Harmonised baselines in the TranSust.Scan project

1st draft

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From the Project Workplan (Workpackage 3, Task 2):

"A harmonised baseline will serve as a benchmark for a wide range of policy scenarios. The baseline will cover the period 2015 – 2030 and will be implemented in all core models."

A major complication in the evaluation of different model studies is the impact of different assumptions underlying the model calculations. These differences are caused by differences in the methodology used, including the type of model chosen, differences in baselines (benchmark projections) and differences in the specification of the policy scenarios. An important issue in baseline construction is the specification of forecasts of future developments. As future developments are uncertain, several sets of possible baselines may be constructed; these are often labelled "baseline scenarios" (e.g. the IPCC SRES scenarios). It is important to distinguish baselines (and baseline scenarios) from policy scenarios: where baselines describe the development of the main model variables in absence of new policies, policy scenarios are used to investigate how new policies, reflecting a counterfactual situation, will affect these developments.

Baselines may be constructed at different levels of detail: at the general level, storylines may be developed that paint a picture of general developments that may take place. At the detailed level, these are then translated into specific assumptions regarding the development of key variables in the model; this is called the benchmark projection. For such benchmark projections, data on the historical situation is also required to identify the initial situation.

As part of the task on Harmonised Baselines (Workpackage 3, Task 2) IVM-VU has, in liaison with UCD, invited all participating modelling groups in the Transust.Scan project to respond to a questionnaire on the calibration of their model baselines. Below, you can find three summarising tables that we have compiled from the completed questionnaires; in the Annex, you can find all completed questionnaires. Our aim is to use this information to discuss with all partners how to find a good compromise between the ambitious Workplan and the inability / undesirability to fully harmonise all models.

Table 1. Key elements of the model baselines

Model	Group	Geographical scale	Time scale	Best fitting SRES storyline
DART	IfW, Kiel	global (22 regions)	2050 (1-year steps)	B2
DEMETER	IVM-VU, Amsterdam	global	2000-2150 (5-year steps)	calibrated to B2
EU-FASOM	University Hamburg	EU-25, 6 international regions	2005-2150 (5-year steps)	none
IMACLIM	SMASH, Paris	global (12 regions)	2001-2050 (1-year steps)	A2 / B2
KLUM	University Hamburg	global (individual countries)	flexible (1-year steps)	flexible
MARKAL	ECN, Amsterdam	OECD 90 EU	1900-2110 (10-year steps)	none
PACE	ZEW, Mannheim	global (incl. EU, other OECD)	2001-2030 possible	B1 & within error bounds of B2
WITCH	FEEM, Milano	global (12 regions)	2002-2100 (5-year steps)	B2
W8D	LIFEA, Lodz	Poland	up to 30 years	none

Table 2. Fit of baseline elements with IPCC SRES B2 storyline

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline
Population	DART DEMETER IMACLIM PACE		EU-FASOM MARKAL	KLUM WITCH?
Economic growth	DART DEMETER KLUM PACE WITCH?	IMACLIM	EU-FASOM MARKAL	
Global Income Equality	DART			DEMETER EU-FASOM IMACLIM? KLUM MARKAL PACE WITCH?
Technological change	DEMETER IMACLIM KLUM WITCH?		EU-FASOM MARKAL	DART PACE
Primary Energy Demand	DART DEMETER IMACLIM WITCH?	PACE	EU-FASOM MARKAL	KLUM
CO_2 Emissions	DART DEMETER IMACLIM KLUM PACE WITCH?	EU-FASOM?	MARKAL	

Note: the W8D model for Poland does not fit this classification and is not calibrated yet.

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Table 3. Main SD indicators according to model baselines (with values where available)

EC	Indicator	2015	2030
I.	GDP per capita	DART DEMETER: global 5900$ EU-FASOM IMACLIM: Europe 18684$ MARKAL: 37.5 k€ PACE: 27.839 € WITCH: global 6941$	DART DEMETER: global 7400$ EU-FASOM IMACLIM: Europe 22542$ MARKAL: 42.0 k€ PACE: 39.344 € WITCH: global 9449$
II.	Labor productivity	DART? DEMETER? EU-FASOM IMACLIM: Europe +18.5%	DART? DEMETER? EU-FASOM IMACLIM: Europe +38.1%
III.	Employment rate	IMACLIM: unempl. Europe 8.6%	IMACLIM: unempl. Europe 8.7%
IV.	Empl. rate of older workers		
V.	Spending on human resources		
VI.	Research and Development expenditure	EU-FASOM WITCH: global 11.0 bln$	EU-FASOM WITCH: global 15.7 bln$
VII.	Information Technology exp.	EU-FASOM	EU-FASOM
VIII.	Financial market integration	EU-FASOM	EU-FASOM
IX.	At risk-of-poverty rate		
X.	Long-term unemployment		
XI.	Dispersion of reg. empl. rates		
XII.	Greenhouse gases emissions	DART DEMETER: global 8.0 GtC EU-FASOM IMACLIM: Europe 5016 MtCO2 MARKAL: 4130 MtCO2 PACE: 3845.1 MtCO2 WITCH: global 9.62 GtC	DART DEMETER: global 9.6 GtC EU-FASOM IMACLIM: Europe 5439 MtCO2 MARKAL: 4565 MtCO2 PACE: 4324.2 MtCO2 WITCH: global 12.96 GtC
XIII.	Energy intensity of the economy	DART DEMETER: global 10.4 MJ/$ EU-FASOM: land-use sector IMACLIM: Eur. 183.3 TEP/mln$ MARKAL: 5.2 MJ/€ PACE: 142 toe/mln€ WITCH: global 244 Mtoe/tln$	DART DEMETER: global 9.0 MJ/$ EU-FASOM: land-use sector IMACLIM: Eur. 175.5 TEP/mln$ MARKAL: 5.2 MJ/€ PACE: 109 toe/mln€ WITCH: global 212 Mtoe/tln$
XIV.	Volume of transport	EU-FASOM: land-use sector IMACLIM: Europe 7507 bln pkm	EU-FASOM: land-use sector IMACLIM: Europe 7507 bln pkm
XV.	Competitiveness	DART? EU-FASOM: land-use sector PACE: 1.04 (terms of trade)	DART? EU-FASOM: land-use sector PACE: ?

Note: the W8D model for Poland is not calibrated yet.

Annex. Completed questionnaires on Harmonised baselines (WP3-T2)

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Name of the model: DART

Institute: Kiel Institute for the World Economy (IfW)

Contact person / Evaluator: Sonja Peterson (sonja.peterson@ifw-kiel.de)

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1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

    DART covers the entire globe and has in the version used for TranSustScan has 22 regions (see table at the end of the document).

    The model horizon is the year 2050. DART is solved in 1-year steps.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

    The baseline of DART is based on the following assumptions

    -   Population growth is taken from World Development Indicators

    -   CO2 emissions from use of fossil fuels are calibrated with the help of supply elasticities to meet the global forecasts for coal, gas and oil emissions of the IEA World Energy Outlook 2004 for the year 2030.

    -   For Human Capital growth 1990 levels of human capital endowment are taken from an article by Hall & Jones (1999). We then assume that the maximum endowment of 12 years of schooling will be reached in 2050 and that this process starts at the computed 1990 levels.

    -   Saving rates are assumed to be constant over time

    -   Total labour productivity is guestimated based on a literature study. The values are adjusted so that annual GDP growth lies within the projections of the EIA until 2020.

    -   All other model results derived from these assumptions.

    When comparing the available data from DART to the IPCC scenarios they best fit to scenario SRES-B2 .

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments

Population	x				same as B2 until 2020, then a little less growth
Economic growth	x				more or less
Global Income Equality	(x)				at the upper level in 2020, larger then in B2 in 2050
Technological change				x	
Primary Energy Demand	(x)				at lower range in 2020, below B2 value in 2050
CO_2 Emissions	x				almost exactly

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

Share of coal in primary energy production

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

The baseline already now more or less reflects the IPCC B2 median story line. To make the fit in some variables even better would require 2 days of work.

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	see Appendix	
II.	Labor productivity	?	?
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A

VI.	Research and Development expenditure	N/A	N/A
VII.	Information Technology expenditure	N/A	N/A
VIII.	Financial market integration (conv. of bank lending rates)	N/A	N/A
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	see Appendix	
XIII.	Energy intensity of the economy	see Appendix	
XIV.	Volume of transport	N/A	N/A
XV.	Competitiveness	?	?

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

An older version of DART was used to simulate the effects of the European Emissions Trading Scheme (ETS) which is associated to the key challenge of climate change and clean energy of the SDS.

References:

Peterson, S (2006). Efficient Abatement in Separated Carbon Markets: A Theoretical and Quantitative Analysis of the EU Emissions Trading Scheme. *Kiel Working Paper 1271*. Institute for World Economics.
Klepper, G. & S. Peterson (2006). Emissions Trading, CDM, JI and More – The Climate Strategy of the EU. The Energy Journal 27(2), 1-26.

Klepper, G. & S. Peterson (2004). The EU Emissions Trading Scheme: Allowance Prices, trade Flows, Competitiveness Effects. European Environment 14(4):201-218.

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

We are currently starting a project where we will couple the DART model to a land-use model of Germany and Europe to assess land-use conflicts in the use of bio-energy and analyse the role of bio-energy in an optimal energy mix. The project will go until 2010, but it is likely that first results are available within the time frame of the TranSust.Scan project.

Appendix

Countries and regions in DART		
EU		**Non-EU**
DEU	Germany	USA	USA
FRA	France	OAB	Canada, Japan, Australia
GBR	United Kingdom		New Zealand
IRL	Ireland	LAM	Latin America
ITA	Italy	FSU	Former Soviet Union
AUT	Austria	CPA	China
BEN	Belgium, Netherlands, Luxemburg	IND	India
SCA	Finland, Sweden, Denmark	ROW	Rest of the World
MED	Greece, Malta, Cyprus		
ESP	Spain		
PRT	Portugal		
BAL	Estonia, Latvia, Lithuania		
POL	Poland		
EEU	Hungary, Slovakia, Slovenia, Check		
	Republic, Romania, Bulgaria		

	AUT	BEN	DEU	ESP	FRA	GBR	IRL	ITA	MED	NLD	PRT	SCA	POL	BAL	EEU
GDP per capita in 1000 USD 2001															
2015	33,7	32,6	30,4	22,4	31,4	32,9	41,0	27,4	15,8	33,3	17,9	34,7	7,2	5,7	5,2
2030	47,9	44,2	40,1	32,5	43,6	44,3	59,8	39,6	21,5	44,6	27,1	46,3	11,3	9,0	7,8

	AUT	BEN	DEU	ESP	FRA	GBR	IRL	ITA	MED	NLD	PRT	SCA	POL	BAL	EEU
CO_2 emissions in MtCO2															
2015	75	153	874	365	410	694	58	506	114	283	82	186	371	47	460
2030	77	147	842	372	393	813	67	505	114	307	93	195	413	51	496

	AUT	BEN	DEU	ESP	FRA	GBR	IRL	ITA	MED	NLD	PRT	SCA	POL	BAL	EEU
energy intensity of the economy (10^6J/USD)															
2015	4,0	7,7	5,2	5,4	3,3	5,1	4,5	4,9	8,0	9,2	6,3	3,8	16,0	15,3	21,2
2030	3,2	6,0	4,2	4,2	2,6	4,5	3,6	3,9	6,4	7,7	5,1	3,2	13,1	12,6	17,6

	USA	OAB	FSU	LAM	CPA	IND	ROW	World
GDP per capita in 1000 USD 2001								
2015	47,9	40,3	2,4	5,3	2,3	0,8	2,1	6,7
2030	60,9	53,9	4,2	7,8	4,4	1,4	3,1	9,0

	USA	OAB	FSU	LAM	CPA	IND	ROW	World
CO_2 emissions in MtCO2								
2015	6959	2445	3028	1886	5054	1662	6182	31893
2030	7767	2405	3387	2290	6648	2295	8063	37739

	USA	OAB	FSU	LAM	CPA	IND	ROW	World
energy intensity of the economy (10^6J/USD)								
2015	6,2	4,6	61,8	7,8	19,0	18,6	14,8	9,0
2030	5,3	3,7	47,5	6,2	14,7	14,9	11,6	7,6

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

    Geographical: world economy without regional differentiation;
    Time scale: 1995 – 2150.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

    Results are mostly in accordance with B2 scenario.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population	+				2050: 9.5 2100: 10.8
Economic growth	+				Per capita 1.5% annually; 2050: 2.0% 2100: 1.6%
Global Income Equality				X	
Technological change	+				implicit
Primary Energy Demand	+				
CO_2 Emissions	+				

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

All available elements are in accordance with the B2 storyline, but not all model variables could be calibrated on this storyline (esp. carbon capture and storage).

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

    None: storyline is already reflected.

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country: world

EC	Indicator	2015	2030
I.	GDP per capita	5900 $	7400 $
II.	Labor productivity	?	?
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A
VI.	Research and Development expenditure	N/A	N/A
VII.	Information Technology expenditure	N/A	N/A
VIII.	Financial market integration (conv. of bank lending rates)	N/A	N/A
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	8.0 GtC (fossil fuel only)	9.6 GtC (fossil fuel only)
XIII.	Energy intensity of the economy	10.4 MJ/$ (primary energy per $ of GDP	9.0 MJ/$ (primary energy per $ of GDP
XIV.	Volume of transport	N/A	N/A
XV.	Competitiveness	N/A	N/A

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

The key challenge of Climate change and clean energy is investigated in Gerlagh et al. (2004) and Gerlagh and Van der Zwaan (2003, 2004), although not all actions identified in the SDS are explicitly modelled (nor can they be).

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

Not decided yet.

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

The model covers EU 25 and about six international regions. The model runs in time steps of 5 years starting in 2005 with a variable time horizon (max. 2150).

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

Regarding the SRES scenarios, the model has no particular preference. Currently, a storyline resembling a "business as usual" scenario is incorporated in the model.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population			X		
Economic growth			X		
Global Income Equality				X	possible but difficult to incorporate
Technological change			X		
Primary Energy Demand			X		
CO_2 Emissions		X?			endogenously calculated

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

N/A

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

The model could be adjusted. The adjustments would take approximately 20 days of work.

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	exog.	exog.
II.	Labor productivity	exog.	exog.
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A
VI.	Research and Development expenditure	exog.	exog.
VII.	Information Technology expenditure	exog.	exog.
VIII.	Financial market integration (conv. of bank lending rates)	exog.	exog.
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	endog. calculated	endog. calculated
XIII.	Energy intensity of the economy	land use sector	land use sector
XIV.	Volume of transport	land use sector	land use sector
XV.	Competitiveness	land use sector	land use sector

Comments: exog. means that the variables are exogeneously specified and have no fixed values.

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

No, such simulations have not yet been conducted.

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

We will produce a paper applying an extended version of EU-FASOM including biofuels within the context of the TranSust.Scan project.

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

   The model pictures the global economy split in 12 regions, and solves yearly from 2001 to 2050.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

   The latest baseline produced by IMACLIM-R (November 2006) shares elements close to both A2 and B2 scenarios. These elements are fully integrated in the modelling system (i.e. fully consistent within IMACLIM's modelling framework), and harmonized, to a great extent, with the baseline of the POLES model (Criqui et al. 2001).

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population					The median 2004 UN projection is used, slightly lower than B2. It is an entirely exogenous assumption, and could easily be changed.
Economic growth					Global economic growth over 2001-2050 is of +1.3% a year, between A2 and B2, closer to A2.
Global Income Equality					Do you mean the distribution of income across regions? I am not familiar enough with the SRES to answer this. The 4 SRES regions (as reported at http://sres.ciesin.org/final_data.html) are compatible with IMACLIM-R's disaggregation. I would need some more time to compute the relevant aggregates, + I would need a comparison criterion to make the exercise more interesting (detailed results obviously cannot match over the whole 50-year horizon, but this probably does not mean that the scenarios contradict—the question being, what does?).
Technological change					I am not sure what you mean here either? 2050 global carbon and energy intensities end up at a level close to A2, slightly higher than B2.
Primary Energy Demand					With 877 EJ, 2050 primary energy production is very close to B2 (869 EJ).

CO_2 Emissions	Global emissions are continually increasing and reach 12.96 GtC in 2050. This is higher than B2 (11.23).

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

I cannot think of anything else.

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

I thought we had ruled out this option? I suppose it would take at least two weeks to explore how the B2 storyline can indeed be reproduced by IMACLIM-R. As a matter of fact there is no guarantee that the scenario is fully compatible with the set of constraints embedded in IMACLIM (as far as I know MESSAGE, which produced B2, is very different from IMACLIM).

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country: Geographical Europe (excepting Ukraine, Belarus and Russia)

EC	Indicator	2015	2030
I.	GDP per capita	18684[1]	22542
II.	Labor productivity	+18.5%[2]	+38.1%
III.	Unemployment rate (in case this is what was meant)	8.6%	8.7%
IV.	Employment rate of older workers	n.a.	n.a.
V.	Spending on human resources (public exp. on education)	n.a.	n.a.
VI.	Research and Development expenditure	n.a.	n.a.
VII.	Information Technology expenditure	n.a.	n.a.
VIII.	Financial market integration (conv. of bank lending rates)	n.a.	n.a.
IX.	At risk-of-poverty rate	n.a.	n.a.
X.	Long-term unemployment	n.a.	n.a.
XI.	Dispersion of regional employment rates	n.a.	n.a.
XII.	Greenhouse gases emissions (MtCO2)	5016	5439

[1] In constant 2001 dollars.

[2] This is an index modifying the labour intensity of productions (exogenous TP on labour), which is also a measureless index (unit based on a normalisation of labour force in 2001).

XIII.	Energy intensity of the economy (TEP per million constant 2001 dollars)	183.3	175.5
XIV.	Volume of transport (billions of pkm)	7507	8347
XV.	Competitiveness	n.a.	n.a.

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

I am developing a spreadsheet of local emissions from transportation activities as a by-product of the IMACLIM-POLES baseline. This is done in collaboration with UCD, they have all the information about it.

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

Cannot be ruled out, but nothing is planned yet.

> *Name of the model: KLUM, KLUM-W*
>
> *Institute: Hamburg University, Research Unit Sustainability and Global Change*
>
> *Contact person / Evaluator: P. Michael Link, Kerstin E. Ronneberger*

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

    KLUM runs on a global geographical scale and distinguishes individual countries. Since KLUM is supposed to be coupled to other models such as GTAP or LPJ, it will operate on the same time scale as the model it is coupled to, generally with annual time steps.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

    In coupled mode, the storyline will be provided by the model that KLUM is coupled to. If KLUM is operated as a standalone version, the model is validated and calibrated using data from the 1960s till present. Future development of agriculture under climate change until 2050 is currently based on data from the *Canadian Global Coupled Model (CGCM1)*, but it seems to be possible to utilize SRES scenarios instead as well.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population				X	
Economic growth	X				represented indirectly by influence on land use decisions
Global Income Equality				X	
Technological change	X				represented indirectly by influence on land use decisions
Primary Energy Demand				X	

		X				represented indirectly by influence on land use decisions and agricultural yields
CO_2 Emissions						

The above entries relate to the standalone version of KLUM. Obviously, all aspects would apply in coupled mode via the model that KLUM is coupled to.

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

   Setup of other scenarios could be completed in a month (approximately 20 working days).

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	N/A	N/A
II.	Labor productivity	N/A	N/A
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A
VI.	Research and Development expenditure	N/A	N/A
VII.	Information Technology expenditure	N/A	N/A
VIII.	Financial market integration (conv. of bank lending rates)	N/A	N/A
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	N/A	N/A
XIII.	Energy intensity of the economy	N/A	N/A

XIV.	Volume of transport	N/A	N/A
XV.	Competitiveness	N/A	N/A

Comments: These SD indicators do not apply to the standalone version of KLUM, which determines "optimal" crop allocations based on climate conditions, previous land use patterns and agricultural boundary conditions. Obviously, some of the indicators above would be determined by a coupled model system by the model that KLUM is coupled to.

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

Not yet.

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

We will conduct an analysis using the extended model KLUM-W which includes water resources in the project framework of TranSust.Scan which will lead to a journal publication.

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

   Geography : OECD 90 Europe = pre-2004 EU15 + Norway, Iceland and Switzerland

   Time scale : 1900-2110 in 10 year steps

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

   None of the IPCC scenarios as such, as the model was developed especially for Europe, a scenario called " Market Drive" derived from an EU forecast from 1996 is used. This scenario is described as follows:

   Market Drive is the market driven scenario. In this scenario the market mechanism is seen as the best way to generate prosperity and handle complexity in uncertainty. The penetration of new, more efficient demand and supply technologies totally depends on market forces and the behaviour of the actors involved. The environmental protection agenda is also set by the market and thus not by public policy. Moreover, energy policy is driven by the desire to minimise government control and to maximise efficient operation of free markets. Barriers will persist in the uptake of efficient equipment. Efficiency gains will only be made for competitive reasons.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population			Could be aligned with IPCC B2 median		Population is not a direct model driver, it is a secondary one related to the build environment, it would require recalculation

					methodology for some demand sectors
Economic growth			Could be aligned with IPCC B2 median		But would require recalculation methodology for all demand sectors
Global Income Equality					Not relevant
Technological change			Could be aligned with IPCC B2 median		Current model uses technology portfolios and endogenised learning curves
Primary Energy Demand			Some calibration could be done		Is a result of the model calculation
CO_2 Emissions			Some calibration could be done		Is a result of the model calculation

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

    -

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

    This would require recalculating al energy service demand levels, adjusting the technology preferences of the model, re-estimate the primary energy import supply curves, ….

    Estimated effort: at least 1 man month if all necessary drivers are provided to the modelling team.

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	37.5 k€2000/capita, from input assumptions	42.0 k€2000/capita, from input assumptions
II.	Labor productivity	N/A	N/A
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A
VI.	Research and Development expenditure	N/A	N/A
VII.	Information Technology expenditure	N/A	N/A
VIII.	Financial market integration (conv. of bank lending rates)	N/A	N/A
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	4130.14 Mton CO_2 only	4565.12 Mton CO_2 only
XIII.	Energy intensity of the economy	5.2 MJ/€2000	4.4 MJ/€2000
XIV.	Volume of transport	N/A	N/A
XV.	Competitiveness	N/A	N/A

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

Climate Change and clean energy
http://www.ecn.nl/docs/library/report/2005/c05034.pdf
http://www.ecn.nl/docs/library/report/2005/c05059.pdf

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

Not yet known

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

> Geographical: EU, Non-EU OECD countries, Rest of the world
> Time Scale: 2001-2030 possible.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

> Storyline based on "European Trends in Energy and Transport" by DG TREN (for EU) and on "International Energy Outlook" by the U.S. Department of Energy (for all other countries).
>
> Our storyline fits with IPCC-B1 and is within the error bounds of IPCC-B2.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population	We use the population data in the IEO that are fully in line with the IPCC scenarios.				
Economic growth	The average annual world GDP growth rate in our model is 3.1, which fits IPCC-B1 and is within the error range of IPCC-B2.				
Global Income Equality	*We do not depict GIE.*				
Technological change	*TC is incorporated by GDP growth* *(or do you refer to TC in energy?).*				
Primary Energy Demand	We use IEO data for calibration. Its prediction is 598e15 Btu of world primary energy demand in comparison to 566e18 J (533e15 Btu) in the IPCC-B2 and 606e18 J (574e15 Btu) in the IPCC-B1 scenario.				
CO_2 Emissions	Our model displays a value of 11.864 GtC emissions in 2020, which is close to the IPCC-B1 value and within the error margin of IPCC-B2.				

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

>   *None*

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

>   *Our model is already rather close to the IPCC-B2 storyline (see above). Yet, this does not mean that adoptions can be easily implemented – after all we use a different data basis.*

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	27.839 €	39.344 €
II.	Labor productivity	X	X
III.	Employment rate	X	X
IV.	Employment rate of older workers	X	X
V.	Spending on human resources (public exp. on education)	X	X
VI.	Research and Development expenditure	X	X
VII.	Information Technology expenditure	X	X
VIII.	Financial market integration (conv. of bank lending rates)	X	X
IX.	At risk-of-poverty rate	X	X
X.	Long-term unemployment	X	X
XI.	Dispersion of regional employment rates	X	X
XII.	Greenhouse gases emissions	3845.1	4324.2
XIII.	Energy intensity of the economy	0.142	0.109
XIV.	Volume of transport	X	X
XV.	Competitiveness	1.04	?

Comments:

As measures of competitiveness, we will provide three more indicators: RCA (revealed comparative advantage), RWA (Relative World Trade Shares) and RTB (Relative Trade Balance) in our analysis. However, they measure competitiveness on a regional/sectoral basis, so we do not provide a single number here.

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

EU ETS, carbon taxes (Report for the EU project TETRIS, Deliverable 6)

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

YES, extension of policy analysis EU to competitiveness issue

<table>
<tr><td>

Name of the model: WITCH
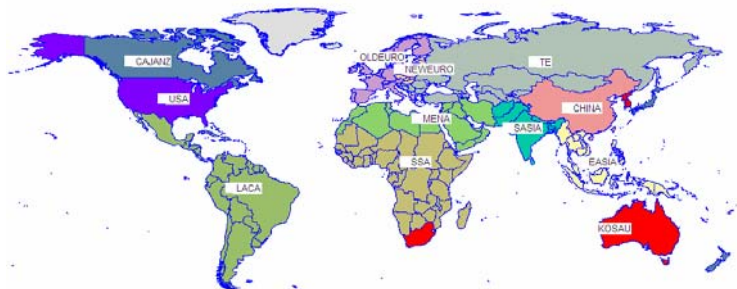
Institute: FEEM

Contact person / Evaluator: Valentina Bosetti

</td></tr>
</table>

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

   WITCH is a defined for 12 macro regions of the world, as shown in Figure 1.
   Figure 1

   Regions:
   1)   CAJANZ (Canada, Japan, New Zealand)
   2)   USA
   3)   LACA (Latin America, Mexico and Caribbean)
   4)   OLDEURO (Old Europe)
   5)   NEWEURO (New Europe)
   6)   MENA (Middle East and North Africa)
   7)   SSA (Sub-Saharan Africa excl. South Africa)
   8)   TE (Transition Economies)
   9)   SASIA (South Asia)
   10)   CHINA (including Taiwan)
   11)   EASIA (South East Asia)
   12)   KOSAU (Korea, South Africa, Australia)

   The time step is 5 years and the base year is 2002. The model runs up to 2100.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

   Emissions related to energy use are expected to grow steadily over time reaching 20 Gton C by 2100. This places our model in the highest range of B2 IPCC SRES scenarios.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population					

Economic growth	X				
Global Income Equality					
Technological change	X				
Primary Energy Demand	X				
CO$_2$ Emissions	X				

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

   -
5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

   Calibrated on it.
6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Region or country:

EC	Indicator	2015	2030
I.	GDP per capita	6941 1995 USD per capita	9449 1995 USD per capita
II.	Labor productivity	N/A	N/A
III.	Employment rate	N/A	N/A
IV.	Employment rate of older workers	N/A	N/A
V.	Spending on human resources (public exp. on education)	N/A	N/A
VI.	Research and Development expenditure	11.01282 Billions 1995 USD	15.73825 Billions 1995 USD
VII.	Information Technology expenditure	N/A	N/A
VIII.	Financial market integration (conv. of bank lending rates)	N/A	N/A
IX.	At risk-of-poverty rate	N/A	N/A
X.	Long-term unemployment	N/A	N/A
XI.	Dispersion of regional employment rates	N/A	N/A
XII.	Greenhouse gases emissions	9.61732 GtC	12.95375 GtC

Kommentar [B1]: Energy R&D only

		2.44E+02 MToe/GDP in trillions	2.12E+02 MToe/GDP in trillions
XIII.	Energy intensity of the economy		
XIV.	Volume of transport	N/A	N/A
XV.	Competitiveness	N/A	N/A

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

We intend to provide a policy analysis in line with the 2020 EU Mitigation Target.

1. What *geographical* and *time scale* underlies the baseline as adopted in your model?

A new version of the **W8D model quantifies** the main socio-economic relationships existent in **the Polish economy**. Its structural parameters – in the great part – were estimated rather than calibrated. This is a macro-econometric model, which has a far-going bearing on its properties and fields of potential usage. Practically, **one can elaborate a baseline solution of the model spanned on the time scale whichever one pleases**. For obvious reasons, the longer the forecast horizon, the more uncertainties and more intervention into the model structure is needed. **However**, **it seems reasonable to consider forecasts up 30 years** or so. Still**, a baseline solution is waiting to be elaborated after we all have reached some consensus regarding common assumptions**. In other words, no baseline solution have been prepared yet.

2. Please identify which *IPCC SRES storyline* (see attachment #1) fits best with the baseline as adopted in your model. (Note: if none of these storylines fit your model, please briefly indicate what type of storyline is incorporated in your model.)

None !!! This is mainly so because – if I understood it well - each of the storylines elaborated by *IPCC* makes strong exogenous assumptions concerning such crucial macroeconomic variables as the overall economic activity (GDP), vital statistics of population (population growth), and technological progress only to arrive at the GHG emissions estimates. In our model all these factors are in mutual interlinks so that a change in one of them triggers changes in the others.

Besides, as the **W8D is a model of the Polish economy, we do not have a firm opinion about the future of the world**. The external circumstances influence the Polish economy only via exports, imports and world prices. However, there is no *explicit* information on these economic aspects in the *IPCC* scenarios.

The main mechanisms underlying the structure of the modified W8D and determining our storyline can be depicted as follows. The central relation of the whole construction is a generalized production function comprising – apart from traditional production factors: built capital and labour force – human capital and endogenous technological progress. The human capital includes both education, learning by doing and health state of the labour force. To meet the requirements of such defined human capital measure one has to possess quite detailed information about the population by age structure and education. In the long-run it is also necessary to account for fertility. Life expectancy that stands for health indicator of the

whole society influences labour productivity and is itself determined – among others - by economic, social and environmental factors. The standing of natural environment represented by air and water quality as well as by waste accumulation affects – among other things – life expectancy, and thus –indirectly – also labour productivity. Technological progress - associated in the model with total factor productivity - is a function of human capital, imported R&D, and science sector activity measured by a stock of accumulated patents. The individual blocks are in mutual, contemporaneous interlinks against one another. In so defined a system, **the driving forces influencing the long-run performance of Poland are**:

- technological progress (measured either by accumulated R&D outlays or accumulated patents),

- human capital accounting for changes in the age structure of the population,

- changes in population growth.

3. To what extent are the main elements in the "IPCC SRES B2 median" storyline available in the baseline as adopted in your model?

One crucial note: although we tick appropriate space in the columns provided, all of it refers the national economy of Poland only, so **this information might be irrelevant from the global perspective.** Besides, these are the expected outcomes of a baseline to be elaborated on the grounds of historical performance (an actual baseline solution is waiting to be elaborated after we all have reached some consensus regarding common assumptions).

	Element in accordance with baseline	Element in contradiction with baseline	Element could be added to baseline	Element not specified / cannot be added to baseline	Comments
Population		X			One should not expect the population of Poland to exhibit an increasing tendency; the aging society must influence the socio-economic development
Economic growth		X			We are predicting higher rates of growth for Poland than the world's average (convergence hypothesis)
Global Income Equality				X	

Indicator					Description
Technological change		X			The rates of growth of technological change and human capital higher than the world's average (convergence hypothesis)
Primary Energy Demand				X	
CO_2 Emissions		X			The rate of CO_2 emissions lower than the world's average due to extensive technological change; if appropriate measures taken (carbon taxes) then the rate even lower

4. Which *other* elements in the B2 median storyline are well represented in the baseline as adopted in your model?

Too little specific question! No information concerning *other* elements! No baseline yet! (for Poland)

5. To what extent could the baseline in your model be adjusted to reflect the IPCC B2 median storyline? Please indicate the effort involved (in days of work).

The W8D is quite flexible in its ability to copy external assumptions, which means that we could incorporate the presumptions made by IPCC in their B2 variants. The question is however: what for? After all, the projections elaborated by IPCC concern the global economy and there is no point in claiming that Poland's performance will mimic that of the whole world's. Besides, taking for granted the assumptions regarding the overall economic activity, technological progress and population growth we would lose what constitutes the very essence of our model – its ability to treat all these issues in their simultaneous interlinks.

6. To identify common quantitative elements in the baselines, please provide the values of the main SD indicators according to the baseline as adopted in your model. You can indicate that your model cannot calculate the indicator by providing N/A.

Note: No baseline ready for Poland yet, so the ticks indicate only what can be forecast without assigning any figures

Region or country:	POLAND	
EC Indicator	2015	2030

I.	GDP per capita	YES	YES
II.	Labor productivity	YES	YES
III.	Employment rate	YES	YES
IV.	Employment rate of older workers	YES	YES
V.	Spending on human resources (public exp. on education)	YES	YES
VI.	Research and Development expenditure	YES	YES
VII.	Information Technology expenditure	NA	NA
VIII.	Financial market integration (conv. of bank lending rates)	NA	NA
IX.	At risk-of-poverty rate	NA	NA
X.	Long-term unemployment	NA	NA
XI.	Dispersion of regional employment rates	NA	NA
XII.	Greenhouse gases emissions	YES	YES
XIII.	Energy intensity of the economy	only *implicitly*	only *implicitly*
XIV.	Volume of transport	NA	NA
XV.	Competitiveness	only *implicitly* (measured by ?)	only *implicitly* (measured by?)

Comments:

7. Are there any policy simulations with your model available that reflect (elements of) the Renewed EU Sustainable Development Strategy (see attachment #2)? If so, please provide the relevant reports and references.

It seems that a lot of weighty questions regarding the Strategy can be answered by means of the new version of the W8D model, especially with respect to socio-economic aspects of sustainable development, among which e.g.:

a) the macroeconomic consequences of the aging society,

b) increasing the mandatory age of retirement,

c) increasing outlays on education and science, e.g. in line with the Lisbon Strategy,

d) increasing outlays on heath services,

e) promoting pronatalistic family policies,

f) promoting sustainable state budget.

So far, however, we can provide only one study carried out by means of the former version of the W8D model dealing with GHG emissions (see paper: *Macroeconomic consequences of introducing taxes on carbon dioxide emission in Poland*).

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8. Do you intend to produce further relevant reports within the time frame of the TranSust.Scan project?

No / Yes - only if need be!