Energy Policy Analysis and Strategies

Concepts and Procedures

Basic questions

- Why do we want/need to plan?
- What time frame to we have to finalize our studies?
- What personal and financial resources are available?
- Who is the recipient of our investigations?

Why do we want/need to plan? (1)

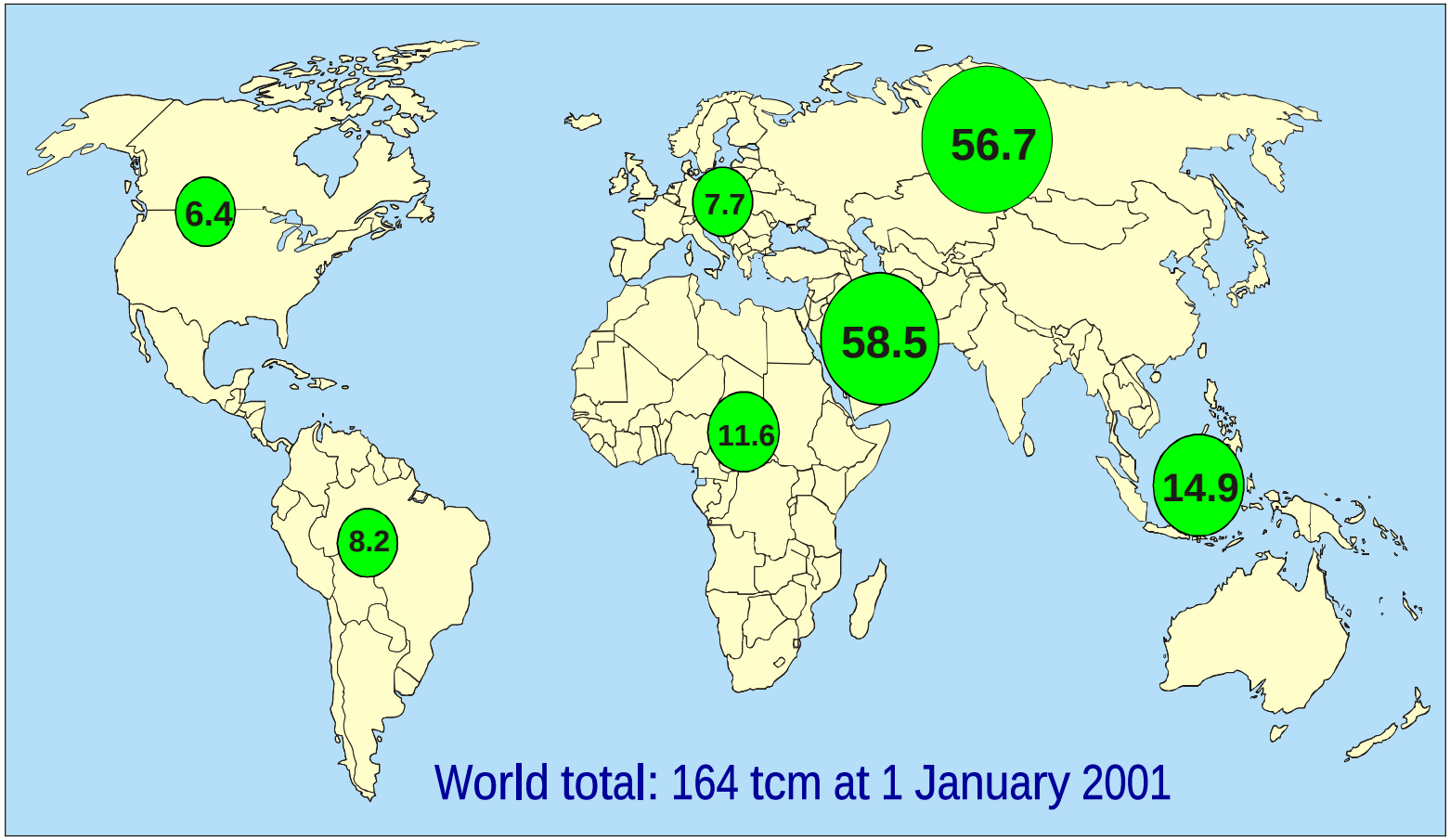
- Are local resources becoming scarce or too expensive?

WORLD ENERGY OUTLOOK

2002

INTERNATIONAL ENERGY AGENCY

Proven Gas Reserves



Ultimate remaining resources (including proven reserves) are an estimated 453 - 527 tcm

Why do we want/need to plan? (1)

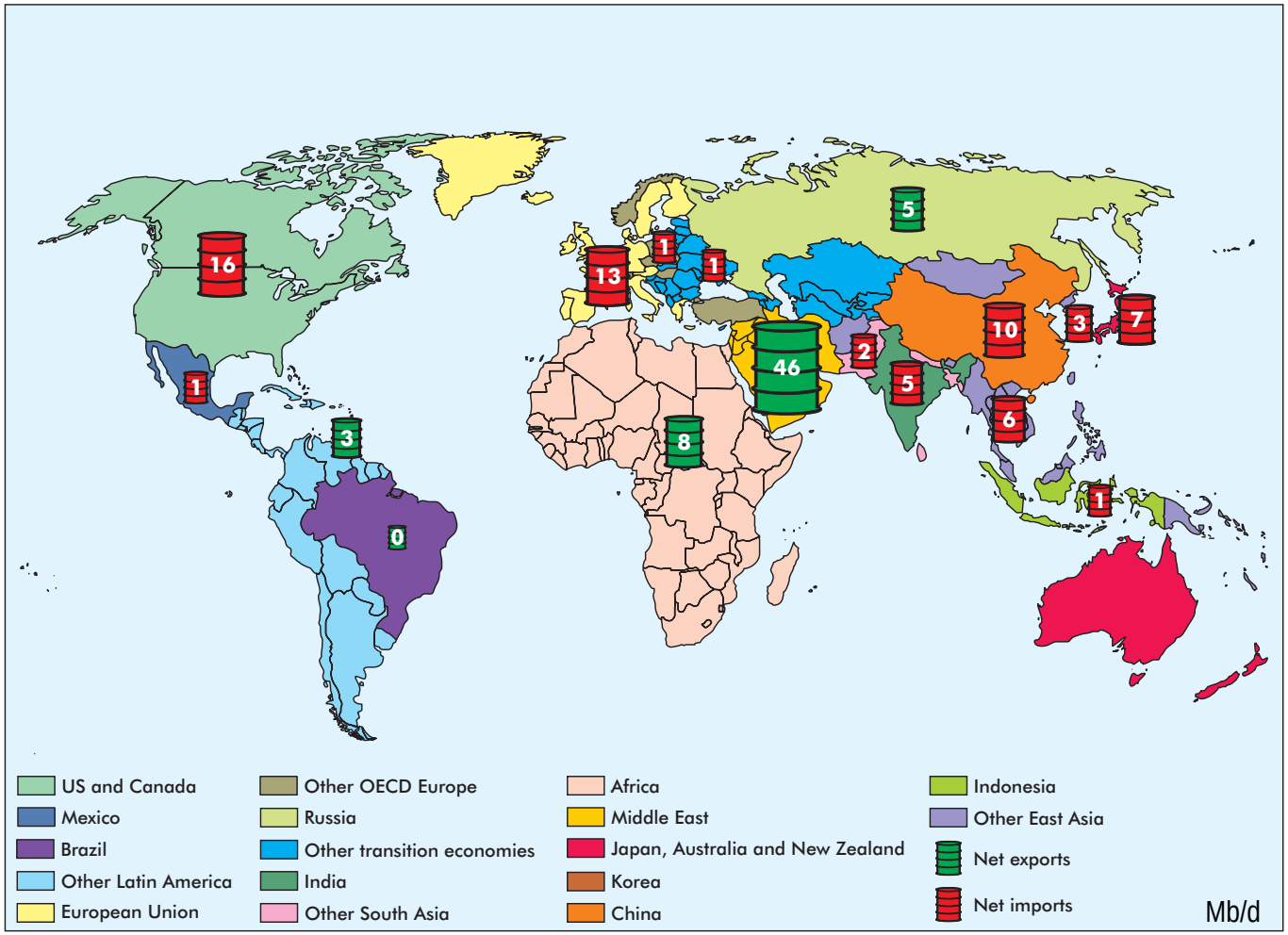
- Are local resources becoming scarce or too expensive?
- Is the current energy supply strategy too insecure?

WORLD ENERGY OUTLOOK

2002

INTERNATIONAL ENERGY AGENCY

Net Oil Trade, 2030

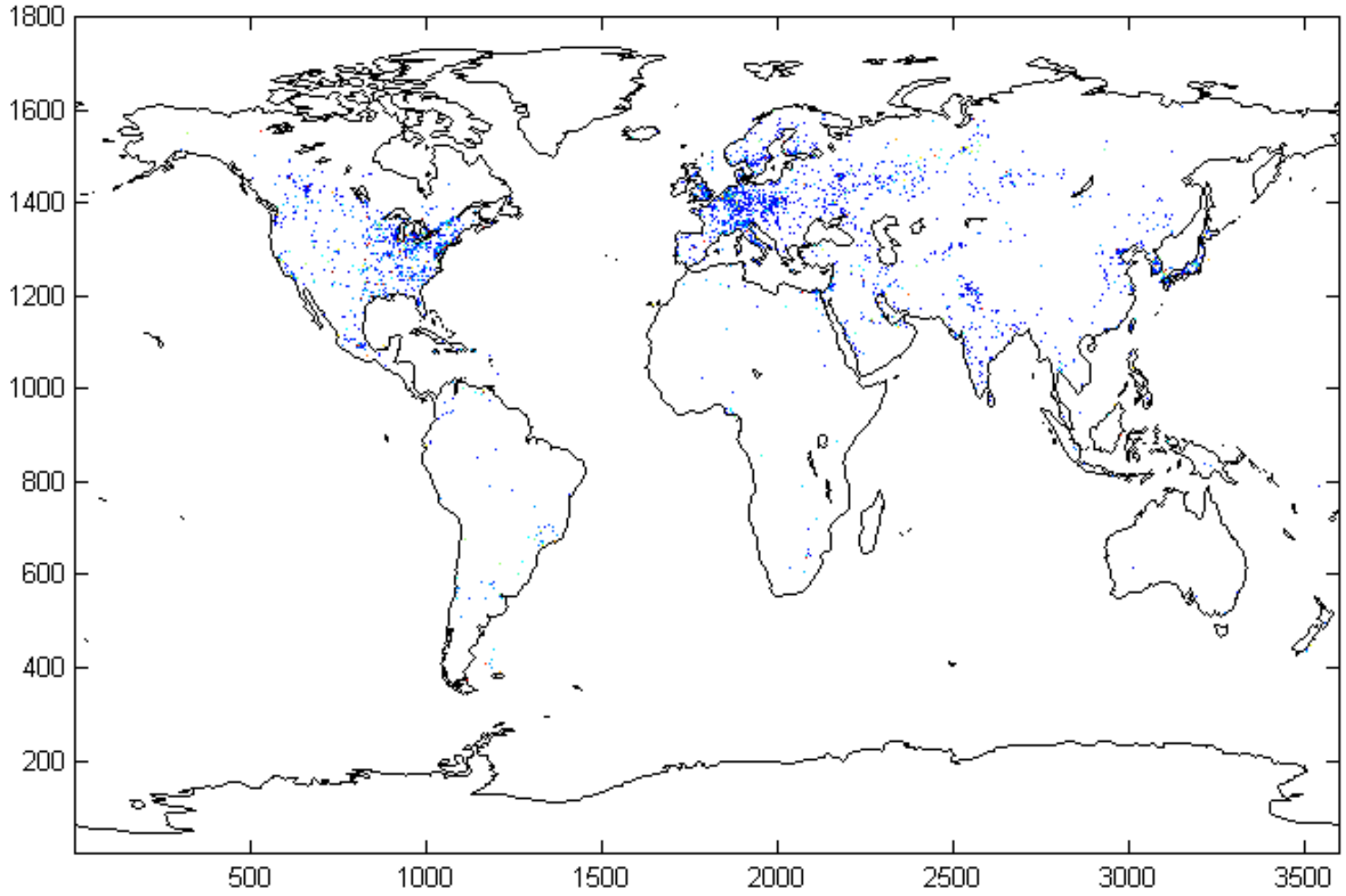


The Middle East strengthens its position as the world's largest oil exporter

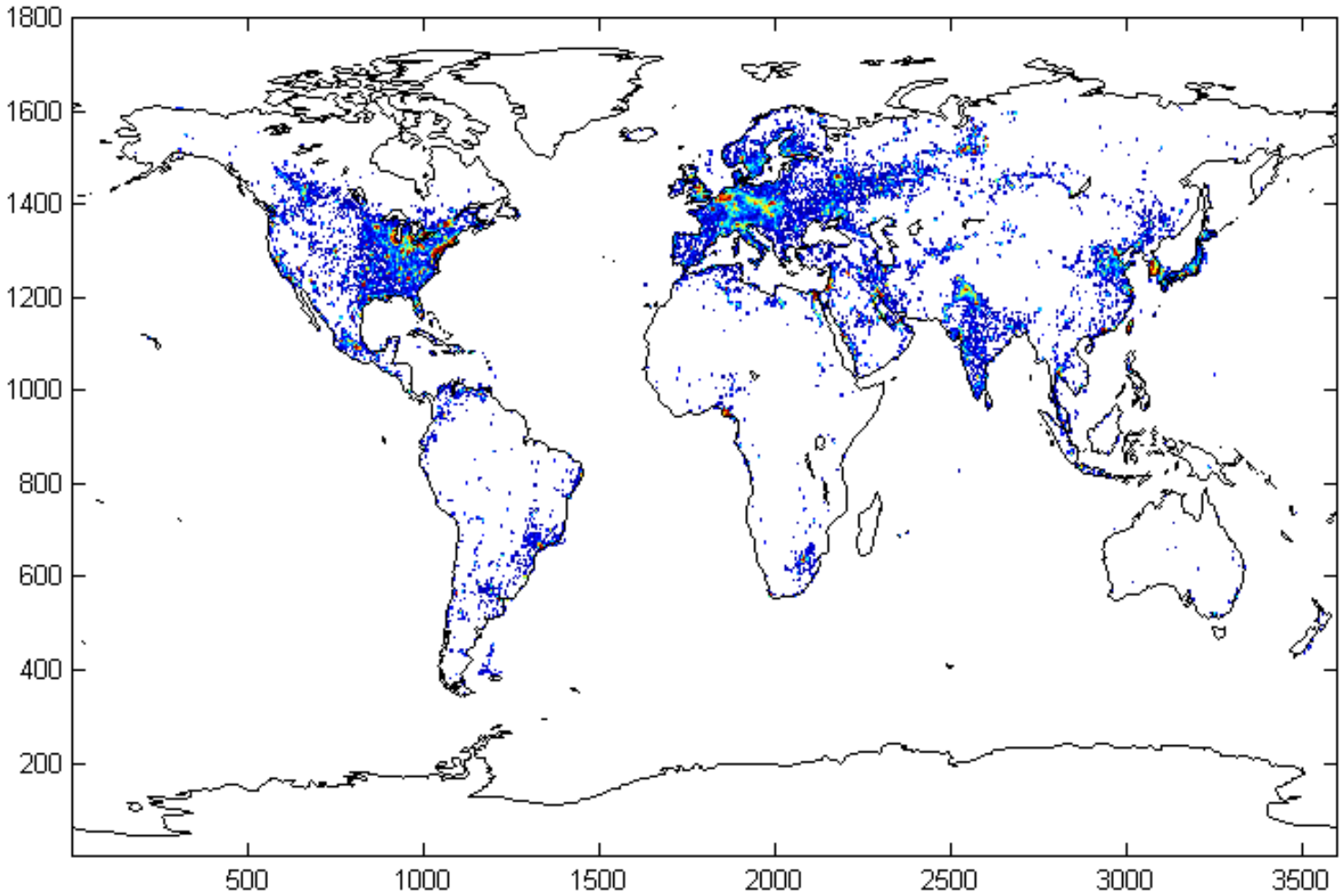
Why do we want/need to plan? (1)

- Are local resources becoming scarce or too expensive?
- Is the current energy supply strategy too insecure?
- Is the current energy supply level too low?

1995


1800
1600
1400
1200
1000
800
600
400
200
500
1000
1500
2000
2500
3000
3500

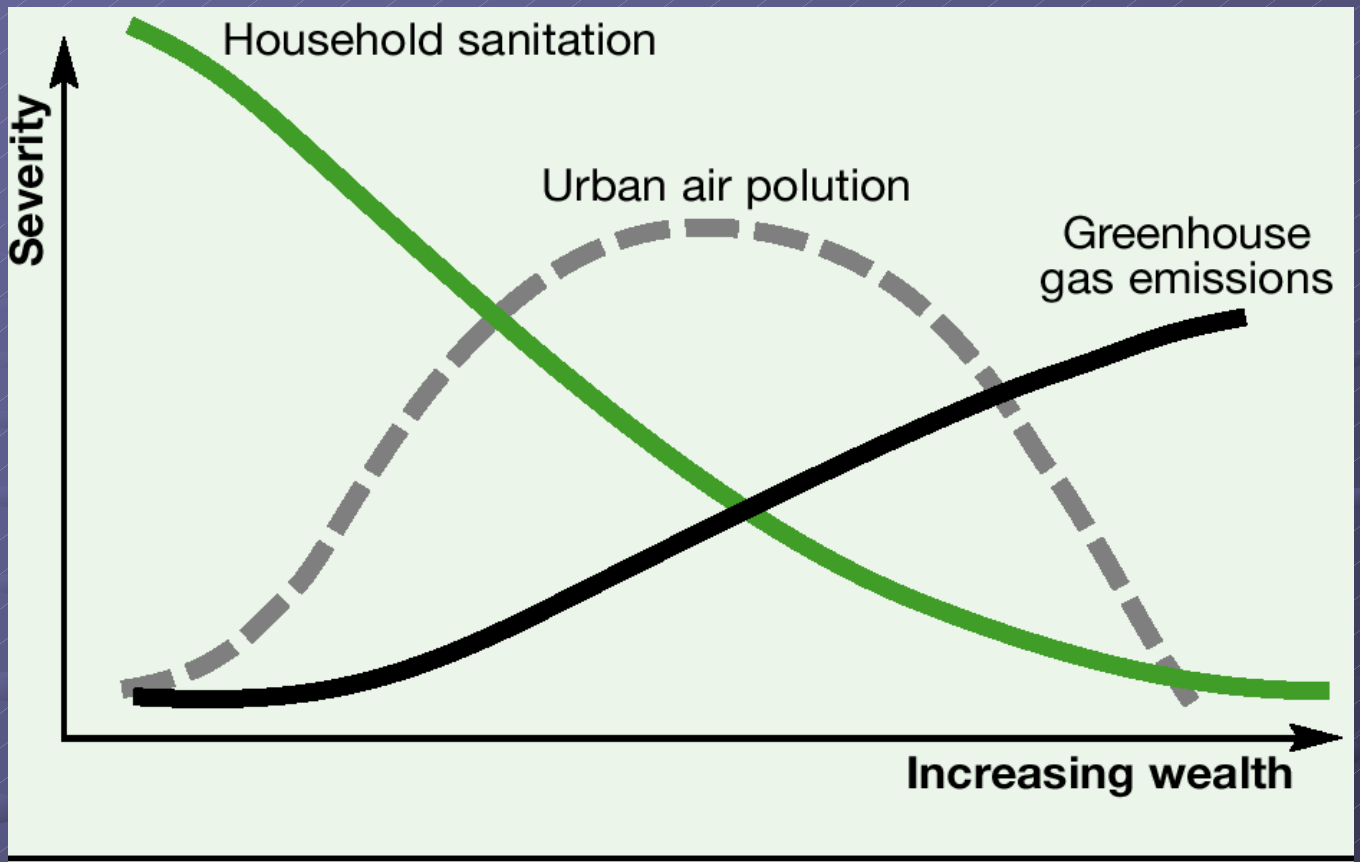
2070


1800
1600
1400
1200
1000
800
600
400
200
500
1000
1500
2000
2500
3000
3500

Why do we want/need to plan? (1)

- Are local resources becoming scarce or too expensive?
- Is the current energy supply strategy too insecure?
- Is the current energy supply level too low?
- Is the current energy supply strategy destroying our environment?

Environmental impact transition



Sources: McGranahan *et.al*. (2000); Smith and Sakbar (1999)

Shifting environmental burdens

Local → Global

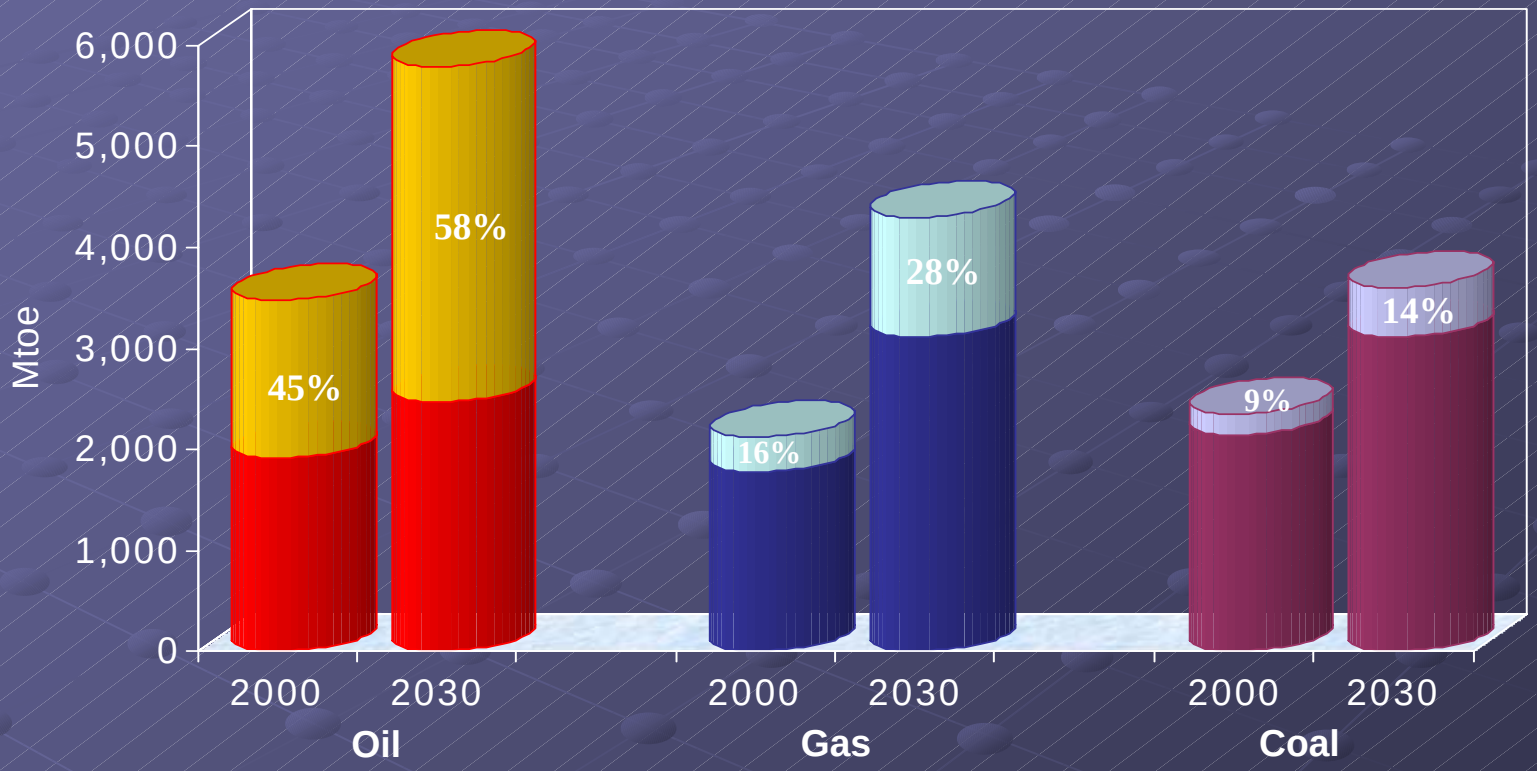
Immediate → Delayed

Threaten health → Threaten ecosystems

Why do we want/need to plan? (2)

- Do we need to know future consumption levels?
- Do we need to investigate future energy carrier requirements?
- Do we need information about regional energy consumption patterns?
- Do we need to analyze possible supply shortages?

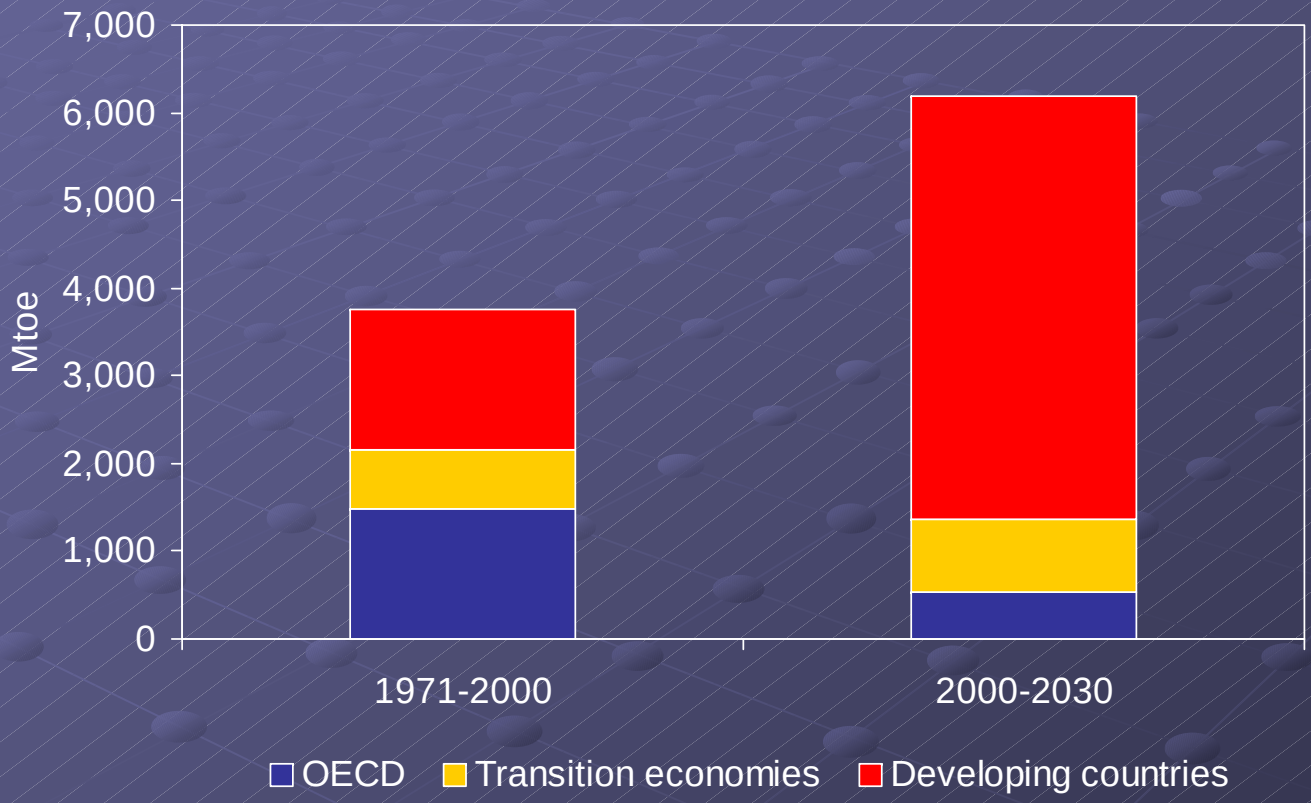
Increase in World Primary Energy Production (WEO 2002, IEA)



Share of inter-regional trade (%)

Energy trade between regions more than doubles between now and 2030, most of it in the form of oil

Increase in World Primary Energy Production (WEO 2002,IEA)



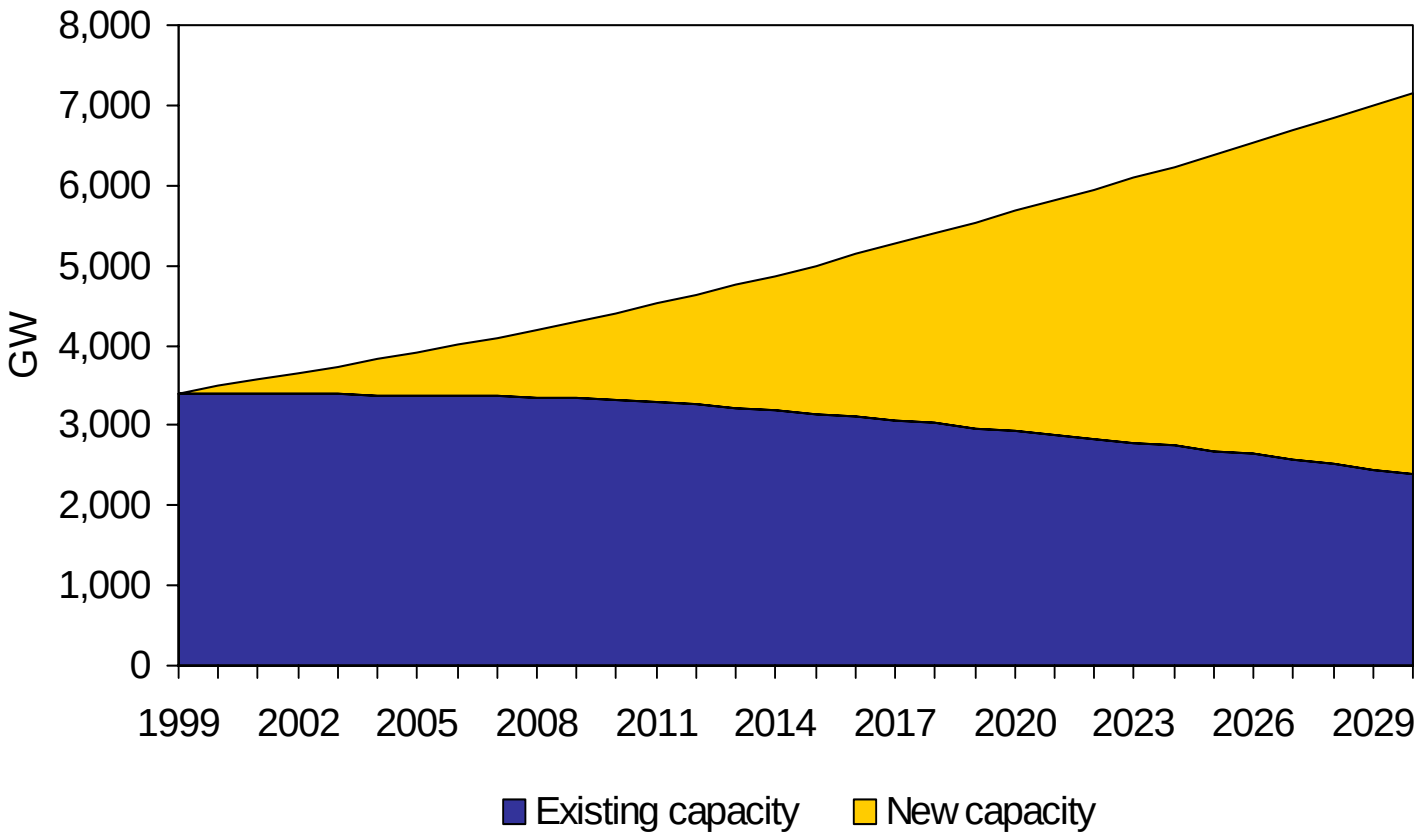
Almost all the increase in production occurs outside the OECD, up from 60% in 1971-2000

WORLD ENERGY OUTLOOK

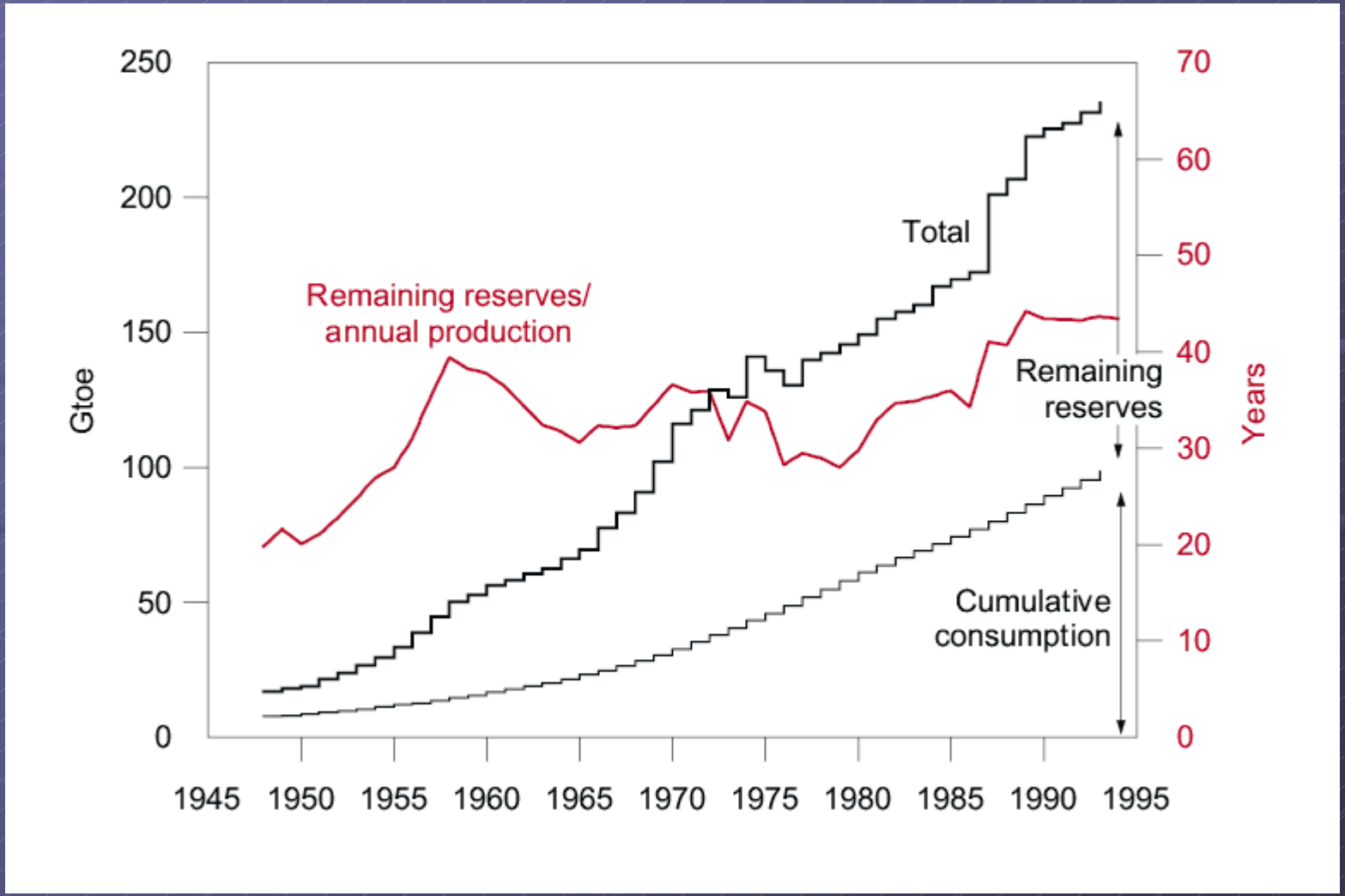
2002

INTERNATIONAL ENERGY AGENCY

World Installed Power-Generation Capacity



Nearly 5,000 GW of capacity is built in 2000-2030, almost half in developing countries


250
200
150
100
50
0
Gtoe
70
60
50
40
30
20
10
0
Years
Total
Remaining reserves/
annual production
Remaining
reserves
Cumulative
consumption
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

Why do we want/need to plan? (3)

- Or did the boss tell you to do so?

- Take the slide ‘Basic Questions’ and:

Probably you will say now:

We need to do all of that!

And you are right, but remember:

- How much time do we have?
- What resources do we have?

Only after we have mastered the first steps:

- What is the exact scope of our study (1)
- What is the time we have to do it (2)
- What resources do we have (3)

We can start to set-up our study

- Not forgetting whom we want to address (4)

Set-up of a study

- Level of analysis
  - regional aspect
  - organizational scope
  - time frame
  - complexity
- Goal
  - Demand side
  - Supply side

Different Levels of Planning
a) regional aspect

- Global
- International
- National
- Regional
- Local

Different Levels of Planning
b) organizational scope

- International Research Institutions
- International Organizations
- National Institutions
- Companies
- Individuals

Different Levels of Planning
c) time frame

- Very long term (>50 years)
- Long term (20-30 year)
- Medium term (1-5 years)
- Short term (days to weeks)
- Ultra short term (a few hours)

Different Levels of Planning
d) complexity

- Single commodity
- Multi commodity
- Single regional
- Multi regional
- Single objective
- multi objective

Different Levels of Planning common combinations (1)

- Very long term global studies
  - International Research Institutions (IIASA, …)
    - Availability of resources
    - Global warming
    - CO_2 emission reduction
- Long term global and international studies
  - International Organizations (IEA, WEC, …)
    - Availability of reserves
    - Environmental pollution
    - CO_2 emission reduction and trade

Different Levels of Planning common combinations (2)

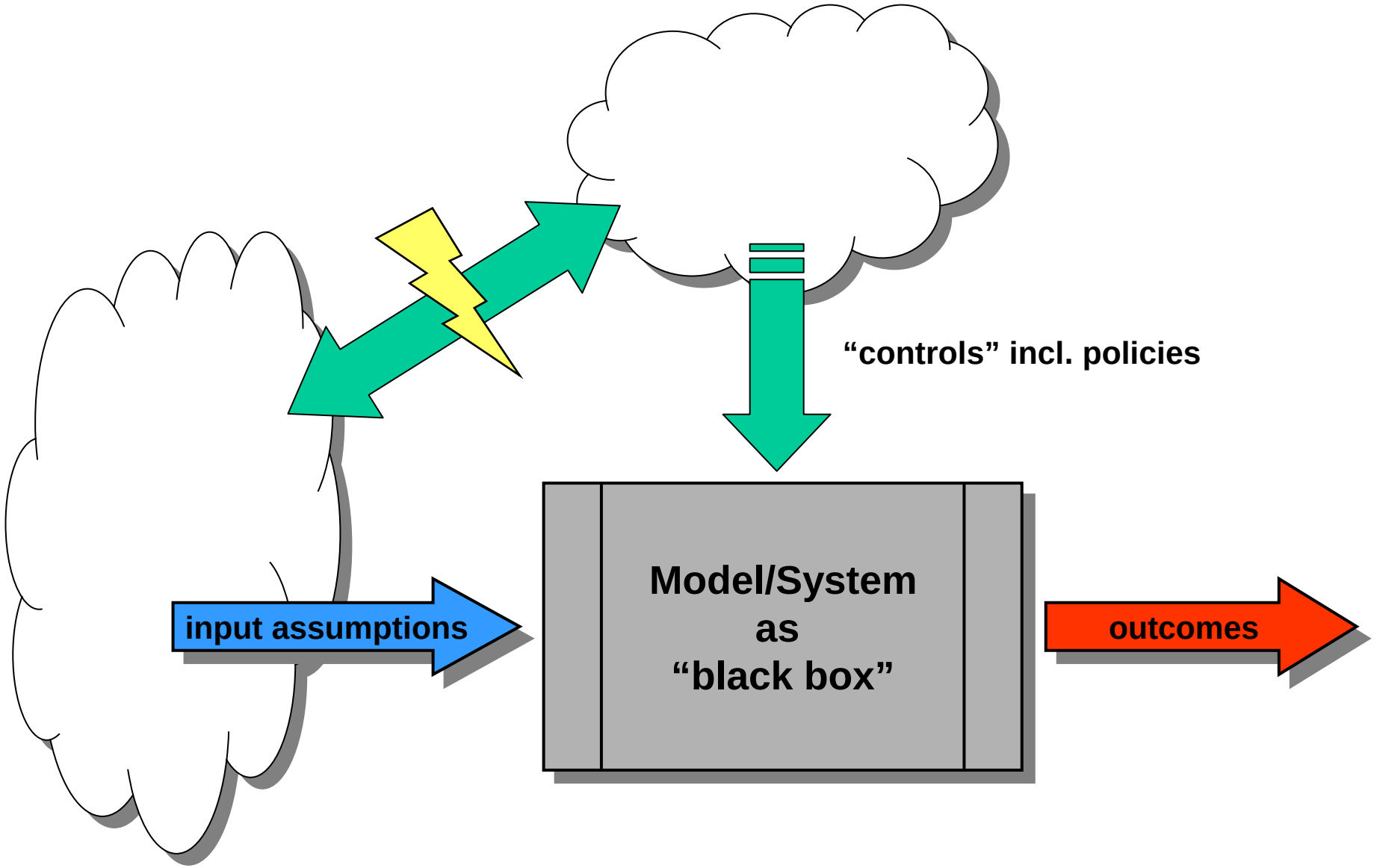
- Medium term national studies
  - National Research Institutions, Universities
    - Security of supply
    - Environmental pollution
    - Market mechanisms
- Short and ultra short term regional studies
  - Industry, Consultants
    - Capacity and operation planning
    - Cost of production
    - Adherence to legal restrictions

Recipients of Studies

- Governmental bodies
- Companies
- General public

Why is this so important?

- We, as analysts, have to tailor our research and finally our presentations to their prime interests!


“controls” incl. policies
input assumptions
Model/System
as
“black box”
outcomes

Analysis Goal

- Demand side modeling
- Supply side modeling
- Equilibrium modeling

Demand side modeling
Approaches

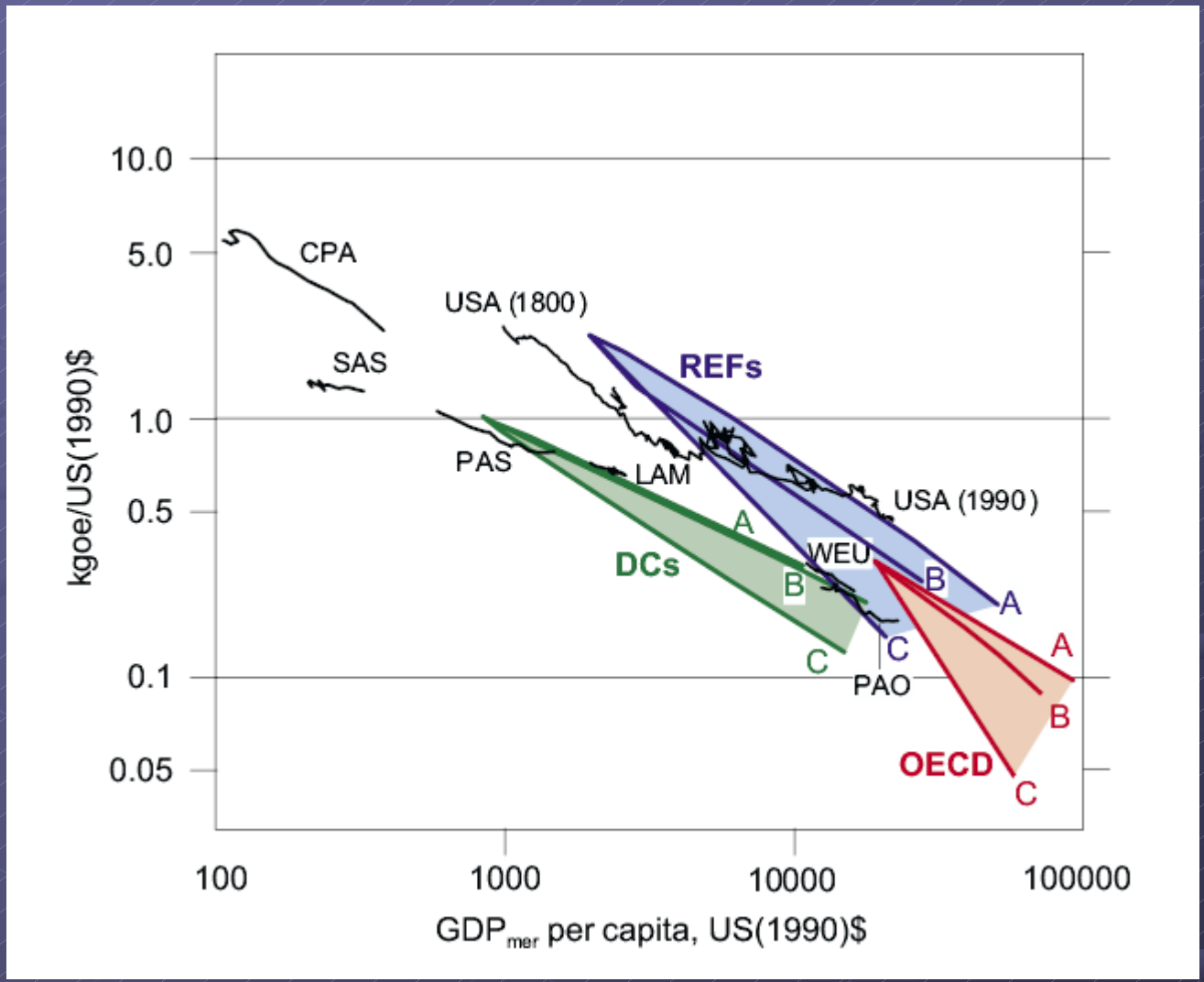
- Top down
- Bottom up
- Scenario writing
- Scenario generation

Top down approach

- Tries to explain energy demand on the basis of a few well known parameters
- Uses statistical analysis to find the relations between the used indicators

e.g.: Demand = f(POP,GDP,Price,…)

Primary Energy Intensity vs. GDP per capita



Bottom up approach

- In principle it also looks at the interrelation of population, GDP, price, etc. and the demand for energy
- But unlike the top down approach the relation is more indirect:

e.g.: growing GDP >
increased personal income >
adjusted industrial structure >
change in energy consumption

What are the differences

- To use a top down approach is easier, for it relies mainly on a few well known figures
- But inherently it keeps historic relations fixed (Note: adjustment factors)
- The use of a bottom up approach requires a lot more data, many of them not being readily available from statistics
- But it allows to consider policy decisions, technical change, etc. more directly

Which approach is better?

This depends on the planning objective

- For the short term usually top down approaches are better as many relations do not change quickly
- For the long term a bottom up approach may fit better as the development of the relevant relations may be better forecasted individually

In reality

- We always will use some combination of top down and bottom up approaches
- Due to lack of time, resources and knowledge we forecast the development of the influencing variables/relations with simple top down models and combine these results to the bottom up energy demand model

Scenarios

- Scenario writing
- Scenario generation

Scenario writing

- Scenarios are used to explore the effects of unknown future developments
- or are used to test which future changes influence the development of the forecasted value most
- Very often ‘Best Case’ and ‘Worst Case’ scenarios are developed – but care should be taken that this is usually a very one dimensional view on the problem

Scenario generation

- Scenarios generation is used to explore the full range of ‘model’-future
- Based on uncertainty distributions on input variables the computer generates randomly hundreds or thousands results and thus a probability distribution for the forecasted value.

"The "appropriate" policy response will depend not only on scientific information about the probabilities and consequences of physical, biologic, and social impact scenarios but also on the value judgments of individuals, groups, corporations, and nations as to how to deal with the potential distribution of gains and losses implied by the buildup of carbon dioxide and other trace gases. There is no scientific answer as to how society should act and no scientific basis for any particular policy choice. All science can do is provide **scenarios** and assess the probabilities and consequences of various plausible alternatives. The public and government leaders need to understand that decisions have to be made in the face of scientific uncertainty by optimizing clearly stated sets of often conflicting values."

Stephen H. Schneider

"Climate", Encyclopædia Britannica Article, 2002 Edition

Writing vs. generating

- Again, the time frame is mainly dictating which way to go:
  - Scenario writing for the longer term
  - Scenario generation for the shorter term

Mathematical methods

- Accounting framework
- Statistical analysis
- Optimization

Additional aspects

- Societal questions
- Environmental considerations
- Trade considerations
- Central vs. decentral supply
- Sustainability of supply

Planning procedures

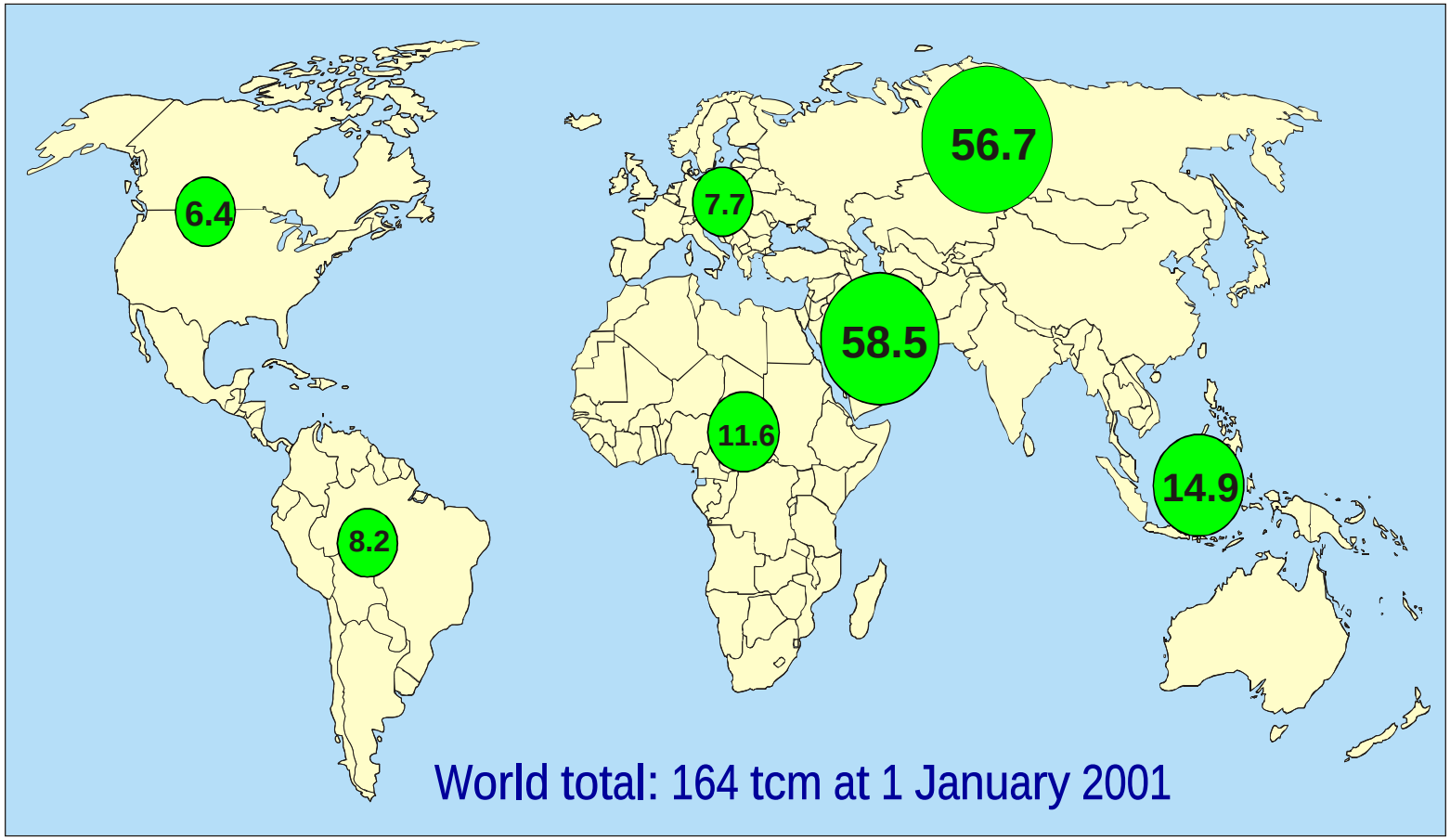
- Collect sufficient statistical data
- Investigate technical details
- Find an adequate model
- Test the model for historic years
- Keep the model as simple as possible and make it as complicated as necessary

WORLD ENERGY OUTLOOK

2002

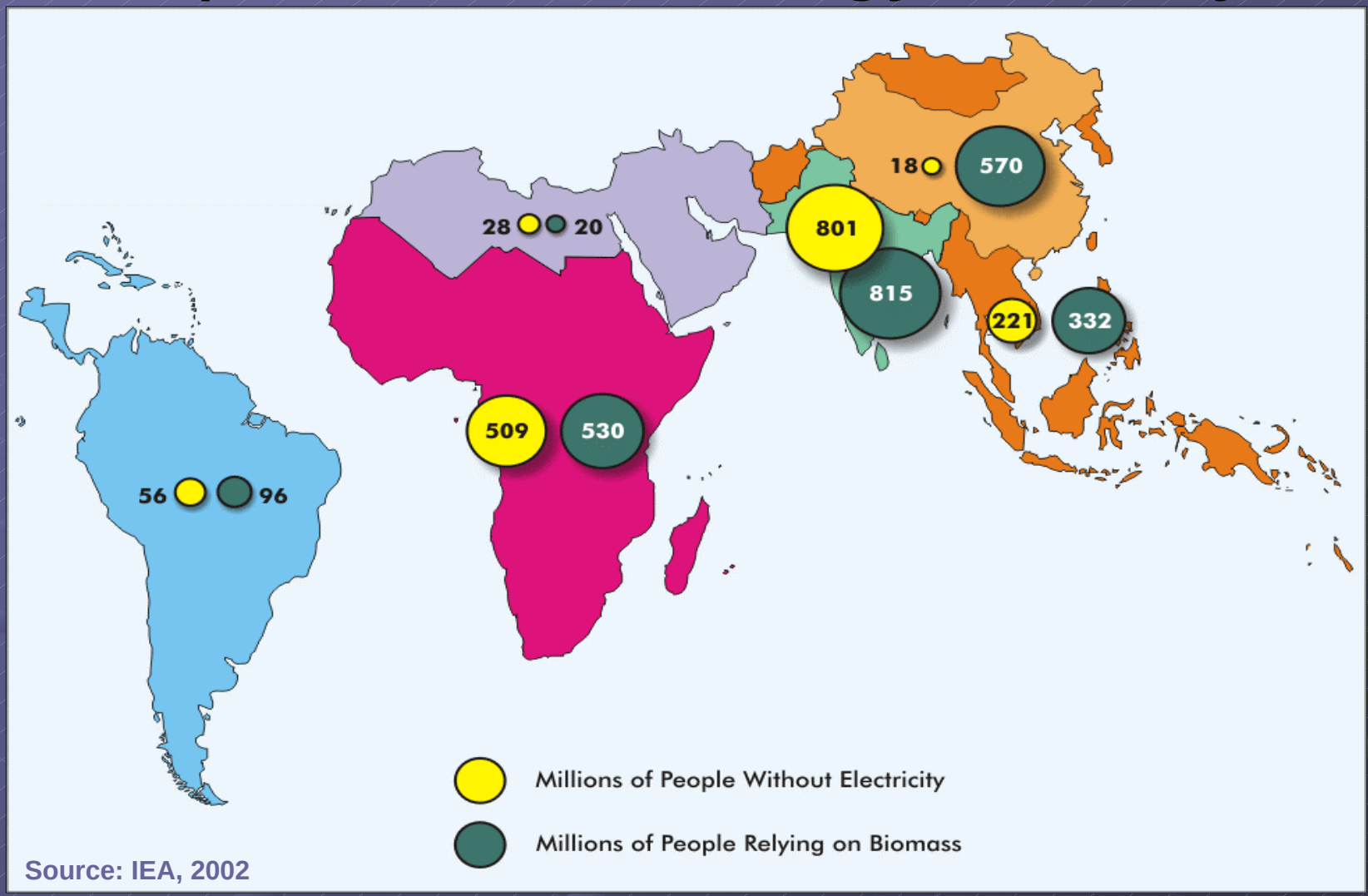
INTERNATIONAL ENERGY AGENCY

Proven Gas Reserves



Ultimate remaining resources (including proven reserves) are an estimated 453 - 527 tcm

Map of Global Energy Poverty



1.6 billion people have no access to electricity, 80% of whom in South Asia and sub-Saharan Africa