



**EXIOPOL**

*a new environmental accounting framework  
using externality data  
and input-output tools for policy analysis*

## **EXIOPOL: The creation of a detailed, harmonized MR EE IO database**

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Exiopol Scientific Director,  
UNEP/OECD Workshop, 1  
December 2009, Paris, France

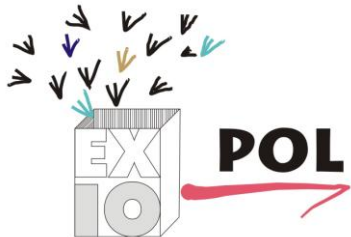


**TNO Kennis voor zaken**



# Presentation Elements

- EXIOPOL in Brief
- Main areas of work on EE IO
- Progress and status



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# EXIOPOL in Brief

- Integrated Project under FP6 of the EU
  - Topic: 'externalities in an economic/environmental accounting framework'
  - 5 Mio EU FP6
  - 2007-2011
- Lead by
  - FEEM, co-ordinator (Anil Markandya), focus on externalities
  - TNO, scientific director (Arnold Tukker), focus on EE I-O
  - 35 other partners, with CML, NTNU, Wuppertal Institute, SERI, Groningen University, EU DG JRC IPTS, GWS, ZEW in EE I-O
- Main clusters
  1. Management & Strategy
  2. Externalities
  3. EE I-O
  4. Illustrative policy applications
  5. Education and dissemination
- Philosophy
  - Protected, open source database
  - To be handed over to IPTS, EEA, Eurostat for formal use
  - Filling an essential gap in the EU toolbox



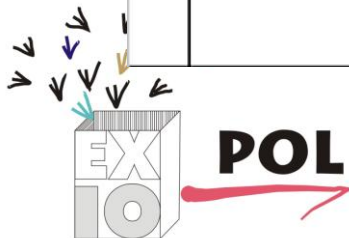
**POL**

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# Some backgrounds on SUT/IOT

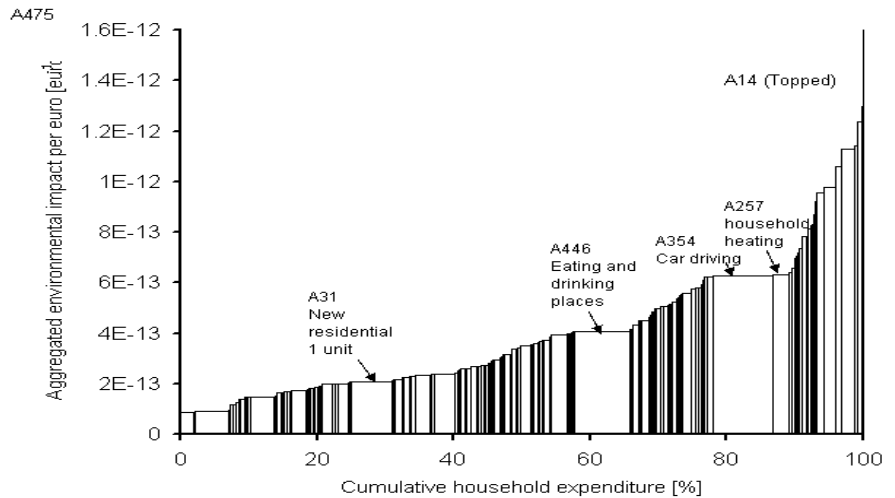
	<b>Products</b>	<b>Industries</b>			
<b>Products</b>		Use	Final use	Exports	Use of products
<b>Industries</b>	Make / Supply				Output of industries
	Imports cif	Value added			
	Supply of products	Input of industries			
		<b>Extensions:</b> - Primary Natural Resource input - Emissions output - etc.			

- EE SUT for a single country
  - Economic Supply and Use
  - By industry: emissions and primary resource use
- Can provide you
  - Per final use category: value added by industry
  - With impact per Euro per industry known: life cycle impacts per final use category
- Advantages
  - Inherently complete
  - Inherently consistent



# Example: the EIPRO study

- TNO, CML, DTU and VITO for DG JRC IPTS in 2005
- Europeanised US data of Suh
- Provided detailed prio's for Integrated product policy
- Most studies based on 'scaling up' LCAs for individual products gave wrong estimates



# The key goal of the project

- Drawbacks of EE SUT/IOT
  - Limited EU data
    - Detail (60 sectors)
    - Emissions (16)
  - No insight in 'pollution embodied in trade'
- Goal of EXIOPOL:
  - Detailed SUT/IOT (130 sectors)
  - Detailed extensions
    - 80 resources, 60 emissions
    - EF, TMR, 4 LCIA themes, ext. Costs
  - For EU27+16 non EU countries

covering 95% Global GNP



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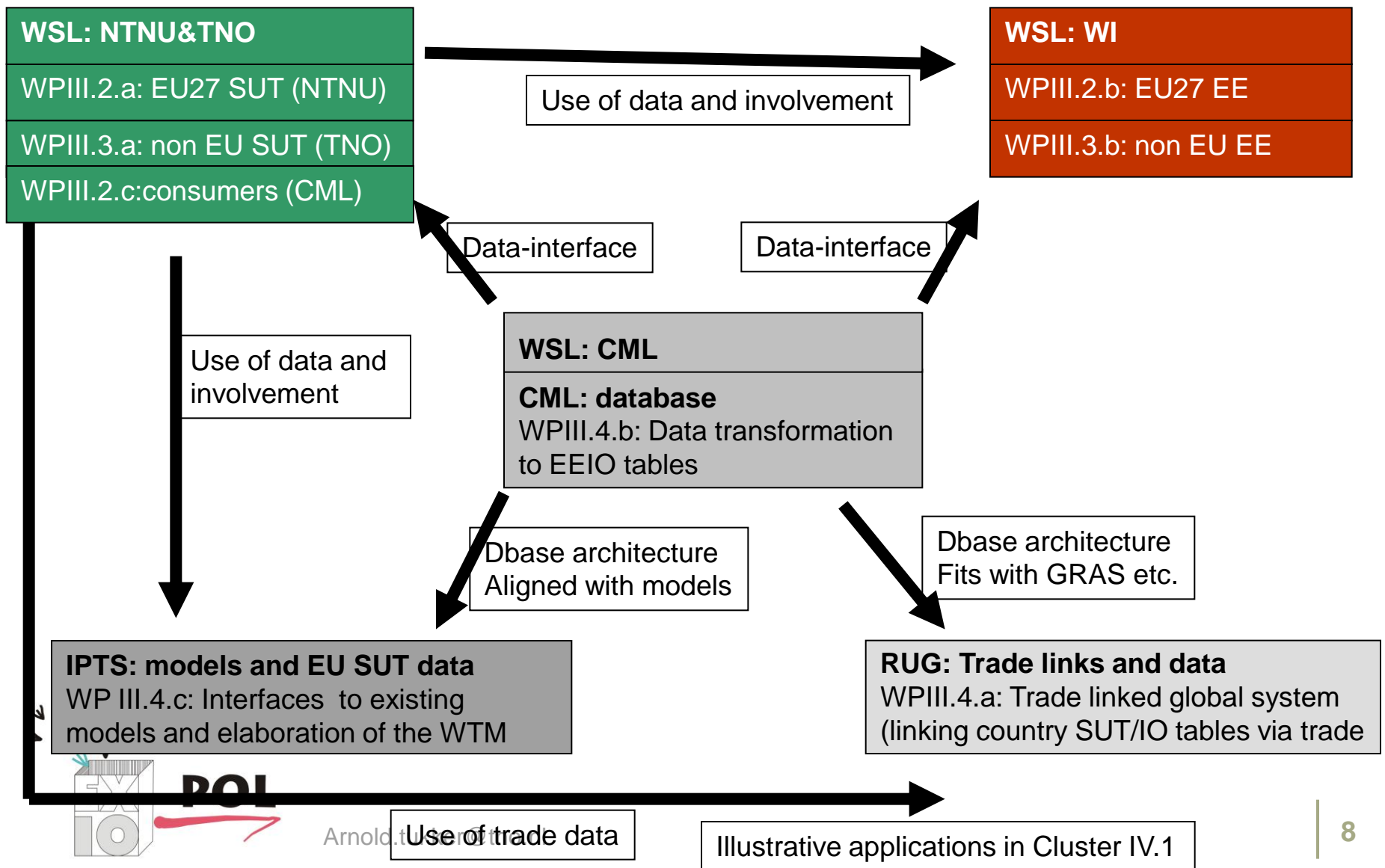
		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	$q$
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	$q_A$
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	$q_B$
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$	$Y_{C,D}$	$q_C$
		$Z_{D,A}$	$Z_{D,B}$	$Z_{D,C}$	$Z_{D,D}$	$Y_{D,A}$	$Y_{D,B}$	$Y_{D,C}$	$Y_{D,D}$	$q_D$
W		$W_A$	$W_B$	$W_C$	$W_D$					
g		$g_A$	$g_B$	$g_C$	$g_D$					
C & L		$Capital_A$	$C_B$	$C_C$	$C_D$					
		$Labor_A$	$L_B$	$L_C$	$L_D$					
Environ Ext		$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
		$AgriC_A$	$AgriC_B$	$AgriC_C$	$AgriC_D$					
		$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
		$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
		$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
		$Land_A$	$Land_B$	$Land_C$	$Land_D$					

# Key tasks

- **Workstream III.1: Inception**
  - WP III.1.a Scope and architecture development: **FINISHED < M12**
  - WP III.1.b: Providing country generic externality data per 'substance':
- **Workstream III.2: Gather, align and detail SUT data**
  - WP III.2.a: EU27
  - WP III.3.a: 16 non EU countries and real Rest of World (rRoW)
  - WP III.2.c: Specific work on households and waste
- **Workstream III.3: Gather environmental extensions**
  - WP III.2.b: EU27
  - WP III.3.b: 16 non EU countries + rRoW
- **Workstream III.4: Trade-links, database, link with models**
  - WP III.4.a: Link SUT data via trade
  - WP III.4.b: Overall database construction
  - WP III.4.c: Interface with models

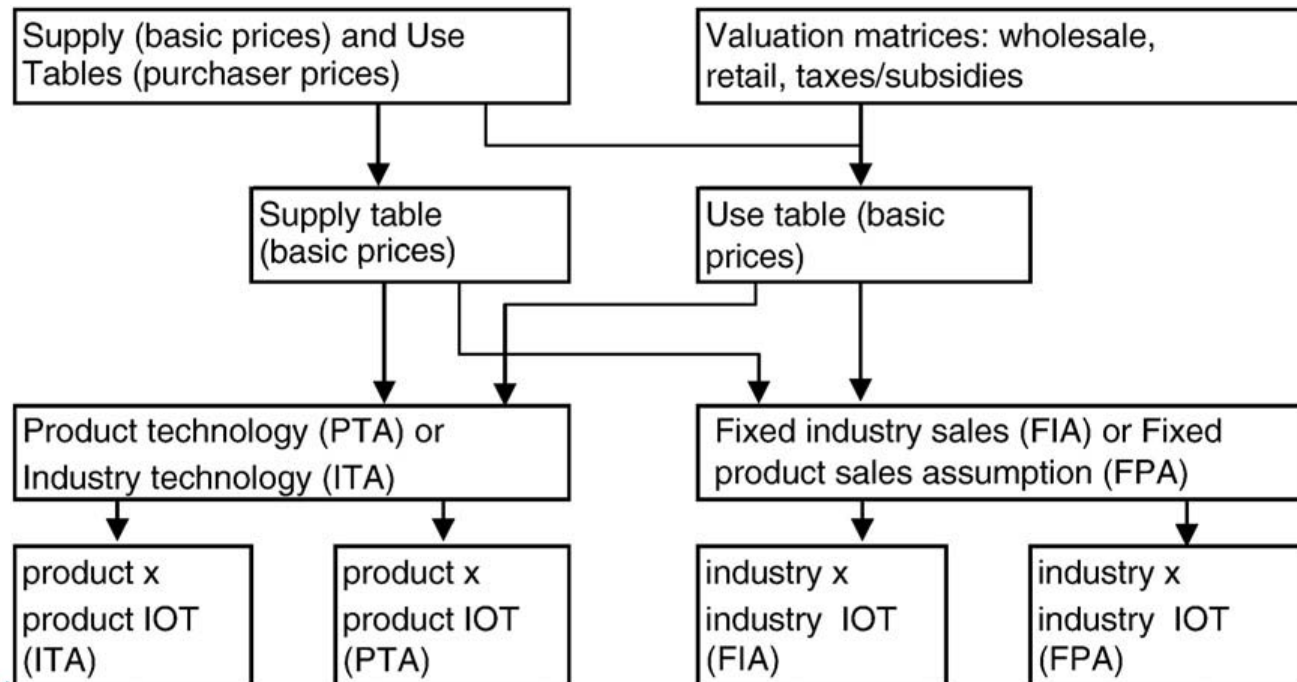


# Or, in another perspective:



# Workstream III.1: Inception

- Basic structure: SUT -> MR EE SUT -> MR EE IOT
- Base year 2000 with (probably) extrapolation to 2005



# Workstream III.2: Gather, align and detail SUT data

- Sector and product classification: NACE 1.1, default: ESA95 (60 sectors)
- Enhanced detail until 130 sectors in view of difference in impact intensities
  - Agro-food
  - Resource extraction/refining and energy
  - Mobility, waste treatment
- Valuation and Import Use matrices
- Added value elements, factor inputs, selected constraints/stocks



# Workstream III.3: Gather environmental extensions

- Environmental extensions + physical flows
  - Emissions (about 50)
    - Based on activity variables and emission factors (TNO's TEAM model)
    - Energy related: IEA database allocated to EXIOPOL sectors
    - Other: dedicated activity variables
    - Cross check with recent Eurostat NAMEA air for 16 emissions
  - Resources (about 80) based on SERI and WI MFA databases, straightforward allocation to EXIOPOL sectors
- Selected energy resources will form a physical layer in the economic SUT
- Should support EF, 4 LCIA themes, MFA/TMR, externality calculations



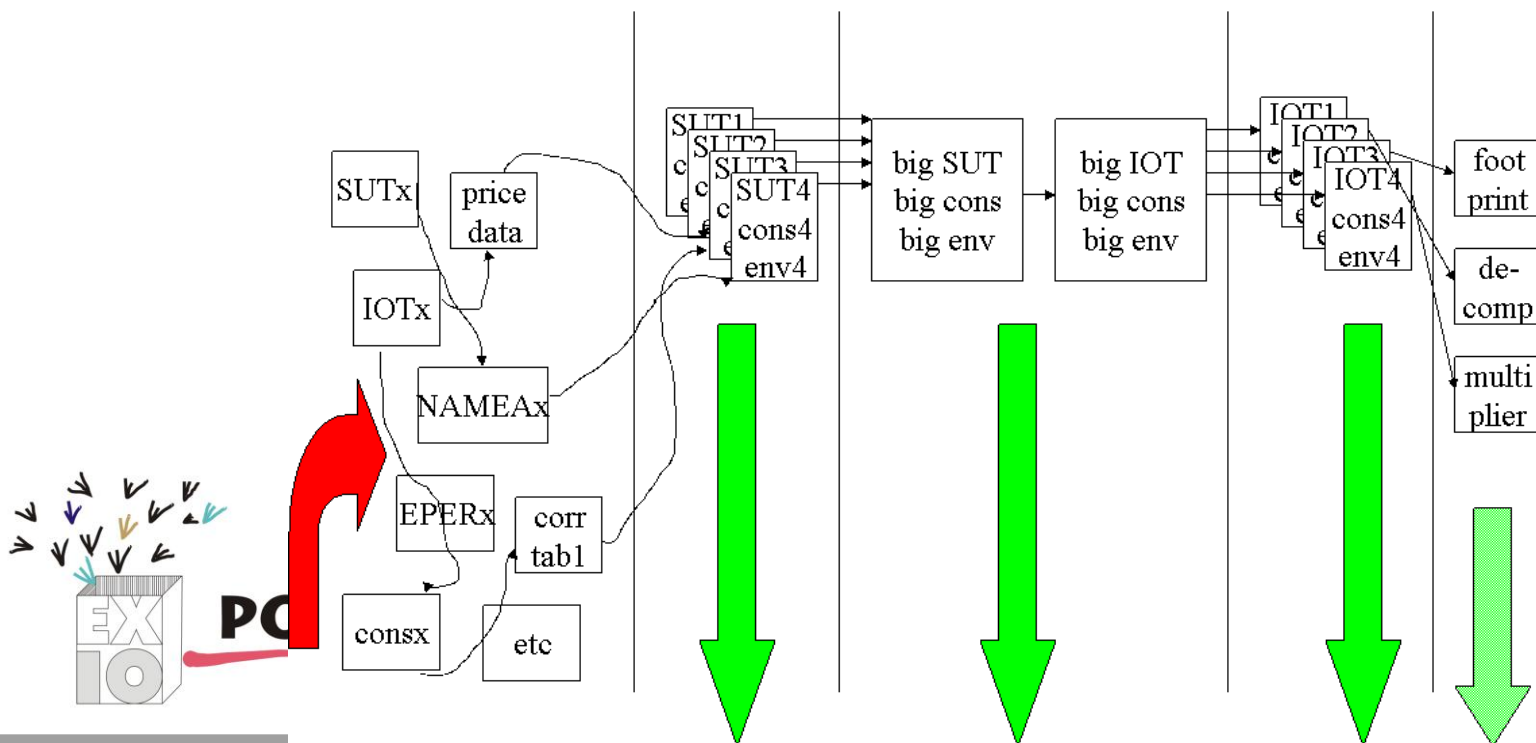
# Workstream III.4: Trade-links, database, link with models

- WP III.4.a: Trade linking
  - Import Use data are starting point
  - Use COMTRADE etc. to calculate which % comes from which exporting country
  - Doing so for all 43 EXIOPOL countries provides implicit exports per country in basic (cif) prices
  - We use exports from SUT (fob) as constraints
  - This matrix is unbalanced; with RAS or minimum entropy method data will be rebalanced and allocate insurance and freight to countries exporting these services
- WP III.4.c : Links with models
  - Mainly a matter of building bridge matrices



# Workstream III.4: Trade-links, database, link with models

- WP III.4.b: Database with five 'big blocks'
  - Block 0: 'Fuzzy front end' with transformations in WS III.2 and III.3
  - Block 1: Harmonized EE SUT in database, individual countries -> trade links
  - Block 2: Trade linked MR EE SUT, world -> transformation to IOT
  - Block 3: Various MR EE IOT
  - Block 4: Inverse, aggregation routines, links to models etc.
  - .....with aggregation routines for EE to relevant indicators (EF, TMR, LCIA, ext)



# What can we do with the result?

- Static
  - Track 'pollution by final consumption' by process of origin globally
  - Uncover differences in impact intensities per sector per country
  - Identify hot spots, from a resource input, sector and consumption perspective
- Historical (in case of time series)
  - Understand decoupling and contributing processes
    - Better emission factors?
    - Change in economic structure?
    - Change in consumption structure?
  - Understand burden shifting processes between countries
- Foresight: needs links with models



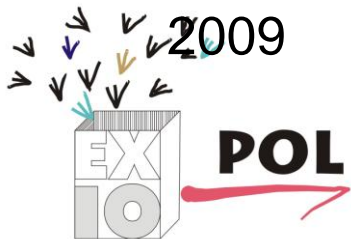
# Spin-off and further involvement

- Further involvement of
  - OECD, WB, EU and others in Advisory Board
  - Several statistical bureaux and Eurostat in other roles
- Strong connections with IIOA and ISIE
- Key challenge: how to turn this project into a ‘open source community effort’ once the basis has been laid in the project
  - IPR issues
  - Presentation and documentation (interactive website?)
  - Institutional embedment and community management? E.g.
    - Management by an EU institution (IPTS? Eurostat? EEA?)
    - Formal EU-RoW collaboration (Eurostat and OECD?)
    - ‘Eco-invent’ or ‘GTAP’ model? (reasonable price for the database provides resources for updates)
    - Interest community of IE and IO experts (ISIE Working group is being set up)



# Conclusion

- The project is now half-way
- Extremely challenging
- We are however quite well in control despite the odd month delay
  - Most Individual country SUT harmonized
  - Most extensions gathered
  - Next year is for fine tuning, trade linking, and transforming to IOT
  - ...although still some surprises occur
- Budget wise things seem in control too
- Gives a rather re-assured feeling – this was the period with most chance of things running out of hand
- More information: EXIOPOL paper in Ecological Economics, April



# Time schedule and critical path

														2010												2011	
			M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	
<b>WP III.2.a and 2.b: Supply, Use</b>	Plan	Real	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
130 sector, 43 country SUT	M27	M29																									
auxiliary data rRoW																											
more detailed added value for WTM																											
<b>WP III.2.a and 2.b: Extensions</b>																											
Resources	M30	M24																									
Water, land, N&P emissions	M30	M30																									
Energy & emissions (allocation IEA data via SUT)	M30	M31																									
Stock/reserves for WTM	M30	M31																									
<b>WP III.4.a Tradelinking</b>																											
Tests on 6x6, 60x60, Asian MR IOT		M25																									
Product and service trade data ready		M29																									
Test trade link script on NTNU/TNO SUT		M31																									
Implement trade link script in data base	M36	M33																									
<b>WP III.4.b Database construction</b>																											
Tests import routines finalised		M29																									
SUT and trade data imported		M31																									
EE imported		M33																									
Implement trade link script in data base	M36	M33																									
MR EE SUT transformed in ixi and pxp MR EE IOT	M36	M36																									
Analytical modules: inverse, aggregation, critical path	M36																										
Impact assessment modules																											
<b>WP III.4.c Link with models (WTM, POLES, CAPRI)</b>																											
Finalise models (if needed)		M29																									
Test links on SUT																											
Test links on MR EE IOT	M36	M38																									
<b>WP IV.II.a,b,c: cse studies</b>																											
Application of models																											
Other case work	M48																										
<b>General issues, not well included DoW</b>																											

