SOCECO2 Final Workshop

CCS vs Renewables: Macroeconomic Comparisons

The effects on employment of CO_2 capture and storage development in France, a macroeconomic and comparative study with regard to renewable energies.

Rémy TELLO, Frédéric GHERSI , Minh HA-DUONG
CIRED (International Research Center on Environment & Development)

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Key results

- CCS creates ≈ 200 jobs / $MtCO_2$
- Wind requires more jobs and capital
- CCS: Lower macroeconomic impacts of climate policy

Outline

1. Input-output analysis
2. Top-down scenario simulation

DATA SOURCES

- INSEE (Institut National de Statistiques et Etudes Economiques)
- ADEME (Agence de l'environnment et de la maîtrise de l'énergie)

Part I - Input-Output Analysis

Characterizing the cost structure of each activity considered to estimate the **number of jobs** (expressed in full-time equivalents) **per euro of final demand**.

Sample of France's National accounts

Year 2004

BRANCHES		GA01	GA02
PRODUCTS			
AGRICULTURE HUNTING ANCILLARY SERVICES	GA01	12 128	103
SILVICULTURAL PRODUCTS	GA02	0	1 346
FISHING AND AQUACULTURE PRODUCTS	GA03	0	0

Source: Insee, national accounts, base 2000
Units: million euros

Employment data in national accounts

	A	B	C	Intermediate Consumption	Final Demand	Production
A	20	30	50	100	100	200
B	50	30	20	100	200	300
C	40	20	40	100	300	400
Direct Jobs	40	20	30			

Matrix calculation method of Michel Husson (1994) applied to the 118-sector table of intermediate inputs (INSEE 2004)

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PRO	200	300	400			

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DIRECT JOB CONTENTS & TECHNICAL COEFFICIENTS
DIVIDE INPUTS BY TOTAL PRODUCTION

	A	B	C	Intermediate Consumption	Final Demand	Production
A	20	30	50	100	100	200
B	50	30	20	100	200	300
C	40	20	40	100	300	400
Direct Jobs	40	20	30			
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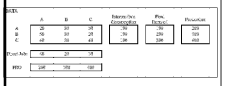
TOTAL JOB CONTENTS CALCULATION



Technical coefficients (alpha)

0,100	0,100	0,125
0,250	0,100	0,050
0,200	0,067	0,100

Inverse Matrix

1,190	0,145	0,173
0,347	1,158	0,112
0,290	0,118	1,158

Unitary contents in direct employment (n)

0,200	0,067	0,075

Unitary contents in total employment (w)

0,283	0,115	0,129

	ACTIVITY BRANCHES (Insee)		EMPLOYMENT CONTENTS TOTAL	EMPLOYMENT CONTENTS DIRECT
34	TRANSPORT ROUTIER (OU PAR CONDUITES) DE	GK03	14,95	9,45
35	FONDERIE	GF53	14,80	8,33
37	FABRICATION D ELEMENTS EN METAL POUR LA	GE21	14,16	7,40
44	FABRICATION DE MOTEURS GENERATRICES ET	GE32	13,27	7,22
48	TRAVAUX PUBLICS	GH02	12,96	6,04
54	FABRICATION DE CYCLES MOTOCYCLES MATER	GE14	12,56	5,83
56	COMMERCE DE GROS INTERMEDIAIRES	GJ20	12,39	6,56
67	FABRICATION D EQUIPEMENTS MECANIQUES	GE23	11,71	5,39
72	TRANSFORMATION DES MATIERES PLASTIQUES	GF46	11,41	6,53
86	INTERMEDIATION FINANCIERE	GL01	10,35	5,10
94	EXTRACTION D HYDROCARBURES SERVICES ANN	GG12	9,28	4,60
106	PRODUCTION DE METAUX NON FERREUX	GF52	7,87	1,86
107	PRODUCTION ET DISTRIBUTION D ELECTRICITE	GG2A	7,19	2,81
111	PRODUCTION ET DISTRIBUTION DE COMBUSTIBL	GG2B	4,34	1,39
114	LOCATION IMMOBILIERE	GM02	2,33	0,33

Units: full-time equivalents per million euro of final demand.

RESULTS 1A

Cost structure assumptions

CCS: 65% capture + 15% transport + 20% storage

Wind Power: based on German study of Lehr et al. (2007)

	CCS				Wind
	Capture	Transport	Storage	Aggregated	
Total unitary employment content	9,28	14,95	4,34	**9,14**	**12,43**

Units: full-time equivalents per million euro of final demand.

1. CCS: Missing analogues for transport and storage activities in the 118 INSEE sectors.
2. Wind power development is really two activities
   - Windmills (production and installation of wind electric energy systems)
   - Wind energy (production of electricity)

RESULTS 1B: BUILDING SYNTHETIC SECTORS

➢ Employment contents in the CCS and Wind sectors

	Windmills	Windmill electricity	Wind (aggregated)	CCS
Direct unitary employment content	9,55	1,67	**6,99**	**4,60**
Total unitary employment content	15,76	3,75	**11,87**	**9,28**
Proportion of indirect employment	39 %	56 %	41 %	50 %

Units: full-time equivalents per million euro of final demand.

➢ Further analysis : Employment contents of the economy, aggregated in two synthetic sectors

	Agriculture & industry	Services
Direct unitary employment content	5,79	9,76
Total unitary employment content	12,52	14,59

Units: full-time equivalents per million euro of final demand.

Conclusion of Part 1

Jobs per M€ of final demand

	direct	total
CCS	4.5	9
Wind	7	12

Assuming 50 € / tCO_2
this is 225 direct and 450 total jobs per $MtCO_2$

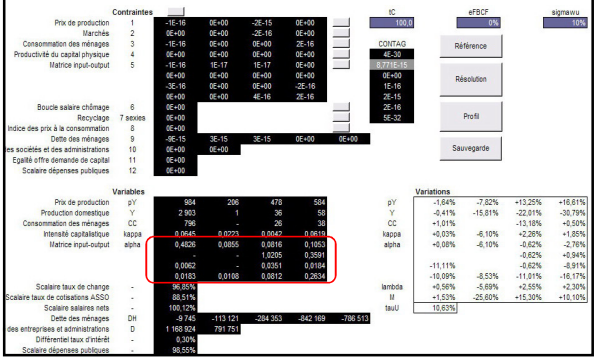
Part II: Top-Down Modeling

Effects of CCS (un)availability in a CO_2 constrained economy

- Direct job creation in the sector
- Price effect on the economy
- Δ Carbon tax income for the state

IMACLIM-S

A top-down, static GE model



Two Model Variants

CCS model	Wind model
Agriculture & Industry	
Services	
Raw hydrocarbon	
Fuel	
Other energies	
CCS	Wind energy
Steel industry	Windmills

Scenarios for the CCS model

Key parameters	*Values considered*
CCS cost	Fixed at 48 € / tCO_2 stored in all scenarios
Level of CCS deployment	None, medium, large
Carbon tax	Null / equal to / higher than CCS cost

		Carbon Tax (CT)		
		0	48	100
CCS incidence on national emissions	0%	A	C	E
	4%		G	
	7%	B	D	F

RESULTS OF CCS SCENARIOS

- Direct job creation in CCS activity is independent from the level of carbon tax (CT).
- The price effect penalizes the economy when there is no CT; is quasi-neutral when CT = CCS cost; is beneficial when CT > CCS cost.
- The higher CT is, the more CCS reduces tax incomes for the state.

⇨ Impact on net employment is negative when CT is null ; positive when CT ≥ CCS cost

SCENARIOS FOR THE WIND MODEL

Key parameters	*Values considered*
Carbon tax	Fixed at 48 € / tCO_2 emitted in all scenarios
Level of wind deployment	49 ktoe / 5 000 ktoe / 10 250 ktoe
Investments in windmills	120 M€ / 7 081 M€ / 7 311 M€

RESULTS

- A raise in energy prices would penalize the whole economy
- On the other side, wind activity would lead to investments & employment

PART 2: CONCLUSION, CCS VS WIND

- Higher employment and investments in the wind scenarios
- CCS: Lower macroeconomic impact

  => Less socio-economic difficulties?
- Long term potential market position of a French CCS industry

CONCLUSION

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- CCS : Lower macroeconomic impacts of climate policy