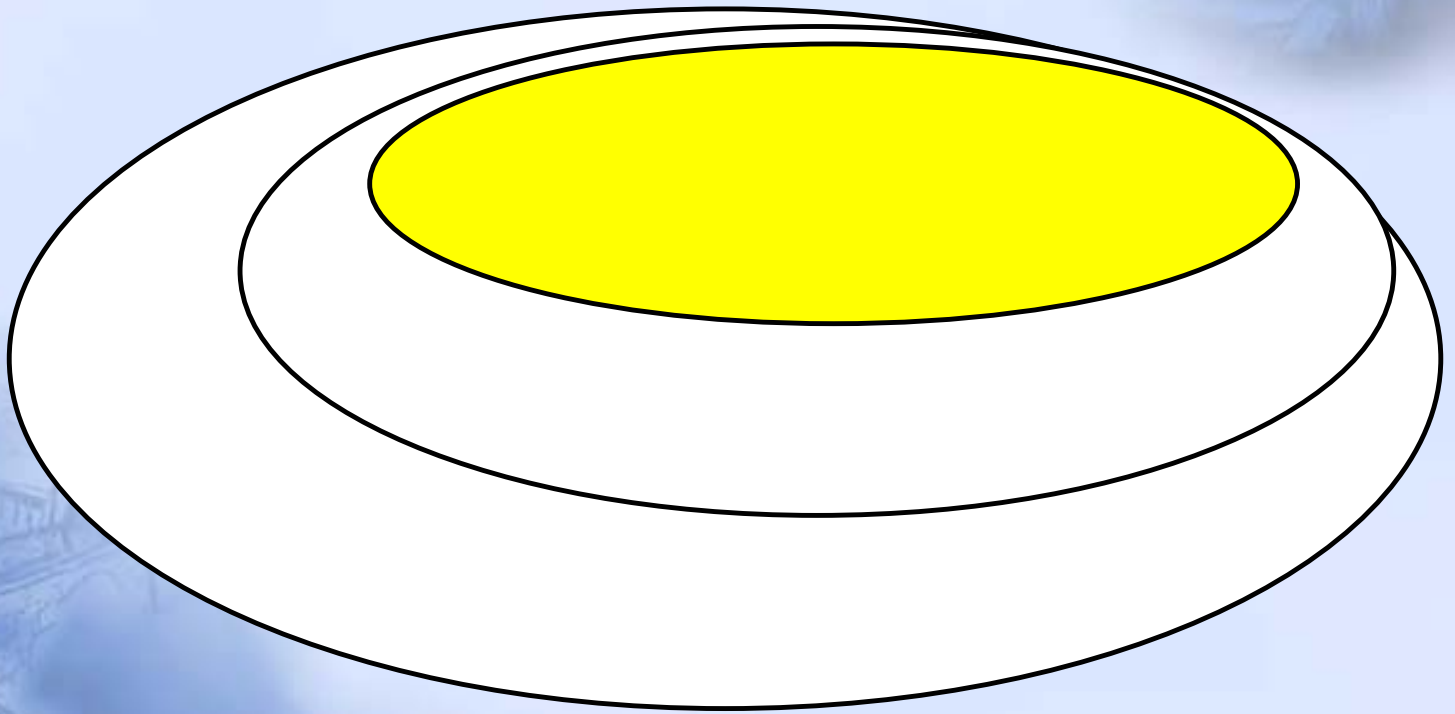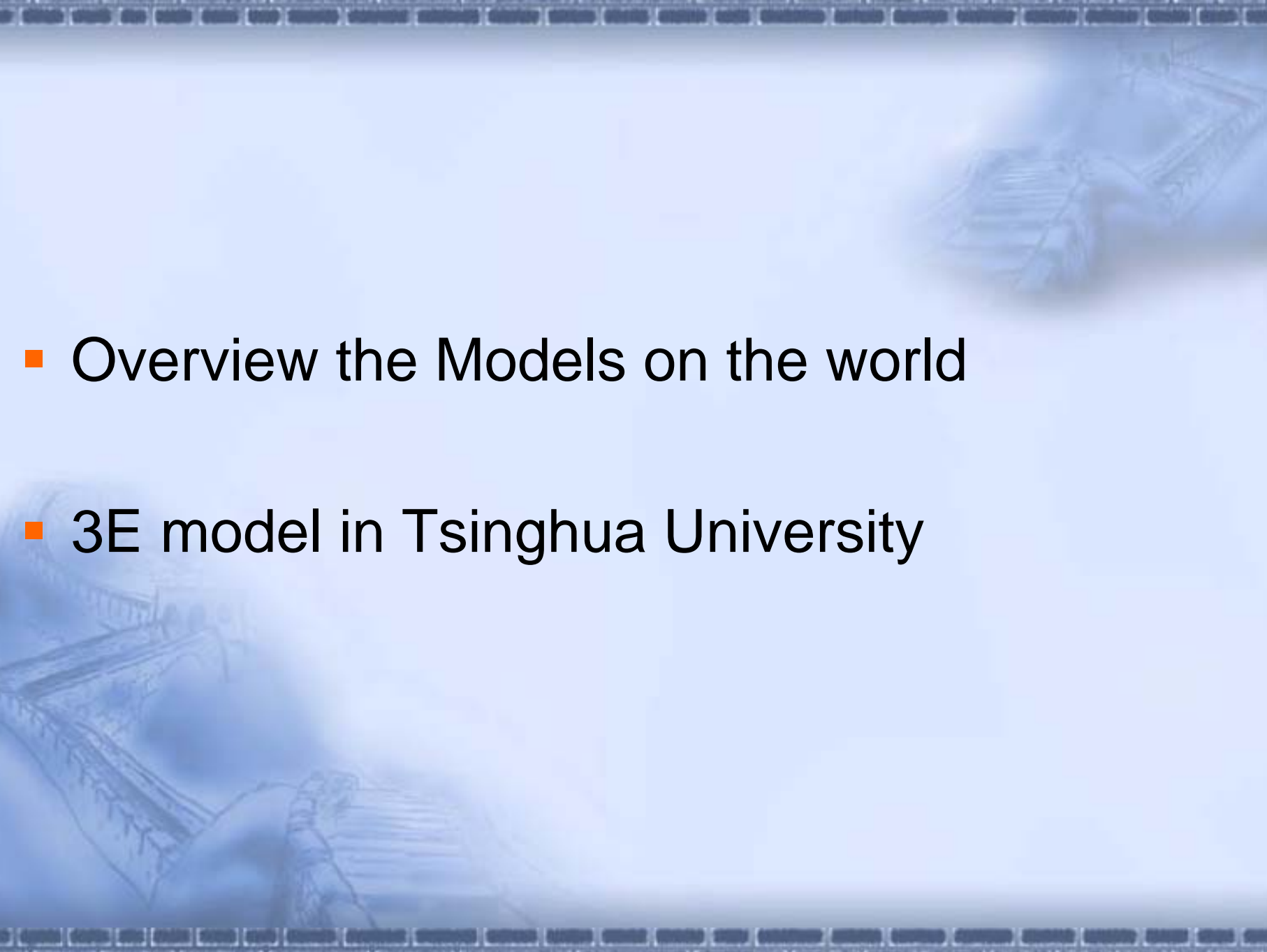# Introduction on Models in GHG Mitigation Research

——Li Jifeng

- Overview the Models on the world

- 3E model in Tsinghua University

Overview the Models in the World

——the first part

Overview the Models on the world

Three approaches of the models used to analyzing the GHG mitigation cost:

➢ Bottom-up models

➢ Top-down models

➢ Hybrid models

Overview the Models on the world

➢ Bottom-up models (Engineering models)

MARKAL Model   (IEA)

ESOM(France)

AIM (NIES, Japan. 1991)

Overview the Models on the world

Common Features of Bottom-Up Models

- usually use optimizing methods to design the energy strategies with the least cost under some GHG mitigation restriction

- exogenous energy demand

- detailed technical description of energy supply, energy conversion and end-use technologies, and in the result, a detailed technology options can be taken out

- little consideration on economic system

  can not tell policy maker what to do

Overview the Models on the world

➢Top-down models

a) macro-economy models

b) I/O model
   Research on environmental policy (Miller and Blair, 1980's)
   CO2 reduction from structure adjustments in Germany and The UK (Proops et al, 1993)

Overview the Models on the world

c) CGE Models

- The microeconomic foundation of CGE models provides a consistent framework for studying price-dependent interactions between the energy system and the rest of the economy. So the effects of some environmental policy can be analyzed.

- the energy system analysis lacking of detailed technological information on the energy system. So that can not tell policy maker why do so

Overview the Models on the world

➤ **Hybrid models**

given the relative strengths and weaknesses of Bottom-up model and Top-down model, integrating them into a model can serve to complement each other.

Prior models

- MARKAL-MACRO
- MENSA-MERG (Australia)
- HERMES-MIDAS (Europe)
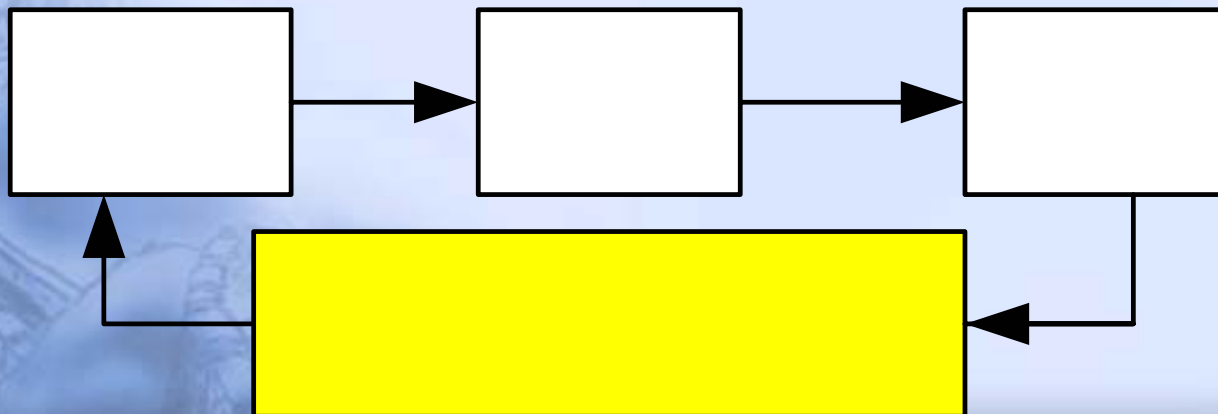
3E Model in Tsinghua University

——the second part

3E model in Tsinghua University

➢ What's it?

An integrating assessing model to study CO2 mitigation cost, cover the economy system and energy system

➢ Structure of the Model (the yellow part is under-designing)

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➢ MEM (Macro Economy Model)

  a macro-econometric model

➢ EDFM (Energy Demand Forecast Model)

  link the MEM and ESOM

  input the Macro-economic parameters, and output the Energy Demand to ESOM.

➢ ESOM (Energy Supply Optimized Model)

  Optimizing the technology choices at the least CO_2 mitigation cost.

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➢ MEM (Macro Economy Model)

▪ the core equation :

GDP=Consumption+ capital formulation+ stock

▪ six modules included:

final demand; government income and resident income; population and labor;

capital formulation; production.

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➢ ESOM

Based on the energy flow network, multi-period linear program model.

- the object function:

    the energy system operating cost is at least.

- the subject includes:

flow equilibrium; demand; capacity; activity;

Pollution emission; end-use equipment investment/ energy resource /foreign exchange

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- Technologies collected into the model:

Total 208 technologies, in which

123 end-use technologies; 69 energy transition technologies; 9 energy import technologies; 7 energy exploiting technologies

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- ### The results of models

a) MAC and CO_2 mitigation cost in diverse sectors in economy system

b) energy system investment, energy system cost

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➤ What's the imperfectness of present 3E models?

the main problem: Lack of the feedback from the energy system to economy system

Thanks for your listening!
Any questions?