VLEEM II - Minutes of the first technical Workshop Ademe, Paris, 29 April 2003

Participants: Markus Biberacher, Thomas Hamacher (IPP), Benoit Frachet, Nathalie Quercia, Bertrand Chateau (Enerdata), Martin Patel, Dirk-Jan Treffers (Utrecht University, Copernicus Institute), Hubert Reisinger (VPL), Paul Lako, K. Smekens (ECN), Jean-Marie Bouchereau (ADEME), Vincent Bagard (LET - Transportmodule-Economic aspect of time allocation), Gerhard Kolb, Ulf Birnbaum (Jülich)

Agenda and participants details in annex 1

Jean Michel Bouchereau welcomes the participants of the VLEEM-2 Workshop**.**

VLEEM-Project overview: B. Château, coordinator

Work programme
WP1: Enhancement of conceptual framework (month 1-9) Nov 02-July 03
WP2: DACES data base on conventional demand/supply modeling (month 1-18) Nov 02-April 04
WP3: Monographs (month 1-12) Nov 02-Oct03
WP4: TASES C++ program (month 6-14) May 03-Dec03
WP5: Case study 2100, 2050, 2030 (month 12-24) Nov 03-Oct 04

Management
The pilot committee (Enerdata, IPP, ECN; sponsors) is expected to meet for the first time on June 23, at the occasion of the next VLEEM meeting.

Dissemination
Most VLEEM partners will attend the worshop organised by the Energy Modelling Forum and IIASA ,24-26 June 2003, Vienna. Two papers will be presented:

T. Hamacher, M. Biberacher: TASES
B. Chateau, N. Quercia: VLEEM demand model

All deliverables, presentations and articles connected to the VLEEM projects are being made available on the Web site of VLEEM: www.VLEEM.org

All partners are free to invite whom they want at the open VLEEM seminars, either for scientific contribution or for dissemination purposes; if travel budget is needed, Enerdata must be involved as early as possible.

➢ State of the Art of WP 1

Overview; enhancement of the macroeconomic framework : B. Chateau

WP 1.1; Enhancement of the sustainability criteria for energy RTD strategies and elaboration of a memorandum on sustainability (expected to be completed June 03)
Next steps:

- Seminar on 30.April 03, minutes 07. May 03,
- proposal for sustainability criteria, to be accepted till end May by partners,
- Chapter: “How to account for human development and sustainability of energy systems in VLEEM” by end of June 03 (part of D1 report)

WP 1.2: very long term economic growth (expected to be completed June 03)
Review of theoretical approaches:

- Ingenue (CEPII): influence of demographic transitions on the world economy through savings and financial needs across generations and flows world wide
- Becker: optimizing allocation of time availability and economic services by individuals, both being limited by time for paid labor
- SEN: accounting for welfare and human development beyond the GDP
- Kondratieff: technology breakthrough and long term economic cycle

Next steps:

- Globalization and formalization of Becker equations, with economic quantities expressed in equivalent paid labour and introducing savings and income not related to current work; IDH as indicator for sustainable human development; introduction in the demand model
- Chapter on "How to account for economic development and equilibria in VLEEM" by end of June 03 (part of D1 report)

WP 1.3: economic exchanges among regions (expected to be completed August 03)
Not covered yet.

WP 1.4: transport system and transport needs (expected to be completed August 03)
Theoretical and modeling development of the future transport systems (presentation by Vincent Bagard– see below)

- Mobility generated by self-accomplishment services; alpha coefficient (share of traveling time on leisure time), theoretical approach

WP 1.5 Production system – water supply, self accomplishment and transport (expected to be completed August 03)
Not covered yet.

WP 1.6 Data (expected to be completed November 03)
Collecting data for the demand model in major developing countries (presentation by Nathalie Quercia– see below)

- collection of current statistics
- preparation of simplified questionnaire for collecting additional necessary data

WP 1.7: Integration of all above parts in the overall VLEEM framework (expected to be completed August 03)
Not covered yet.

Miscellaneous
Extra time needed for WP1: 3 months because we started a little late
All done by Enerdata
Other partners: contribution to workshops and brain storming.

Transport system : V. Bagard (WP 1.4)

Quantitative analysis
Graphic (1971-1998): Share in final energy in % versus GDP/cap:
Share of transport energy needs increases with increasing affluence from nearly nothing at 500 $ GDP/cap to 40 % with 20.000 $ GDP/cap.

Graphic: average annual growth rates of different services at constant price spending in France, from 1960-2000
Communication approx. 9 %/a; transport ; leisure ; average
Growth of travels 1985 to 2000: work + 28 %, leisure + 53 %
In transport related to leisure, high speed and distances grow overprotionally

Graphic: influencing parameters to leisure activities outside home
$C_{leisure}$ = f(time, goods)
Transport: cost in time and cost in good

Findings
Dissymetric effect of economic growth: with increasing GDP goods increase, however time availability = constant. Encourage the productive substitution of domestic time by domestic goods and services as long as domestic time is compressible

Rising demand of leisure commodities = rising demand of leisure time and goods
With increasing wage rates increasing opportunity costs

With increasing GDP, leisure time gets more “expensive”

(Tangible goods + intangible goods)/time = marginal utility of time (money + satisfaction, pleasure)

Average stay at one place for holidays is decreasing (1975-2000 from 21 days to 13 days)
Increasing variety of opportunities in the same time segment (visits, escapades…) = increasing travel needs
Leisure goods increased 230 %, while leasure time increased by 30 %:
Home working goods (washing machine) increased, home working time decreased a little

Modeling: increasing number of leisure time targets, travel distances and travel speed

Data collection: N. Quercia (WP1.6)

Type of sources:
1. Transverse sources: Enerdata database, World Bank, FAO, US Census Bureau.
2. National sources: National statistical institutes, Ministries, studies.
3. Estimations.

Some data are from world regions, some from representative sample countries

It is necessary to deepen data collection about:
- Rural/urban differentiation.
- Dwelling production.
- Africa.

A questionnaire was prepared to collect more data (see attachment). Consortium partners are requested to inform ENERDATA of any contact point they have, to which the questionnaire can be sent (please provide e.mail).

➢ State of the Art of WP 2

Linkage DACES-VLEEM: Overwiew (M. Patel)

Scope: conventional demand side technologies from DACES, future technologies in transport and energy intensive industry, supply side from DACES

Link VLEEM-DACES: Extension of DACES by materials, freight, buildings and other, calibrating elasticities in VLEEM, inflate DACES from NL, 2050 to EU and the development dynamics

DACES 2050 progress:
Heat demand residential sector
Electricity and head demand development till 2050 for frozen efficiency strategy and very efficient strategy.(no new technology families are taken into account – e.g. no new technology for food conservation like inert gas or vacuum utilization instead of food cooling, e.g. no household roboter)

Unknown technologies must be treated in a top down macro economic way, because we do not know these technologies. But their minimal - maximum demand should be estimated and taken into account.

Strength of DACES meeting the demand from the end use sector by the supply side

Next steps:
- Road freight technologies and service demand/energy demand, including speed development (with increased value of the transported goods, the speed for transport should increase in order to avoid lack time and capital binding – which technologies and infrastructure can fulfill the increased transport and speed demand?)
- Energy intensive industry materials plus the industrial processes in which they are applied (till August 2003)

Methodology: DJ Treffers

Graphic: Consumption/capita = f(GDP/capita) for different material
Needed: Knowledge which material is used for what
Then the material need is estimated
Then the energy need for producing this material is estimated
Analysis for energy efficiency potentials: 5 %/a for efficiency improvement of new production plants, O.K. till the year of 2020, later on weak; focus is on the energy intensive part of the whole material chain
Estimate for energy use for various materials in 2050 for heat, electricity, fuels

Hydrogen technology for steam generation?

Calibrating e elasticities (specific energy consumption (SEC) and activity (ACT)) = f (information)
Useful_Energy = SEC*ACT*(1+((I_{2100}/I_{2000})^0.01)*e)

Assumption: It is expected that the production of bulk materials will get more and more similar world wide

Next steps:
- Further refinement: split of final energy use by types
- More bulk materials
- Once through for EU-15
- Application for buildings and freight transports
- Further regions (region specific elasticities)

Discussion and conclusions

B. Chateau:
- Carefull: DACES should focus on demans side technologies and produce energy demand by energy carriers on the basis of the needs of energy services as calculated by VLEEM demand model, and not overlap
- Freight transport: DACES should take ton-km per speed categories generated by VLEEM demand model as an input (not overlap), and apply appropriate technologies according to speed categories.

T. Hamacher :
- Demand side technologies cannot be treated independantly from energy supply technology paradigm
- There is a relation between the efficiency of the process for energy intensive bulk material production, and the energy carrier used (which has to be consistent with the supply technology paradigm.

Conclusion:
- urgent need for a closer interaction between the three components of the final VLEEM model: energy services, supply technology paradigm (TASES), demand side technologies (DACES-2050)
- technica workshop planned on 22 May, Utrecht

➢ State of the art of WP4

Back casting: conditions of a market entry of new technologies: T. Hamacher

Simulation or optimization of the end point system is possible to check if/how sustainability criteria are met

To translate needs into energy units it is necessary to interpret the needs with a technology cluster. Interpretation of needs with technology clusters: as much information as possible to be used for technology. For example, Transys analysis/simulation tool for houses (can be adapted by climate and technology to different world regions.

Diffusion pattern: no model existing yet: start with diffusion curves from the end point.

Scenarios and identification of milestones = first step of backcasting (with example PV):

- Overall framework:
  - continuous climate change efforts
- major events
  - no acceptance for nuclear and sequestration
  - depletion mid points of natural gas (2060) and crude oil (2035)
  - potential of non-solar renewables reached (2058)
- Restrictions:
  - Renewable solutions restricted in potential
- Strategies:
  - market entry (2005)
- Milestones
  - PV cost competitive in restricted applications (2018)
  - hydrogen to enter fuel market (2050)
  - implementation of large solar thermal plants in the south (2070)
  - set-up of a new electricity storage infrastructure (2090)
  - set-up of new electricity transport infra-structure (2095)

Analysis of the market entry of technology or paradigm a mix of quantitative and qualitative approaches:

- Involved actors (matrix to check if the different actors are losers or winners, respectively)
- Important technical issues (infrastructure requirements)
- Economic issues
- Environmental issues (sustainability criteria)
- Geo-political matters

Global model + 3 local examples (towns) for investigating actual load and production patterns.
2 case studies under way, will be presented in June at IIASA-EMF conference.

Software of the demand model, sub-models dialogue : B. Frachet

TASES, Enerdata-Demand-Software and other Modules are built in parallel, but must remain however compatible.
One transcription module creates from the output of a module a text file which can be fed into the data base of the other modules
The program is done in C++

Simulation of a high renewable end case with TASES: M. Biberacher

Data Sources:

- Wind atlas from www.Sander-Parnter.ch, Disagregated from 6 to 1 hourly values by Weibull-wind speed distribution curve
- Solar: www.satellight.com
- Energy demand: UCTE-demand by country extrapolated (2000-2100), electricity, low and high temperature demand

TASES:

- Simulation
- Linear optimization (MPS-matrix of up to 1 GByte) – CPLEX or MOSEK solver
- Evolutionary optimization
- Actor based optimization

Case study: High renewable case for UCTE-countries
Each country one node (G, F, Es, It 2)

First results:
PV 10,000 km²
Wind: 314 GW
Hydro: 91,7 GW
Wood potential for heat:

300 TWh of hydrogen storage would be needed
Pumped storage has to be used for daily load shift; for longer energy shifts, hydrogen is used

Case study: High fossil case
Much less hydrogen storage needed

IPP works on low temperature and cooling patterns

Next focus: Load curves for Europe

Discussion, conclusions

- IPP stresses the necessity that the VLEEM results on energy demand should be also delivered as load curves.
- Agreement on the format of the transcription modules among sub-models should be reached at the next technical workshop at Utrecht (22 May).

➢ State of the art WP3

Additional technologies considered for monographs : overview (K. Smeekens)

Technology list:
- Extraction
- Conversion, fossil and non fossil
- CO2 capture and storage

Regionalisation:
- Model grid
- Regionalization of technologies
- trade

Extraction:
- Developments on off-shore extraction, coal bed methane
- Non-conventional fossil fuels
- Hydrogen production

Conversion:
- Biomass: energy utilization and biofuel processing technologies (ongoing work on ECN) **including Biomass potential**, not included non energy use of biomass like bio feedstocks, woody products (however, maybe some ideas on that) – till end 2003
- Fossil: existing data base: UU, IPP, ECN
- Non-fossil:

Coal:BGR (Bundesanstalt für Geowissenschaft und Rohstoffe, Braunschweig?): Overview of resources and reserves (U. Birnbaum does not belief that new mining techniques will be necessary, as the coal reserves accesible by existing mining technologies are huge).

Conversion of coal to liquids as compared to hydrogen
Is this enough, some break through needed?

CO2-Capture and Storage:
- Large scale only ocean storage?, ECBM (coal bed methane), EOR, depleted fields
- Sources: IPCC, IEA-GHG, Vleem 1

Geothermal is open

Proposal: Workshop on very long term technologies (coal, CO2-sequestration. Hot-dry-rock…..) proposed for Jülich

Inputs from ECN: monographs, roadmaps, TASES (B Lako)

Overview of hydropower and hydro power projects
- Theoretical, technical and economic potential
- Capacity
- Start of commercial operation
- Cost

Running hours typically 3500-5000 h/a

Specific investment costs over cumulative installed capacity, most at about 1000 $/kW in China, at about 1700 $/kW in Central America, Canada: 2000 $/kW

Potentials in developing world

Discussion:
- possibilities of exports of large amounts of hydropower (T. Hamacher)
- influence of climate change on hydro potentials (B. Chateau)

Inputs from Verbundplan : monographs, roadmaps, TASES (H Reisinger)

The presentation concern hydro power reserve potential, load curves, clean coal technologies, hydrogen-electricity comparison

Inputs from Juelich: monographs, roadmaps, TASES (G Kolb, U Birnbaum)

Progress on the Fission monograph (G Kolb)

Inclusion of technologies near to potential deployment
New development activities
Road map for generation IV nuclear energy:
- Gas-colled fast reactor systems
- Lead cooled fast reactor systems
- Sodium cooled fast reactor systems
- Molten salt reactor systems
- Supercritical water cooled reactor systems
- Very high temperature reactor system (1000 °C)

Some of them are also for heat or hydrogen production

Mathematical formulation:
VLEEM 1: Excel based model (problems with changing technologies and time steps)
VLEEM 2: C++ based programs,first stand alone model for validation, then merged into TASES

Graphics: Market penetration of high nuclear case + capacity additions with a reduction of the Plutonium stockpile

Next steps:
- finalization of the nuclear mass balance model (till Aug03)
- Integration into TASES (end 2003)
- Update of monograph (end 2003)

Sustainable Energy Policy to Meet the Needs of the Future (U Birnbaum)
- increasing share of renewables
- increasing share of distributed generation
- 6th frame work program

WADE; World Survey of Decentralized Energy 2002/2003

Problem of fuel cells is their weight: 200-250 kg for a car engine

Miscellaneous :Bertand Chateau

- Seminar on sustainability (Enerdata will write a synthesis afterwards) – chair for the seminar Ademe
- Further work program, meetings: back to back with IIASA meeting on June 24-26: On June 23 in Vienna, Verbundplan main office
- Dissemination:
  - Participation in conferences strongly recommended,
  - Website: publications + minutes + links
  - ideas for dissemination activities
- Counterparts in developing countries for data
- VLEEM I final payments

Topic	**Information/Action**	**Action by**
WP1	Minutes of sustainability seminar till 07. May 03	Enerdata
	Proposal for sustainability criteria, Review of sustainability criteria till end May	Enerdata **All**
	Chapter: "How to account for human development and sustainability of energy systems in VLEEM" by end of June 03 (part of D1 report)	Enerdata
	Chapter on "How to account for economic development and equilibria in VLEEM" by end of June 03 (part of D1 report)	Enerdata
	Distribution of transport time modelling approach	LET
	Questionnaire on new data	Enerdata
	Sources to which send these questionnaires: addresses to be sent to Enerdata (IPP-India and Tanzannia, Salvador Rivas in El Salvador,…)	**All**
WP 2	Distribution of MATTER/MARKAL model data for construction of dwellings that is not reported on www.ecn.nl	Koen
	Data on: Road freight technologies and service demand/energy demand, Energy intensive industry materials plus their processes (till August 2003)	Utrecht
WP 4	Presentation on first TASES case study results till end of June	IPP
WP 3	BGR data on coal reserves	Birnbaum
	Hydrogen group of the commission interim report on the internet: distribute Internetaddress	Birnbaum
	Monography on Geothermal energy (conventional + hot-dry-rock)	ECN
	Biomass: energy utilization and biofuel processing technologies (ongoing work on ECN) **including Biomass potential** – till end 2003	ECN
	Fuel Extraction – open, to be decided	
	Update of Sequestration Monograph (costs, potentials by final storage, energy requirements)	ECN
	THERMIE-coal technology report send to Hubert	Patel
	Fuel cell monograph update with implication on the electricity grid. Including price reduction by component	Ulf Birnbaum
Meetings	Meeting – demand modelling in Utrecht 22nd May	Utrecht, IPP, Enerdata
	Meeting in Vienna June 23	**all**
	Meeting in October (23-25) 2003 in Garching with Oakridge people – on impact of fusion on developing countries	Hamacher
Invoicing	Invoice for the final payment of VLEEM I to be sent to Enerdata	ECN

Bibliography:

B. de Vries, J. Goudsblom (eds.); Mappae Mundi; Humans and their Habitats in a Long-Term Socio-Ecological Perspective – Myths, Maps and Models; Amsterdam University Press, Amsterdam 2002; ISBN 90 5356 535 3 (Book on historic development of human population as reaction on environmental conditions)

Rapport Mondial Sur Le Developpement Humain 2001 – Mettre les nouvelles technologies au service du development humain; United Nations Development Program, New York 2001; ISBN 2-8041-3727-9

Wolfgang Sachs, Gustavo Esteva; Des ruines du development; Les Editions Ecosociete, Montreal, 1996; ISBN 2-921561-05-0

Bruno Keller; Klimagerechtes Bauen; B.G. Teubner, Stuttgart

HJM de Vries, DP van Vuuren, MGJ den Elzen, MA Janssen; The Timer Image Energy Regional (TIMER) Model; Report 4615020224/2001; Technical Documentation; RIVM, Bilthoven, 2001

D.P. van Vuuren, H.J.M. de Vries; Mitigation scenarios in a world oriented at sustainable development: the role of technology, efficiency and timing; RIVM report 490200 001; September 2000

Metz, B., et al.; Towards an equitable global climate change regime: compatibility with Article 2 of the Climate Change Convention and the link with sustainable development; Climate Policy 2 (2002) 211-230 (Elsevier – www.climatepolicy.com)

Vuren van D.P., Vries de H.J.M.; Mitigation scenarios in a world oriented at sustainable development: the role of technology, efficiency and timing; Climate Policy 24 (2001) 1-22

Vries de B., et al.; Perspectives on global energy futures: simulation with TIME model; Energy Poliy 27 (1999) 477-494 (Elsevier – www.elsevier.com/locate/enpol)

Janssen, M.A., Vries de, B.; Climate Change Policy Targets and the role of technological change; Climatic Change 46 (2000) 1-28

Vries de, B., et al.; Greenhouse Gas Emissions in an Equity-, Environment- and Service-Oriented World: An IMAGE-Based Scenario for the 21st Century; Technological Forecasting and Social Change 63 (2000) 137-174

ANNEX 1

Agenda

9.30 –9.35 : **WELCOME** (J.M. Bouchereau, ADEME)

9.35 –10.00 : **OVERVIEW OF VLEEM 2 DEVELOPMENT** *(B. Château)*

10.00 – 11.00 : **STATE OF THE ART OF WP1** (animator: B. Chateau)
- Preparation of the seminar on sustainability (*B. Chateau*)
- Enhancement of the macro-economic framework (*B. Chateau*)
- Transport system (*V. Bagard, LET*)
- Data collection *(N. Quercia, ENERDATA)*

11.00 – 11.15 : Coffee break

11.15 – 12.00 : **STATE OF THE ART OF WP2** (animator: M. Patel)
- Linkage DACES-VLEEM: overview (*M. Patel*)
- Methodology *(D. Van Treffers)*

12.00 – 12.45 : **STATE OF THE ART OF WP3** (animator: K. Smeekens)
- Additional technologies considered for monographs: overview (K. *Smeekens*)
- Inputs from ECN: monographs, roadmaps, TASES *(P. Lako)*

12.45 – 14.00 : Lunch

14.00 – 15.30 : **STATE OF THE ART OF WP3, CONTINUED** (animator: K. Smeekens)
- Inputs from Juelich: monographs, roadmaps, TASES *(G. Kolb, U Birnbaum)*
- Inputs from IPP: monographs, roadmaps, TASES *(T. Hamacher)*
- Inputs from Verbundplan: monographs, roadmaps, TASES *(H. reisinger)*

15.30 – 15.45 : Coffee break

15.45 – 17.00 : **STATE OF THE ART OF WP4** (animator: T Hamacher)
- simulation of a high renewable end case with TASES (*M. Biberacher*)
- Back-casting: condition of market entry of new technologies *(T. Hamacher)*
- Concept of the demand model *(B. Frachet, Enerdata))*

17.00 – 18.00: **MISCELLANEOUS** (animator: B. Chateau)
- Seminar on sustainability 30-04
- Agenda further work programme, meetings
- Dissemination of VLEEM results