2025
							No. of dates			8
							Dates			
5	USDEUR	Exchange rate USD/EUR	default	USD/EUR	MODi	01-01-2010	1.25	1.35	1.40	1.40
6	GBPEUR	Exchange rate GPB/EUR	default	GBP/EUR	MODi	01-01-2010	1.14	1.18	1.25	1.25
7	OILCRUDE	Crude oil sales price (FOB)	default	USD/bbl	MODi	01-01-2010	71.40	74.30	77.10	83.10
8	CO2QUOTA	CO2 Quota/CO2 EU Allowance price	default	EUR/tonne	MODi	01-01-2010	13.26	20.05	28.10	33.50
9	ELECWS	Wholesale Electricity price	default	EUR/MWh	MODi	01-01-2010	51.00	56.31	62.17	68.64
10	GASNATURAL	Natural Gas sales price at wellhead	default	EUR/MWh	MODi	01-01-2010	21.28	22.15	22.97	24.75
11	ANTHRACITEHARDCOAL	Anthracite Hard Coal price	default	USD/tonne	MODi	01-01-2010	71.40	103.61	141.74	167.82
12	BITUMINOUSCOAL	Bituminous Coal price	default	USD/tonne	MODi	01-01-2010	78.54	113.97	155.92	184.61
13	LIGNITE	Lignite price	default	USD/tonne	MODi	01-01-2010	71.40	103.61	141.74	167.82
14	STEEL	Steel price	default	EUR/tonne	RPi	01-01-2010	450	450	450	450
15	UCCi	E&P costs capex / Upstream capital cost index	default	index			100	102	103	108
16	UOCi	E&P costs opex / Upstream operating cost index	default	index			100	103	106	128
17	LABOURi	Labour cost index (oil industry)	default	index			102	109	105	109
18	RPi	Retail price index	default	index			100	110	122	135
19	FUELOIL	Fuel oil price at fuel station	default	EUR/tonne	FUELOILi	01-01-2010	85.68	89.16	92.52	99.72
20	ELECCONS	Consumer Electricity price (at place of consumption)	default	EUR/MWh	MODi	01-01-2010	102.00	148.65	203.91	241.61
21	FUELOILi	Fuel oil price index	default	index			100	104	108	116

- Defines all prices and indices necessary to calculate KPIs of Chain Units
- ECCO Scenarios Implemented
- Region / User Customable

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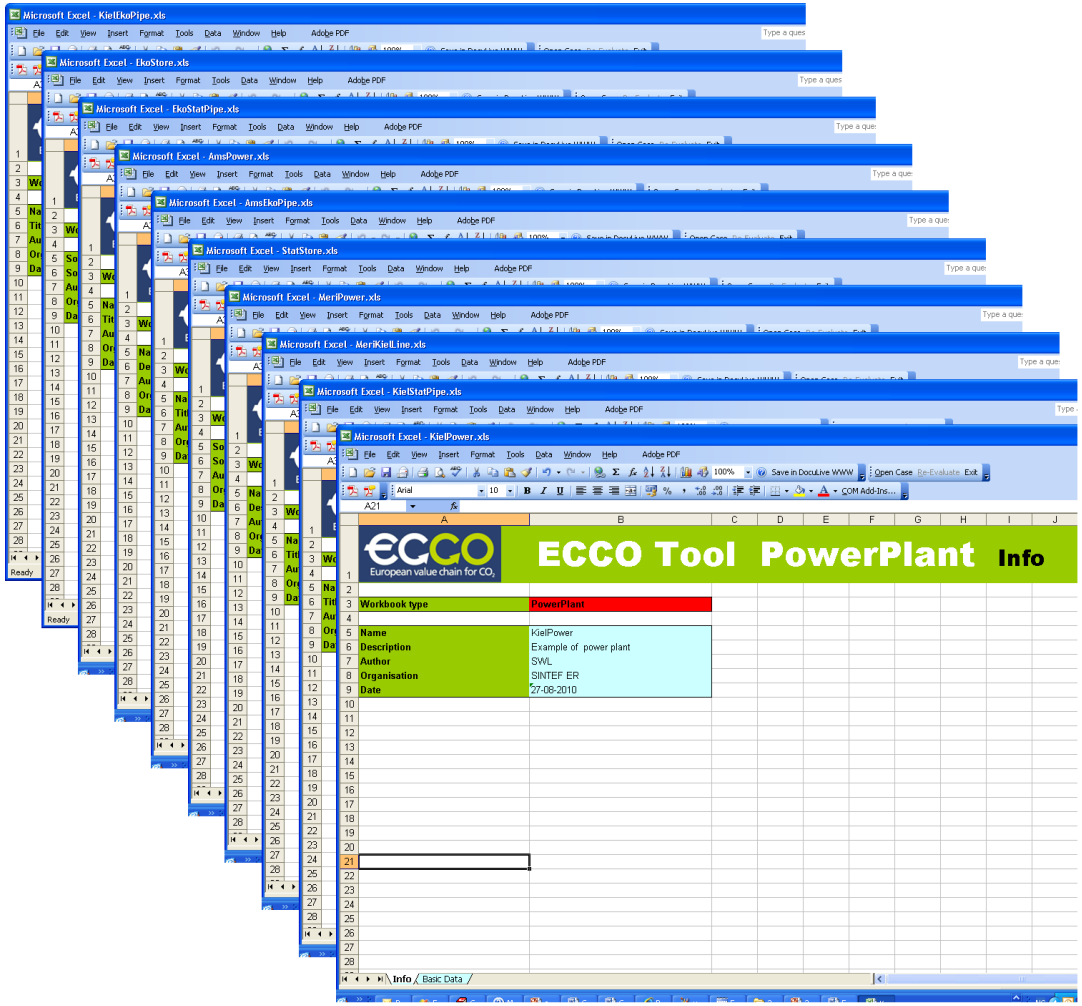
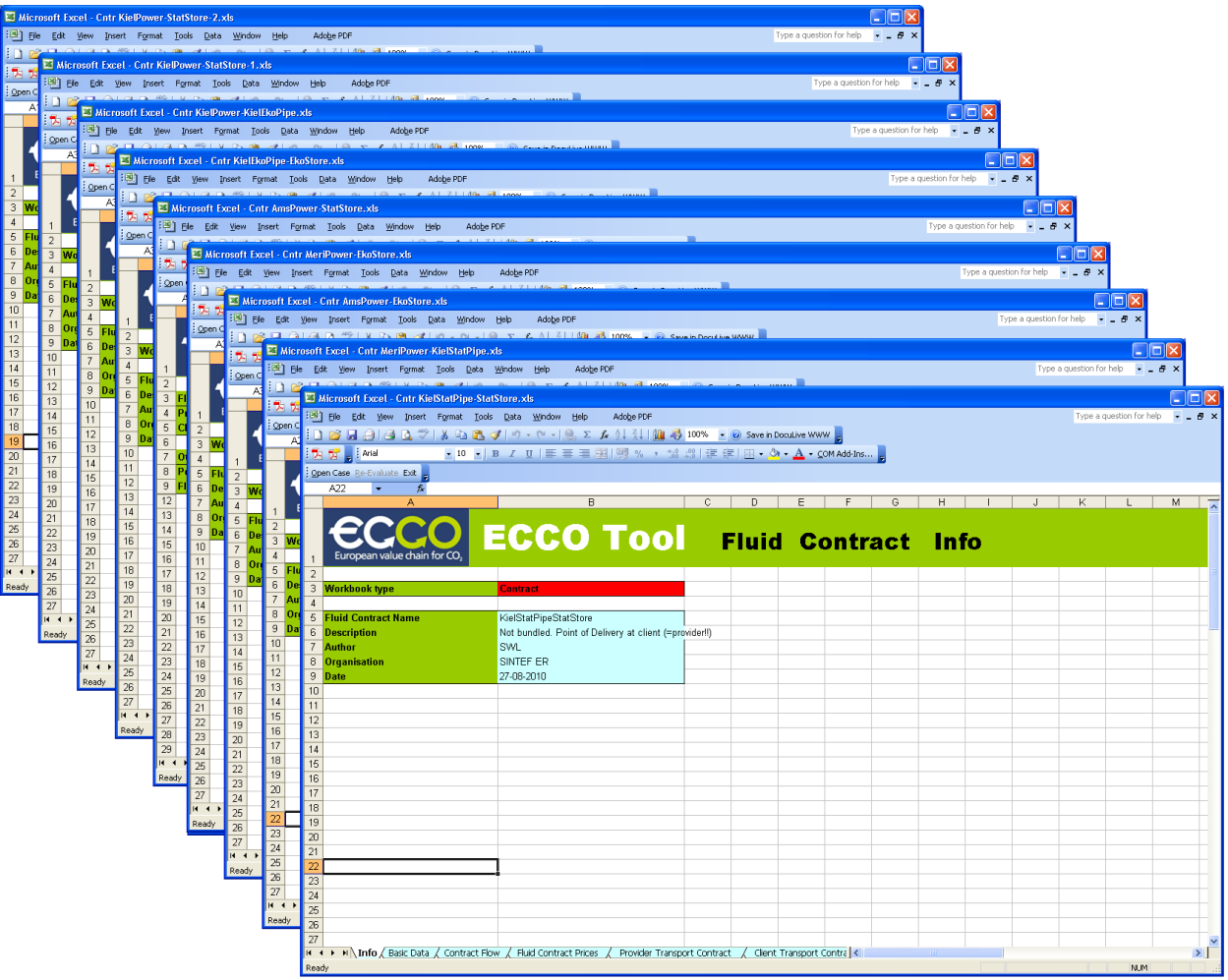
Chain Unit Workbooks



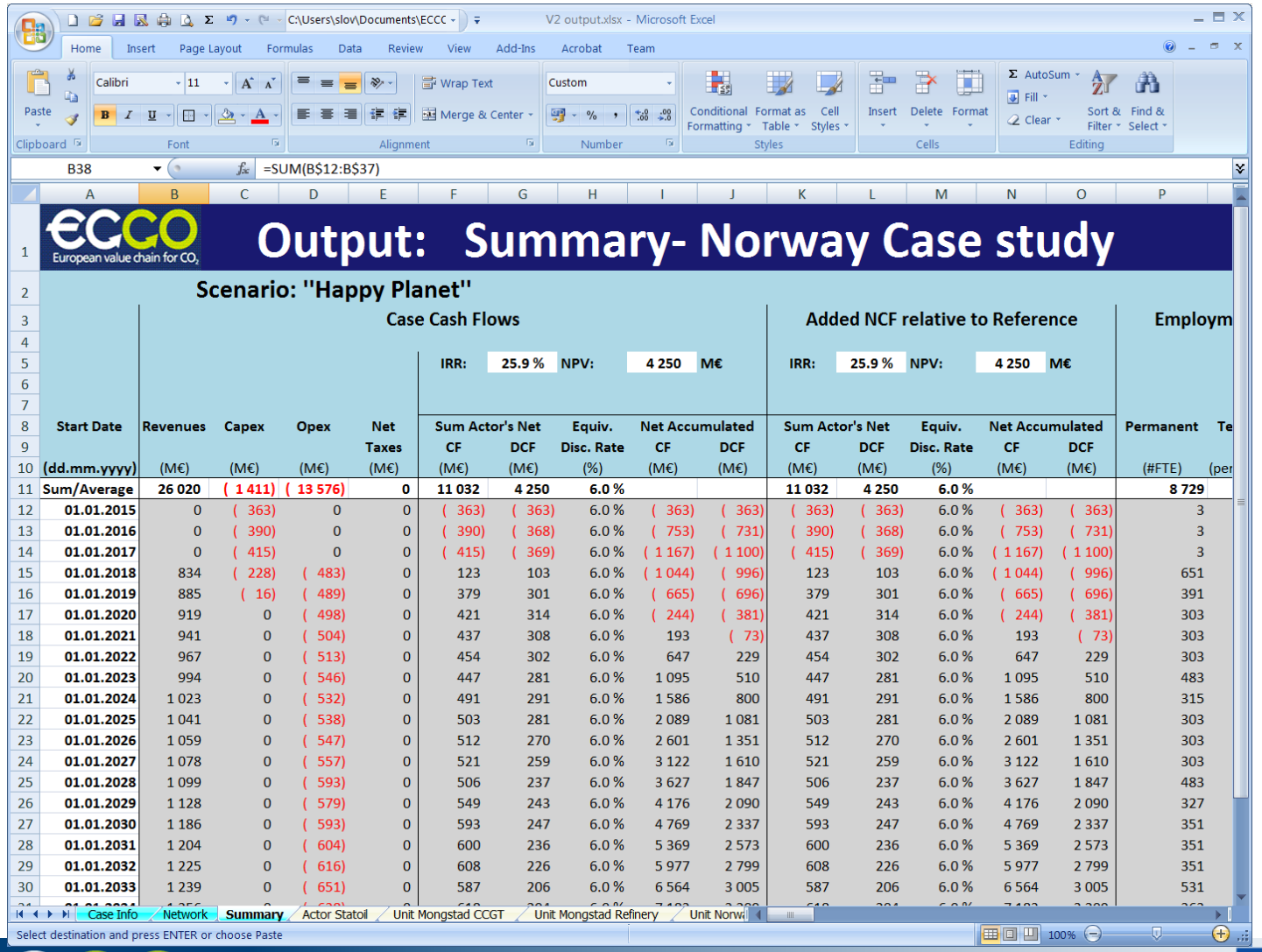
- One for each chain unit required
- Workbook specific to type

Contract Workbooks



- Define all payments and flows between chain units
- One workbook per source / recipient pair
- Includes transport specification

Output Workbook



ECCO European value chain for CO_2

Output: Summary- Norway Case study

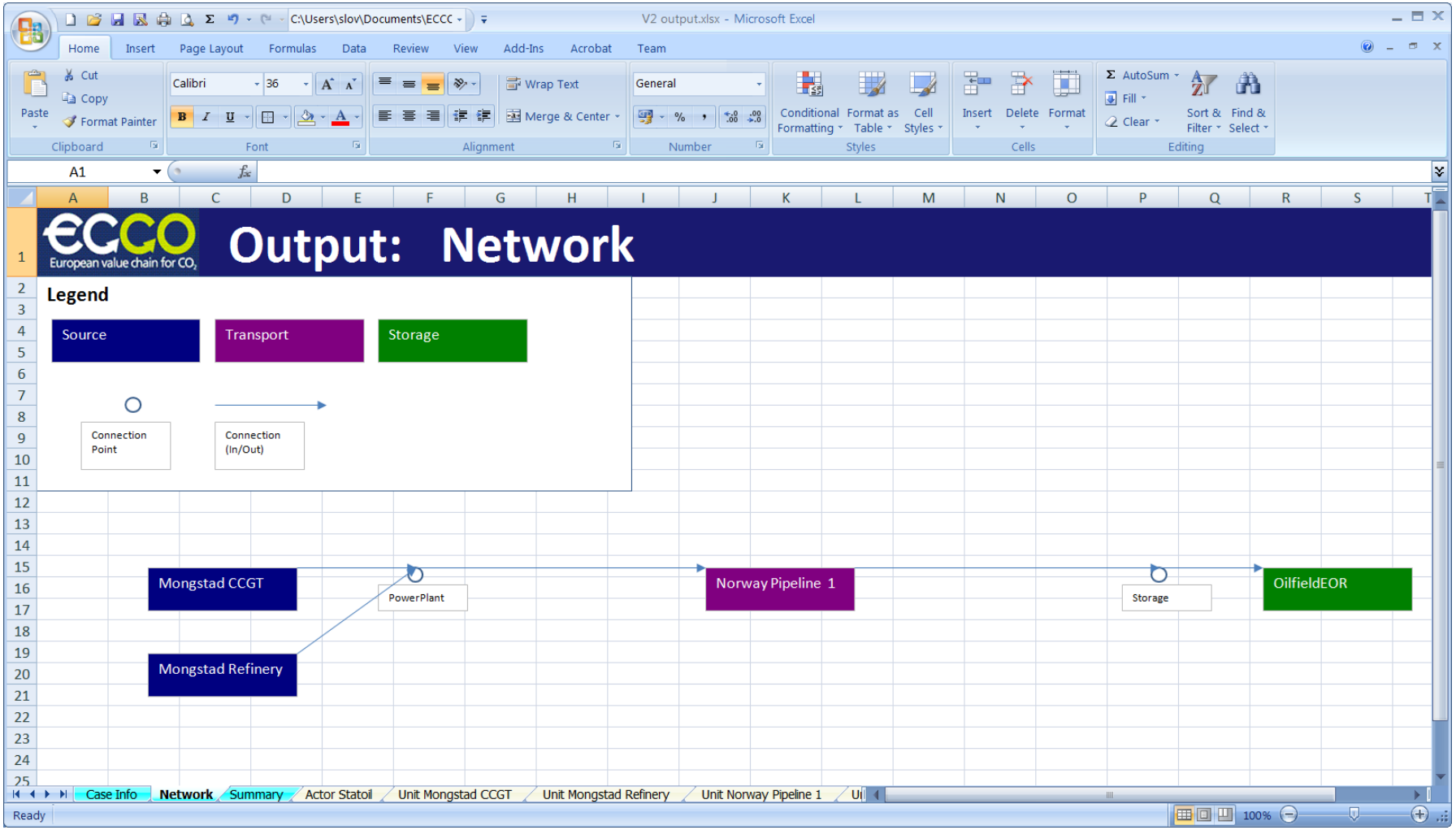
Scenario: "Happy Planet"

	Case Cash Flows									Added NCF relative to Reference					Employm	
					IRR: 25.9 %		NPV: 4 250		M€	IRR: 25.9 %		NPV: 4 250		M€		
Start Date	Revenues	Capex	Opex	Net Taxes	Sum Actor's Net CF	Sum Actor's Net DCF	Equiv. Disc. Rate	Net Accumulated CF	Net Accumulated DCF	Sum Actor's Net CF	Sum Actor's Net DCF	Equiv. Disc. Rate	Net Accumulated CF	Net Accumulated DCF	Permanent	Te
(dd.mm.yyyy)	(M€)	(M€)	(M€)	(M€)	(M€)	(M€)	(%)	(M€)	(M€)	(M€)	(M€)	(%)	(M€)	(M€)	(#FTE)	(per
Sum/Average	26 020	(1 411)	(13 576)	0	11 032	4 250	6.0 %			11 032	4 250	6.0 %			8 729	
01.01.2015	0	(363)	0	0	(363)	(363)	6.0 %	(363)	(363)	(363)	(363)	6.0 %	(363)	(363)	3	
01.01.2016	0	(390)	0	0	(390)	(368)	6.0 %	(753)	(731)	(390)	(368)	6.0 %	(753)	(731)	3	
01.01.2017	0	(415)	0	0	(415)	(369)	6.0 %	(1 167)	(1 100)	(415)	(369)	6.0 %	(1 167)	(1 100)	3	
01.01.2018	834	(228)	(483)	0	123	103	6.0 %	(1 044)	(996)	123	103	6.0 %	(1 044)	(996)	651	
01.01.2019	885	(16)	(489)	0	379	301	6.0 %	(665)	(696)	379	301	6.0 %	(665)	(696)	391	
01.01.2020	919	0	(498)	0	421	314	6.0 %	(244)	(381)	421	314	6.0 %	(244)	(381)	303	
01.01.2021	941	0	(504)	0	437	308	6.0 %	193	(73)	437	308	6.0 %	193	(73)	303	
01.01.2022	967	0	(513)	0	454	302	6.0 %	647	229	454	302	6.0 %	647	229	303	
01.01.2023	994	0	(546)	0	447	281	6.0 %	1 095	510	447	281	6.0 %	1 095	510	483	
01.01.2024	1 023	0	(532)	0	491	291	6.0 %	1 586	800	491	291	6.0 %	1 586	800	315	
01.01.2025	1 041	0	(538)	0	503	281	6.0 %	2 089	1 081	503	281	6.0 %	2 089	1 081	303	
01.01.2026	1 059	0	(547)	0	512	270	6.0 %	2 601	1 351	512	270	6.0 %	2 601	1 351	303	
01.01.2027	1 078	0	(557)	0	521	259	6.0 %	3 122	1 610	521	259	6.0 %	3 122	1 610	303	
01.01.2028	1 099	0	(593)	0	506	237	6.0 %	3 627	1 847	506	237	6.0 %	3 627	1 847	483	
01.01.2029	1 128	0	(579)	0	549	243	6.0 %	4 176	2 090	549	243	6.0 %	4 176	2 090	327	
01.01.2030	1 186	0	(593)	0	593	247	6.0 %	4 769	2 337	593	247	6.0 %	4 769	2 337	351	
01.01.2031	1 204	0	(604)	0	600	236	6.0 %	5 369	2 573	600	236	6.0 %	5 369	2 573	351	
01.01.2032	1 225	0	(616)	0	608	226	6.0 %	5 977	2 799	608	226	6.0 %	5 977	2 799	351	
01.01.2033	1 239	0	(651)	0	587	206	6.0 %	6 564	3 005	587	206	6.0 %	6 564	3 005	531	

Output

- KPIs for:
  - Case
  - Actors
  - Chain Units
- Inconsistency Warnings
- Network (Excel 2007 version)

Output Workbook: Network Sheet



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KPI Examples

- Cashflows
  - Discounted and undiscounted
  - Revenues / Opex / Capex / Net Tax /
  - Costs of: Quotas / Capture / Storage / Avoided CO_2
  - NPV /IRR
- Employment
- CO_2 Captured / Transported / Stored / Avoided
- Electricity and Oil Produced
- Energy Consumption

Summary

- ECCO Tool: Calculation of key performance indicators of CCS value chains
- Output on case, actor and chain unit level
- Macro-Economics
- Simple chains -> Networks
- Modularized design