Wir schaffen Wissen – heute für morgen

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Climate Change Scenarios and Technology Transfer Protocols

PSI, 6. Februar 2010

Outline

- Goal/Motivation
- Key questions
- Model formulation and key data
- Emission profiles of the 550/450ppmeq cases
- The corresponding Cap & Trade cases
- The Global Tax cases and variants of TTPs
- Technologies, Emissions and Economic benefits
- Conclusions

Goal of the study on TTPs

The key idea behind TTPs is to have the North financing carbon-free technology transfer to the Southbased on their carbon-tax revenues.

The study should define benefits and check if TTPs could serve as a new approach in the Climate Change negotiations

Overarching questions:

- Are TTPs more convincing than Cap & Trade policies?
- Give a practical example of how TTP could work and evaluate benefits
- Which technologies need support to facilitate technology diffusion?

A modified MERGE model is applied to study TTPs and evaluate the benefits for all world regions.

Model changes

Two types of new model variables are introduced:

TTR_R1(R2,t): Payments from a donor R1 region to receiving R2 regions in period t

SACT(R2,k,t): Subsidized Activities (i.e., energy flows) for technology k, period t, in R2

And two new model equations:

1) Technology-transfer payments bound for R1 countries for each period:

Technology Transfer payment TTR_R1 from an R1 country to all R2 countries should be less than equal to the total tax revenue of region R1 in a given period.

2) Tax-Subsidy per R2 country should allow for banking:

The discounted sum of capital transfers of all donor regions to an R2 region is equal to the discounted subsidies for learning activities (SACT) in favor of carbon-free technologies in that region.

Other Model Changes

SACT-variables appear also in

- all energy balances
- In demand equations,
- the definition of cumulative activities and in
- the objective function.

To avoid demand rebounds in recipient regions prices remain unchanged but subsidies are accounted for as a lump-sum and are substracted from the energy cost of the recipient countries.

While the tax-revenues are not substracted from the energy cost of donor countries as revenues support technology transfer to recipient regions they are substracted from the cost of the recipient countries.

Also GDP definition and the Negishi weights in the donor and recipient regions differ.

Scenarios Analyzed

The Baseline that follows present trends and regulations

Some CBA cases with optimal evaluation (first best) of emission paths for a given discount rate, Climate Sensitivity and WTP for comparison with TTPs

Stabilize Carbon Concentrations (SCC) to 550 ppme or 450 ppme (2° C) cases, e.g., second best optimal evaluation of emissions levels over time and of the global marginal costs.

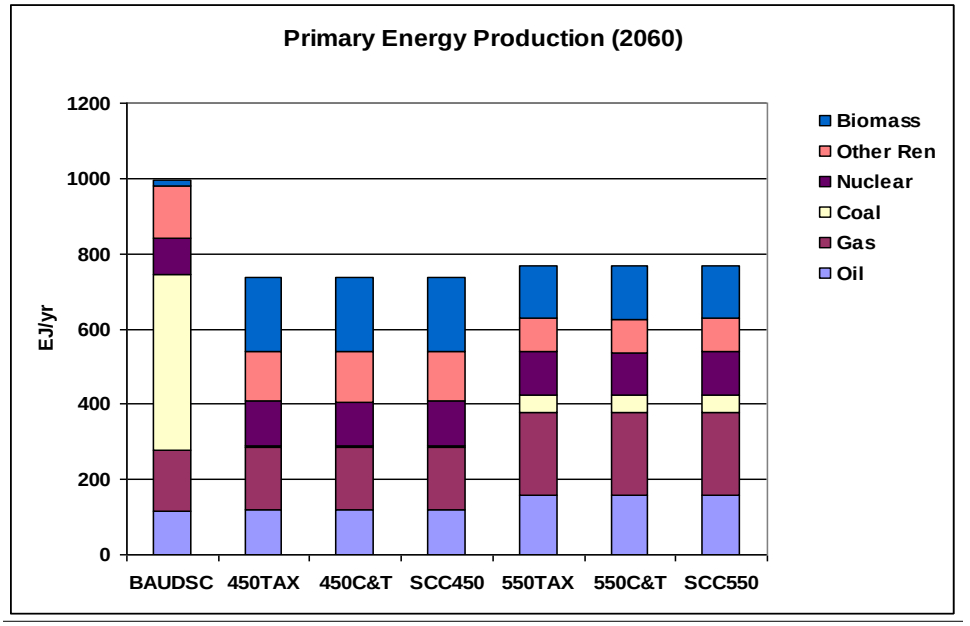
Cap & Trade policies that correspond to the SCC global emission levels but introduce initial endowments of carbon rights in favor of LDCs

Global TAX cases for the tax levels of the SCC cases

Finally, we specify and evaluate different TTPs scenarios where the tax revenue of industrialized countries is used to finance the transfer of carbon free technologies to LDCs and support learning investments.

We claim that although SCC or C&T or GTAX cases are all second best and equivalent optimal solutions the TTPs are even better.

Stabilize CC Versus Cap &Trade (C&T) cases



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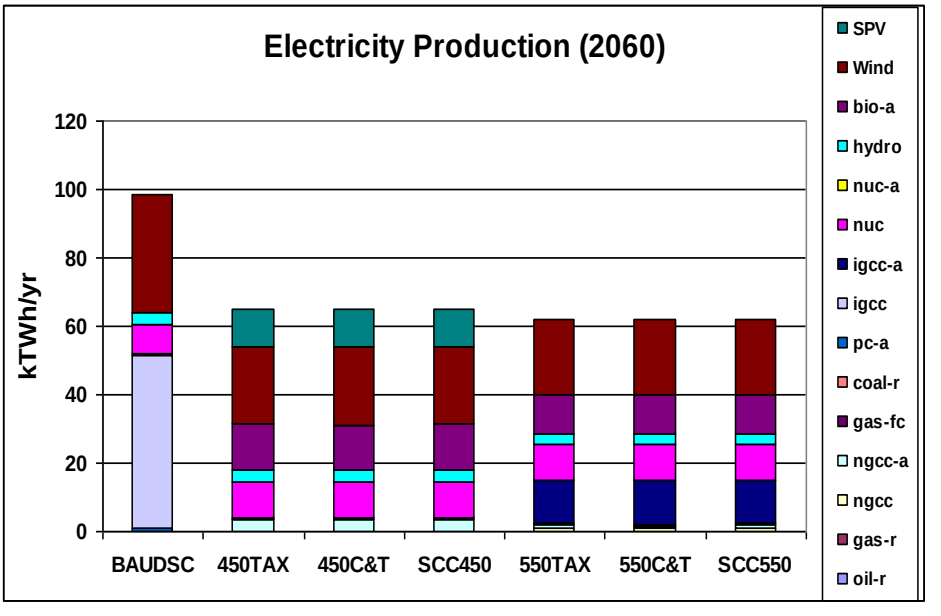

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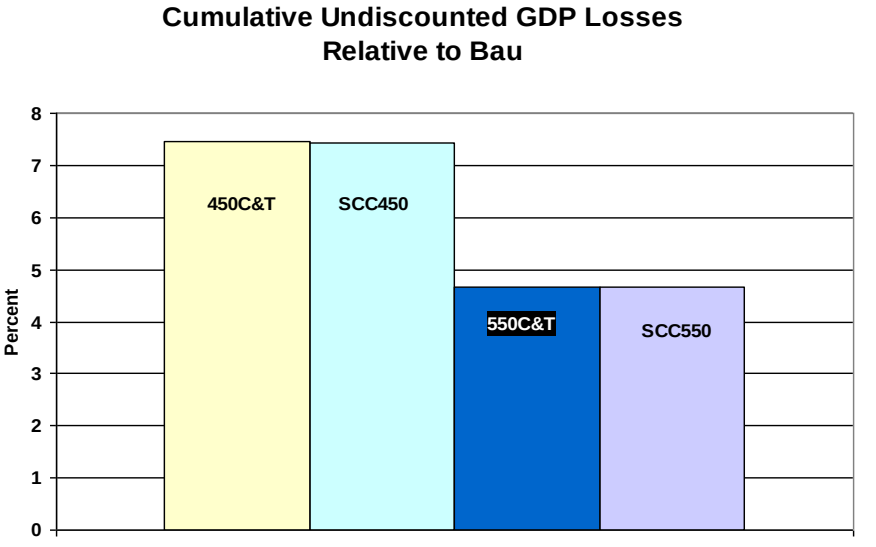


Scenarios and Rules for the TTPs cases:

Rules of the game for a win-win strategy: Donor countries transfer always their tax-revenue to support non-Annex B regions but via exports in favor of their own industry.

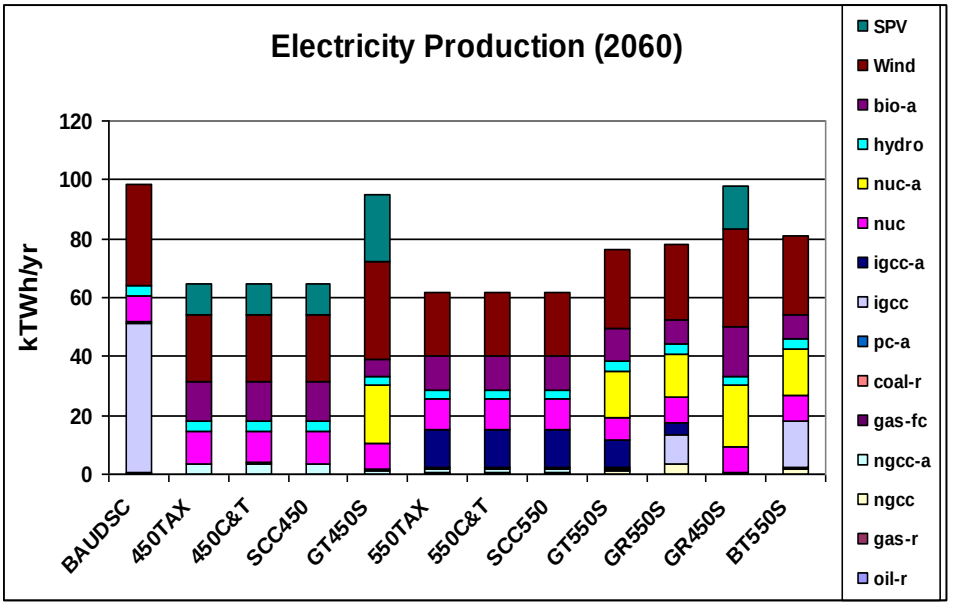
TTPs Scenarios analyzed:

GTS: Global taxes as in SCC and tax-transfers to LDCs via TPPs

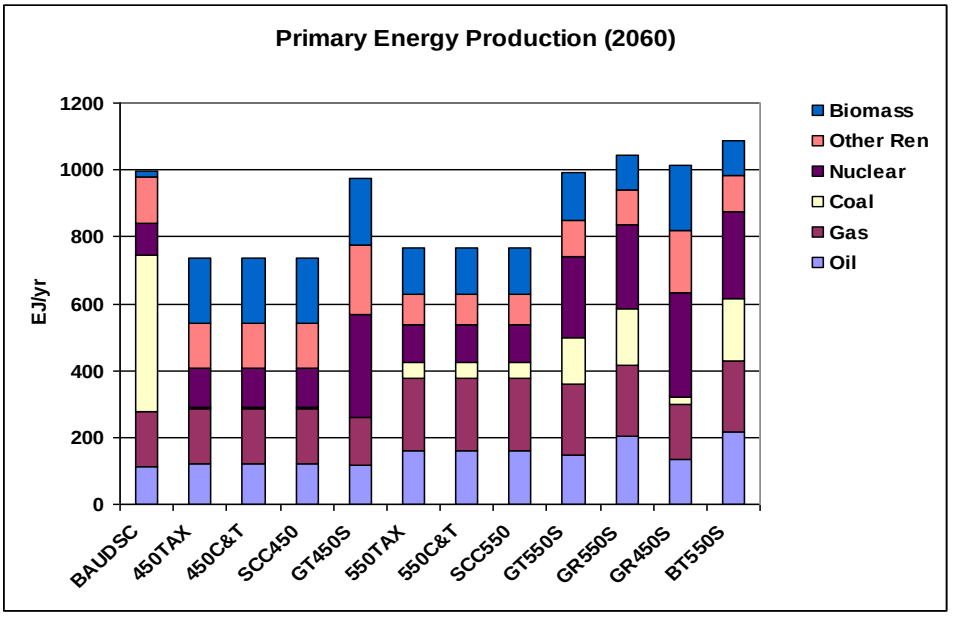
BTS: Taxes as in SCC but for Annex B only and tax-transfers to LDCs

RTS: Taxes as in SCC for Annex B and with 30 year delay in LDCs;

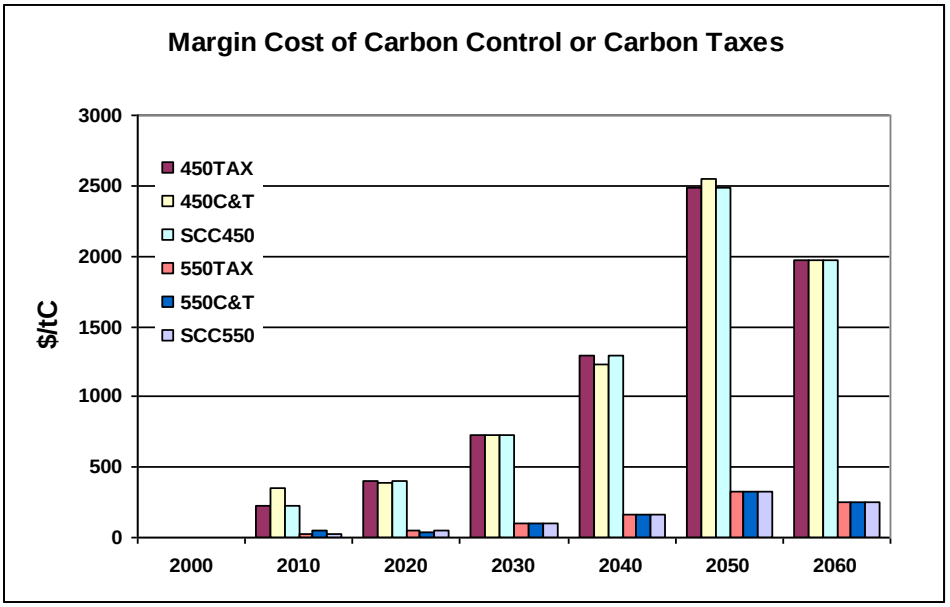
Scenario Comparison



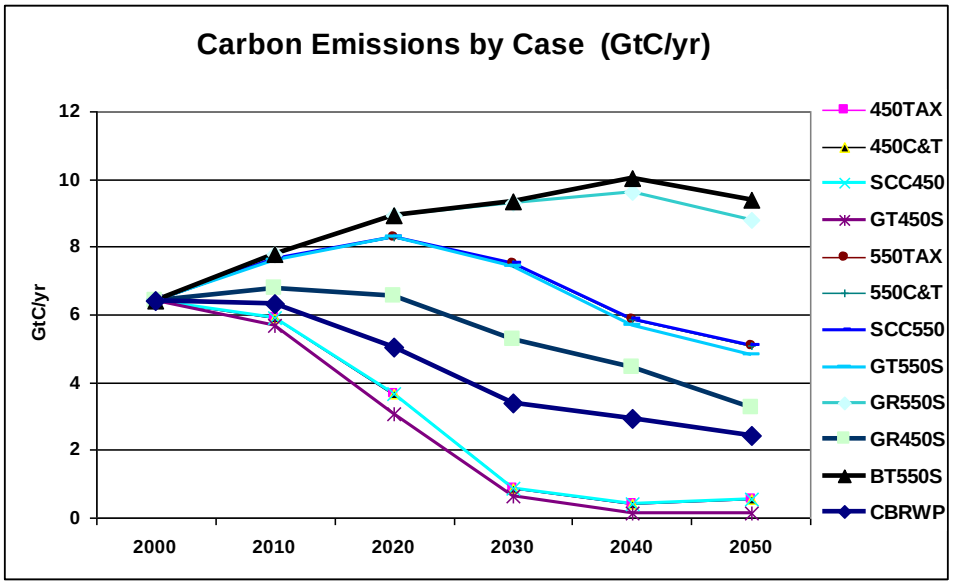
Scenario Comparison



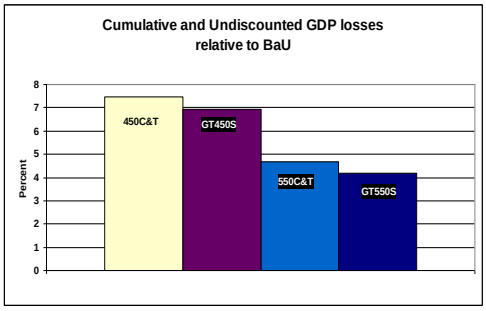
Stabilize Carbon Concentrations (SCC) Versus Cap &Trade (C&T)

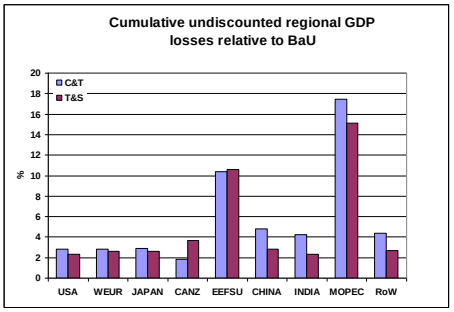


Emission Pathways for the CCS and C&T cases

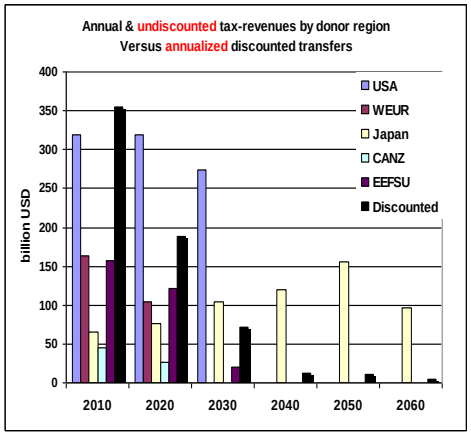


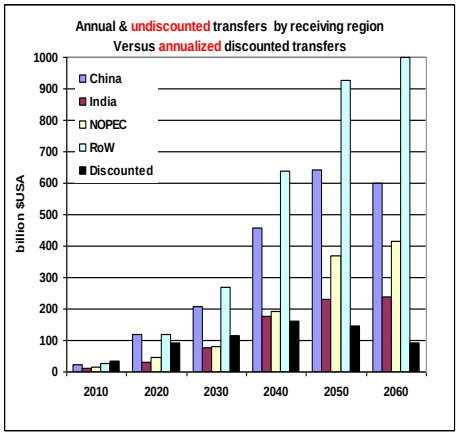
Economic Impact of TTPs: GDP losses and Cumulative Undiscounted GDP relative to BaU by region





Annualized Regional Ctax-Revenue and TTPs transfers (450 T&S)

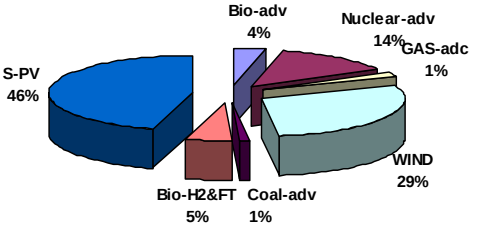




MERGE-TTP is a new approach specifying technologies and regions to be supported, and the source, destination and amount of payments.

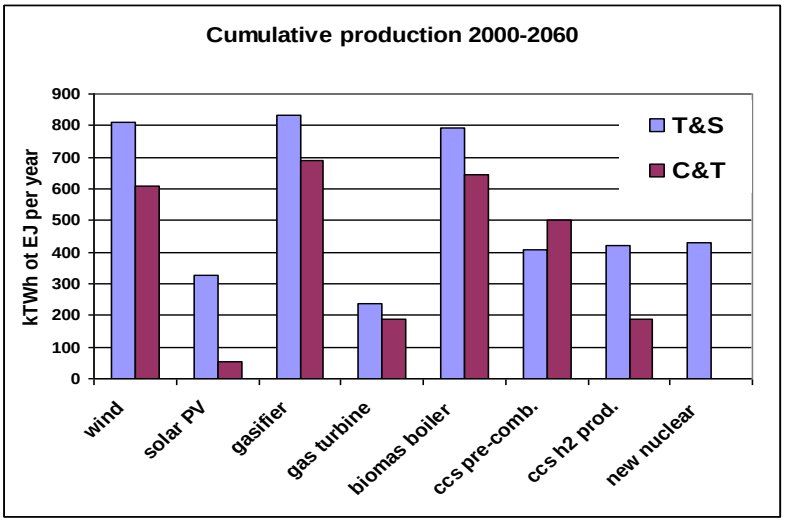
Scenario Comparison: Technology support

Distribution of subsidies by Technology (450T&S)

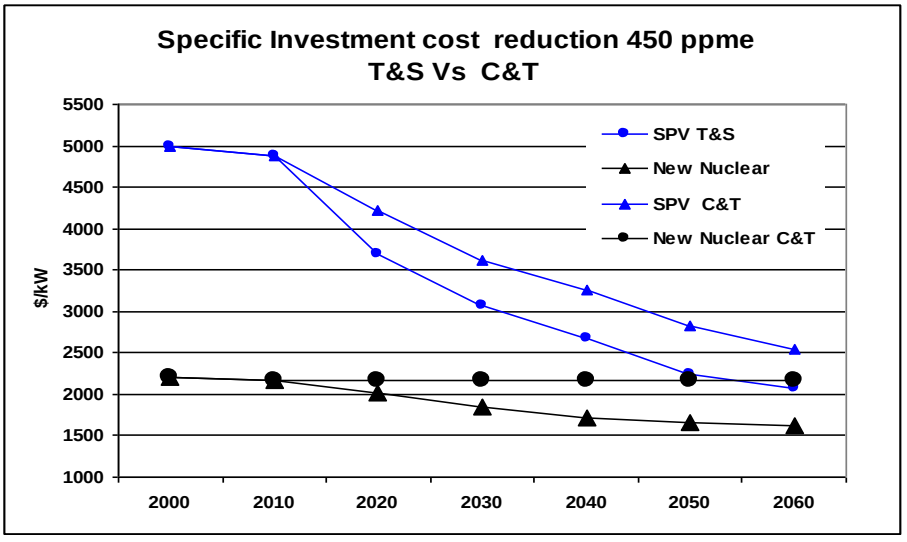


S-PV, Wind, Advanced Nuclear are the main winners

Cumulative production with and w/o Subsidy



Specific Investment cost reduction with accelarated LBD due to subsidies



Conclusions

TTPs is a win-win strategy defining what is to be supported by whom and where technology is to be transferred to reach a common goal based on efficiency.

The TTPs have positive outcomes and could serve as guidence to reach a compromise in the negociations; as e.g., in the case where taxes are shifted 30 years later for LDCs we get emissions profiles similar to a CBA case with Stern discount rates.

Some technologies like SPV, Gen-IV nuclear and Wind profit the most.

Northen countries have good chance to booster exports of carbon-free technology while LDCs have direct benefits reducing their economic losses if participating to TTPs.

Carbon emissions are reduced but not much as the low energy cost of subsidized systems increase economic output and emissions (rebound effect).

The method could be extended to all end-use sectors and other modes of subsidies

EXTRA slides

Electric

		Lifetime	Eff	Load	Inv. Cost	O&M	Var O&M	Feedstck	Inv. Cost	O&M	Gen-Cost
		years		factor	$/kW	$/kW/y	U$/GJ	$/GJ	$/kW	$/MWh	mills/kWh
oil-r	Exist.	20	0.303	0.65	991	63.6	0.57	3	0		62.83
gas-r	Exist.	20	0.333	0.65	987.7	50.6	0.56	2	200		49.26
ngcc	NGCC	20	0.51	0.65	360	36.6	0.63	2	200		30.7
ngcc-a	" & CCS	20	0.459	0.65	360	60	0.88	2	742	86.4	45.91
gas-fc	Gas FCell	20	0.599	0.65	1213	43.5	0.63	2	1250		56.63
coal-r	Existing	30	0.37	0.65	1050	38	0.72	1.6	0		36.83
pc	Pulv. Coal	30	0.429	0.65	784	47.5	0.75	1.6	800		42.56
pc-a	PC& CCS	30	0.365	0.65	784	90	1.13	1.6	1342	86.4	60.93
igcc	IGCC	30	0.425	0.85	901	40	0.88	1.6	500		34.33
igcc-a	" & CCS	30	0.361	0.85	901	52	1.23	1.6	1009	42.3	44.42
nuc	Exist.	30	0.327	0.8	1800	70	2		0		33.9
nuc-a	Gen IV	30	0.345	0.85	0	70	4		2200		43.02
hydro	Existing	50	1	0.45	2850	49.5	0.12		0		52.59
bio-a	Bio &CCS	20	0.4	0.75	1091	146	0.92	2	1409		74.06
wnd	Wind-all	20	1	0.3	0	13.5	0.83		1200		44.76
spv	Solar PV	20	1	0.3	0	9	1.25		5000	4.2	160.68

Non Electric

	Resource	Life	Eff	Load	Inv. Cost	O&M	Var O&M	Feedstck	Inv. Cost	O&M	Cost
	ZJ	years		factor	$/kW	$/kW/y	U$/GJ	$/GJ	$/kW	$/MWh	U$/GJ
oil1-10	12-18.	ND	1						ND		*3-5.25*
gas1-10	20	ND	1						ND		*2-4.25*
coal1-10	100	ND	1						ND		*2*
ura		ND	1						ND		
bio	250	ND	1	.65					ND		*2-10.*
coal-FT		30	0.65	0.8	550	80	1	1.6	500		*9.34*
bio-FT		30	0.51	0.8	1150	80	1	2	1409	42.3	*14.8*
gas-H2		40	0.7	0.9	600	60	3	2	0		*9.2*
gas-a-H2		40	0.7	0.9	600	60	3	2	200		*9.61*
coal-H2		30	0.65	0.8	700	60	3	1.6	300		*10.42*
coal-a-H2		30	0.6	0.8	700	60	3	1.6	500		*10.93*
bio-H2		30	0.5	0.8	350	60	3	2	1100		*13.12*
nuc-H2		30	0.5	0.8	0	0	3		3400		*11.77*
sth-H2		20	0.3	0.35	0	0	3		4500	2.8	*35.73*