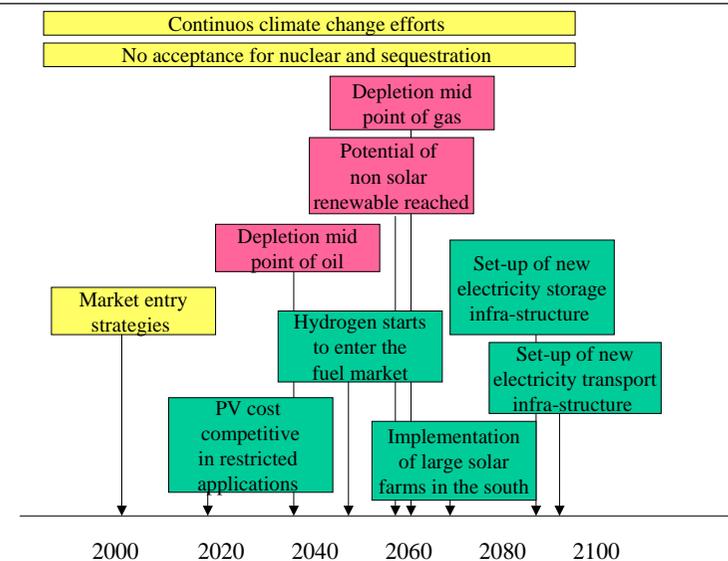## VLEEM II: The role of software in the analysis

1. Back-casting: a list of major events

2. The software-hierarchy

3. Balance model as simple work-hoarse

4. The three steps of the analysis:
   interpretation of needs with cluster
   design of end-point with TASES
   back-casting with balance model and TASES

## VLEEM II: Back-casting

VLEEM II: Major "event" types

Major event types:

* political, economic and social settings (strong support of climate change, limited world trade, no enthusiasm to support large scale nuclear)

* major indispensable events (depletion of resources, evidence of climate change becomes obvious or even dramatic, ...)

* major investments in energy conversion and infrastructure, major organisation arrangements (construct first fusion plant, global acting companies,...)

VLEEM II: The VLEEM Software Philosophy
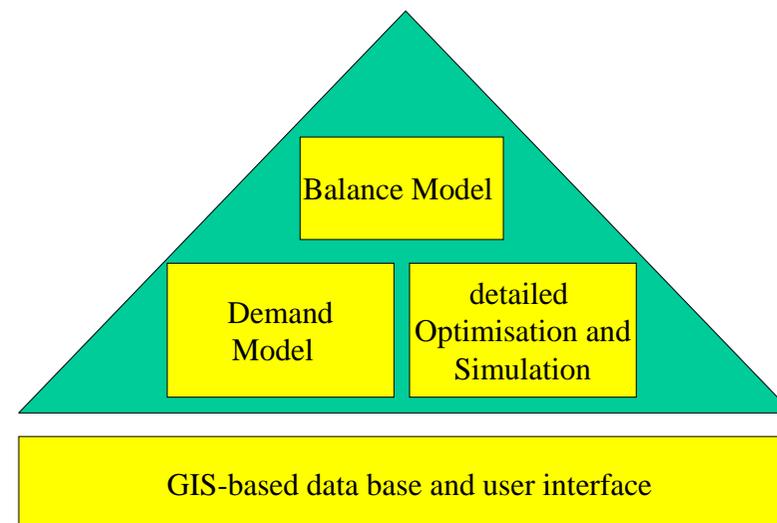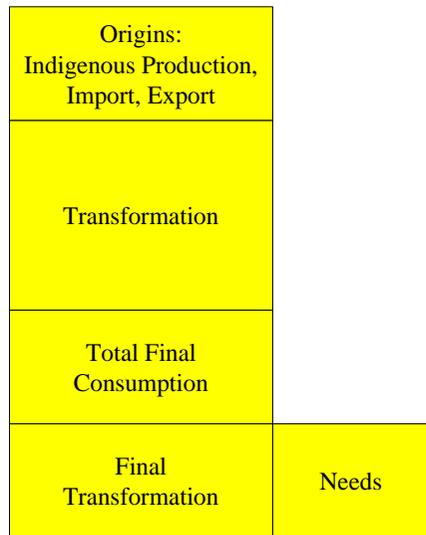
VLEEM II: The balance model

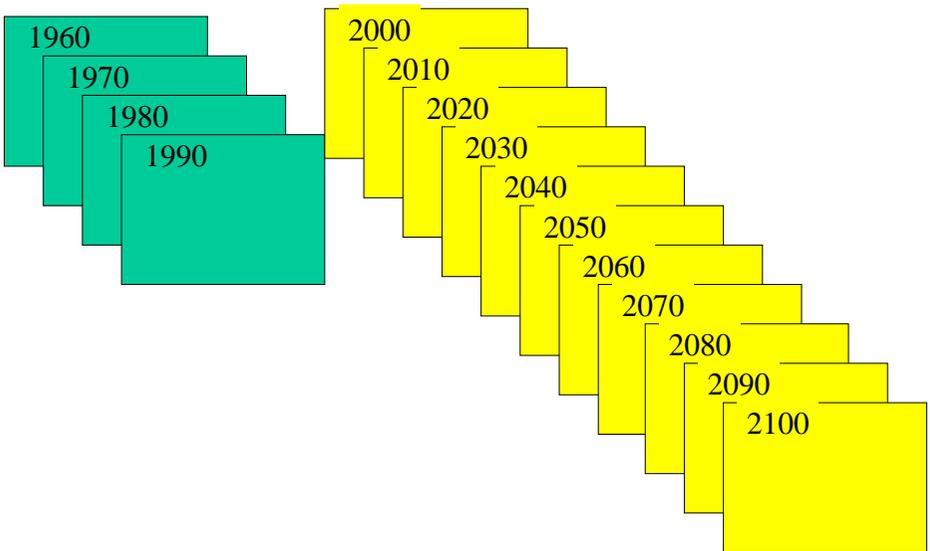|		coal	gas	...	electricity	heat
Indigenous Production						
Import						
Export						
Power Plant						
Heat plant						
...
TFC						

	need1	need2 ...	
low-energy house+electricity heating			
train-like person transport			
Total	3000	5000	

Years: 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100

Origins: Indigenous Production, Import, Export

Transformation

Total Final Consumption

Final Transformation

Needs
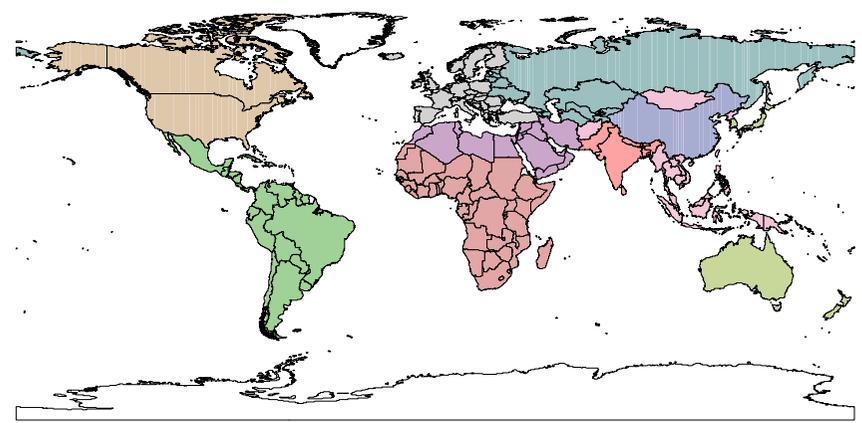
VLEEM II: The balance model

The balance model is a simple "optimisation" tool delivering balance tables for all milestone years.

Objective function: A sum of all primary energies and installed capacities, which are weighted according to the "user"
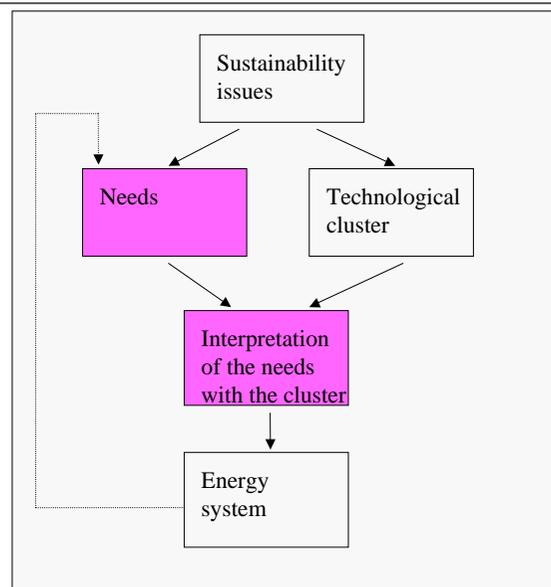
Constraints:
* reach end-point
* supply needs
* do not violate diffusion pattern
* keep old installation
* keep resource limits
* keep emission limits
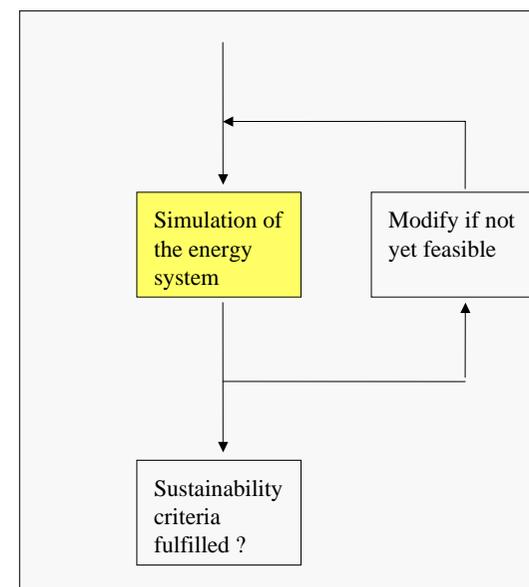* ...

VLEEM II: Additional balance models (nuclear)

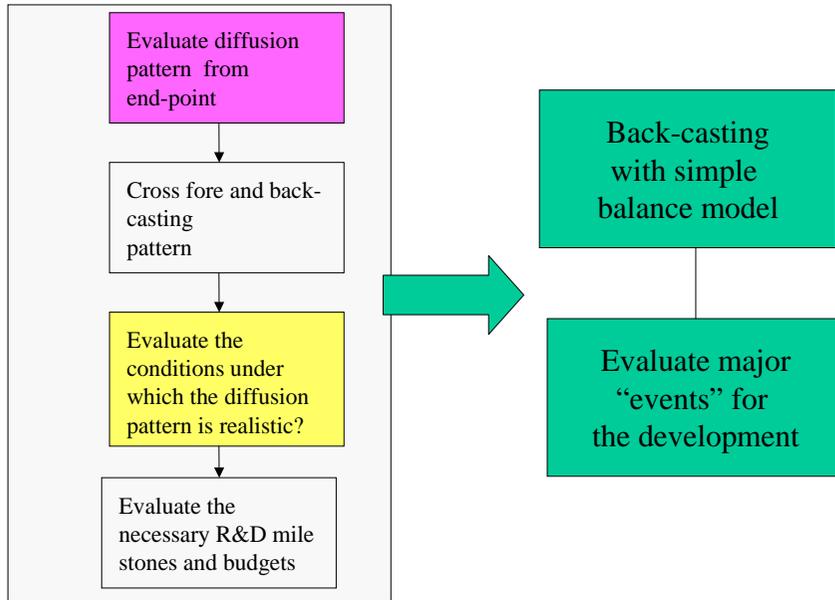* in a similar fashion a more detailed model for nuclear fuels and waste can be developed

VLEEM II: General outline of the methodology

Sustainability issues

Needs

Technological cluster

Interpretation of the needs with the cluster

Energy system

VLEEM II: General outline of the methodology

Simulation of the energy system

Modify if not yet feasible

Sustainability criteria fulfilled ?

VLEEM II: General outline of the methodology **IPP**

Evaluate diffusion pattern from end-point

↓

Cross fore and back-casting pattern

↓

Evaluate the conditions under which the diffusion pattern is realistic?

↓

Evaluate the necessary R&D mile stones and budgets

→

Back-casting with simple balance model

Evaluate major "events" for the development

Conclusion **IPP**

* ARCVIEW offers a simple way to link all analysis tools, to have a common data base (geographical referenced) and a "simple" user interface

* software for all steps in the VLEEM analysis exist

* linkage needs to be established

* the informal part of the back-casting needs still some formalisation (first important step: list of major events)