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**College on Evaluation of Energy Technologies
and Policies for Implementation of Agenda-21**

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Energy Policy Analysis and Strategies

**Andrii GRITSEVSKYI
International Atomic Energy Agency (IAEA)
Planning and Economic Studies Section
Department of Nuclear Energy
Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna
AUSTRIA**

These are preliminary lecture notes, intended only for distribution to participants

Energy Policy Analysis and Strategies

Concepts and Procedures

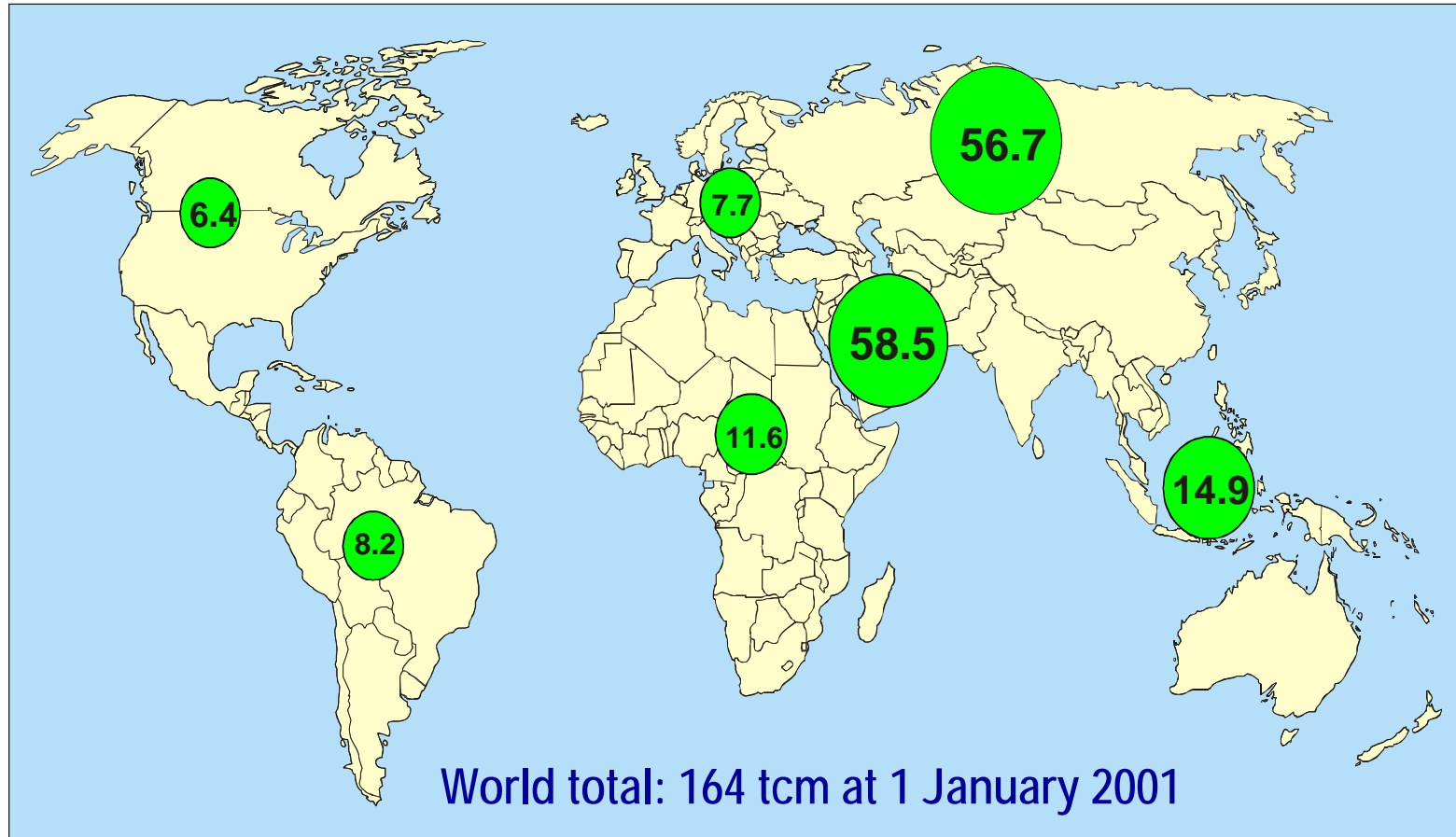
Basic questions

- Why do we want/need to plan?
- What time frame do 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?

Proven Gas Reserves

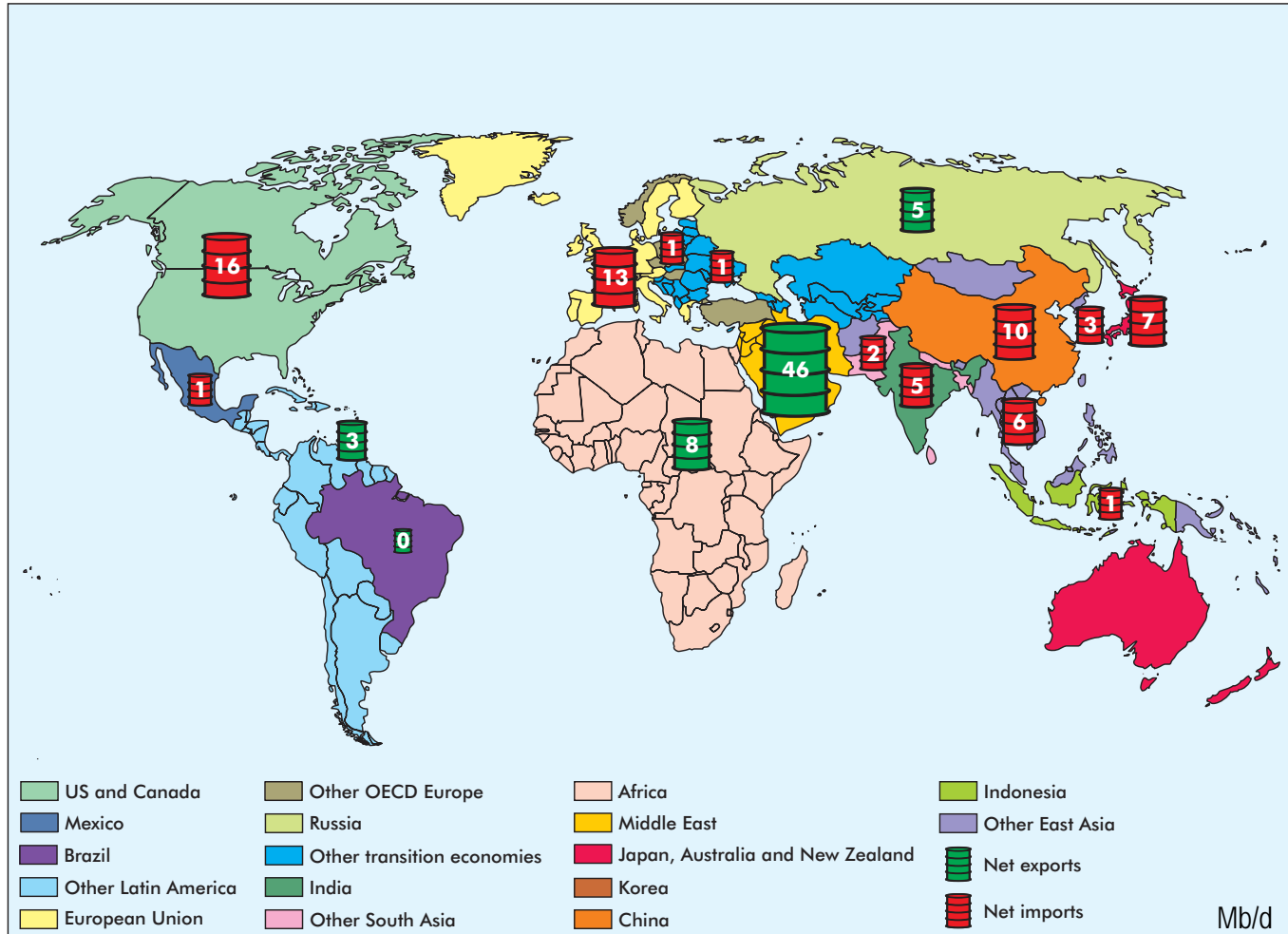


Ultimate remaining resources (including proven reserves) are an estimated 453 - 527 tcm

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

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

Net Oil Trade, 2030



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

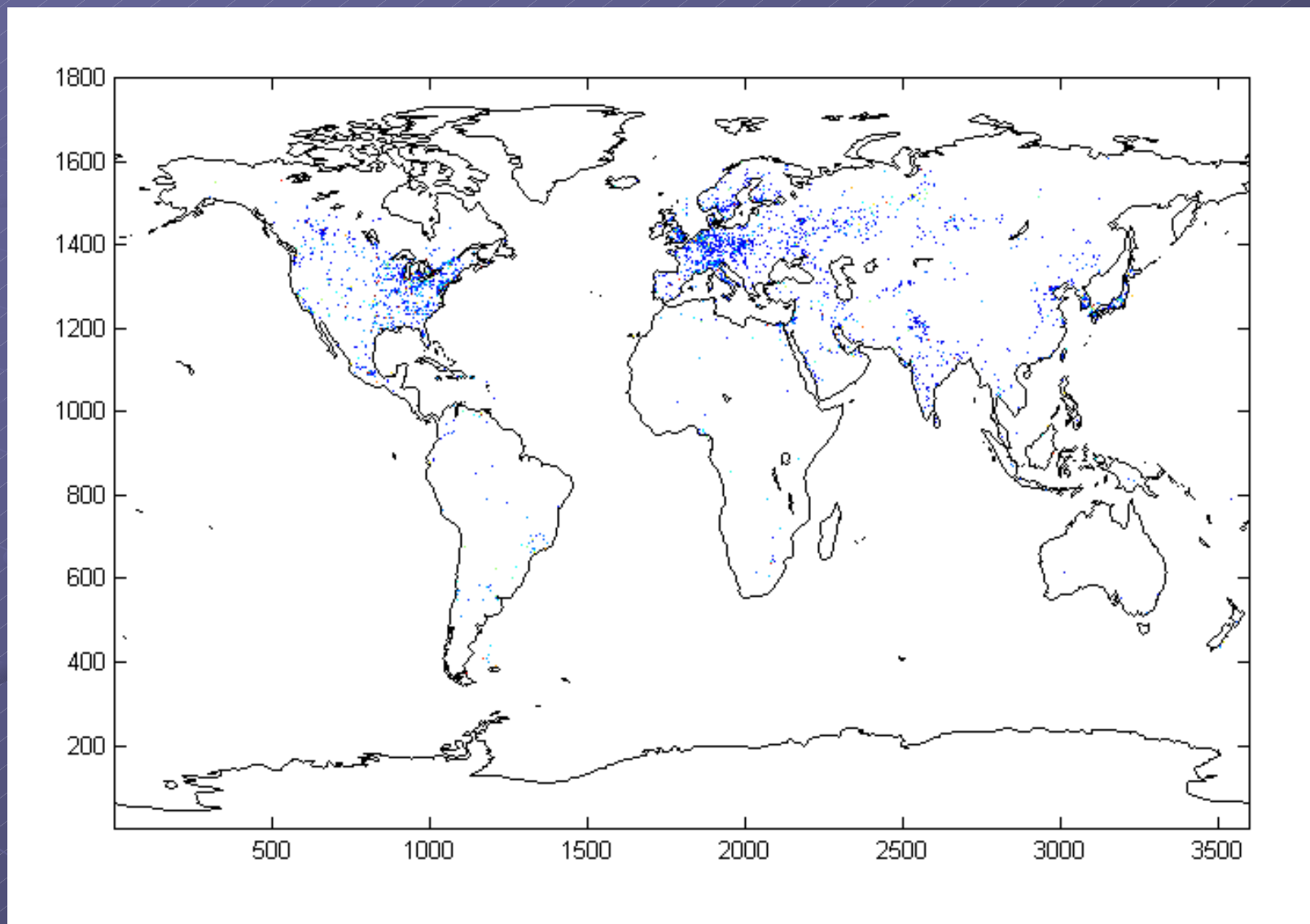
2002



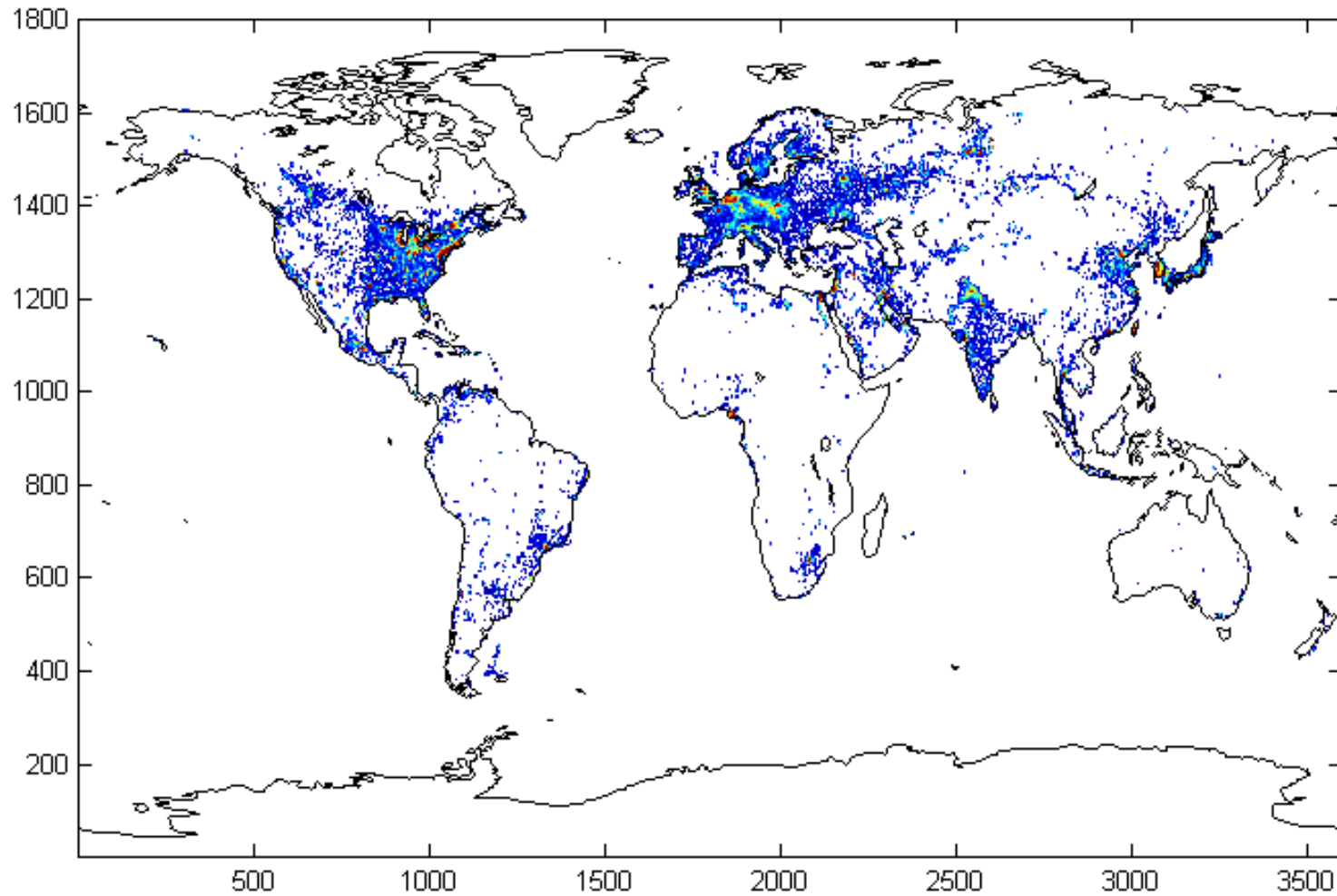
Why do we want/need to plan? (1)

- 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



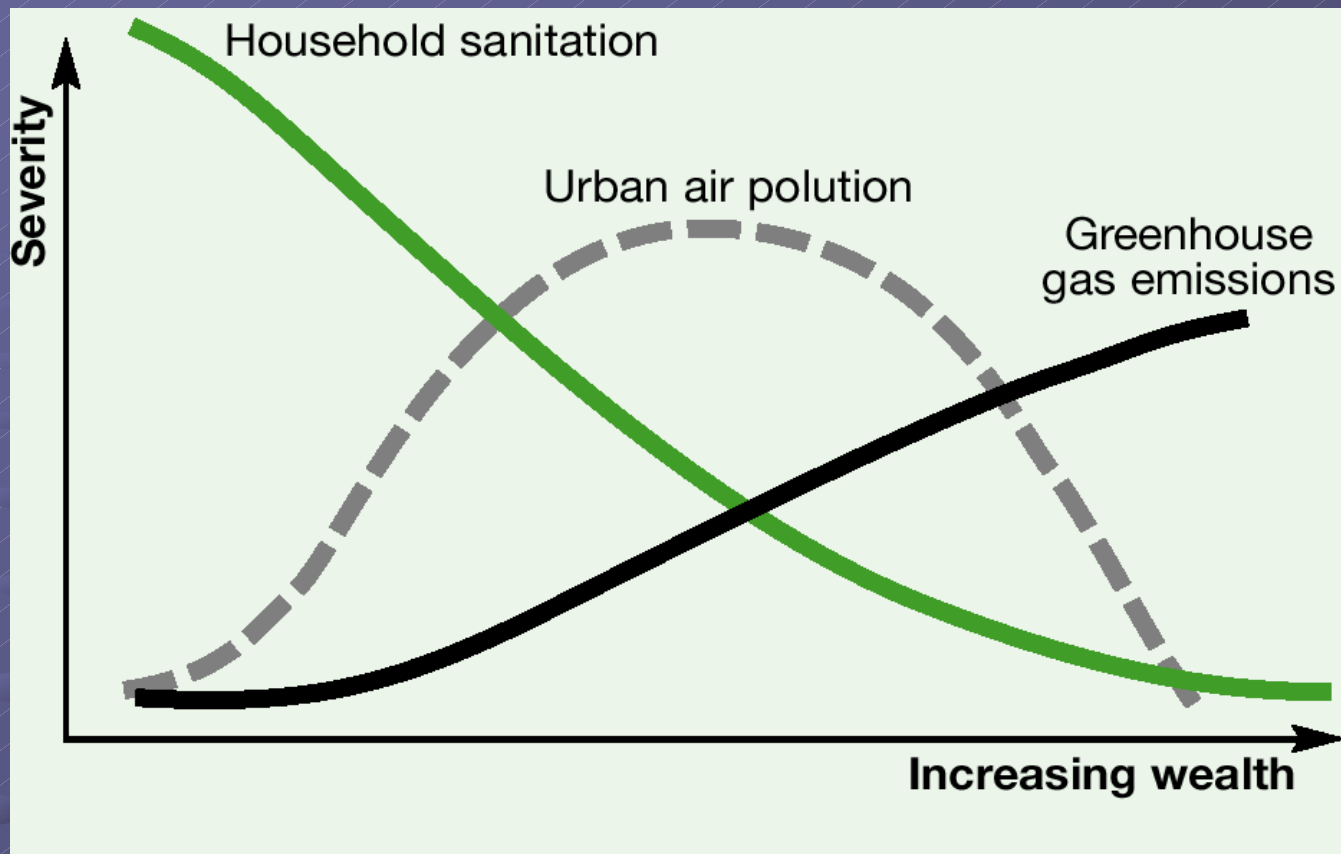
2070



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

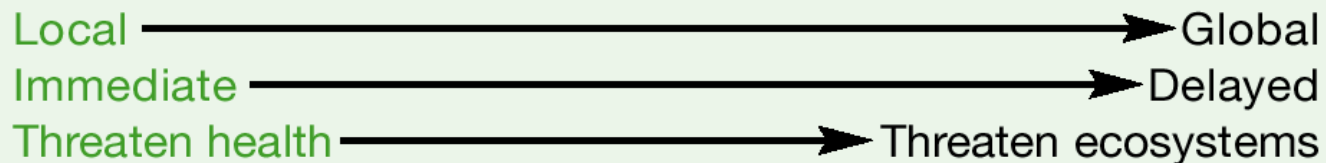
- Are local resources becoming scarce or too expensive?
- Is the current energy supply strategy too insecure?
- Is the current energy supply level too low?
- Is the current energy supply strategy destroying our environment?

Environmental impact transition



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

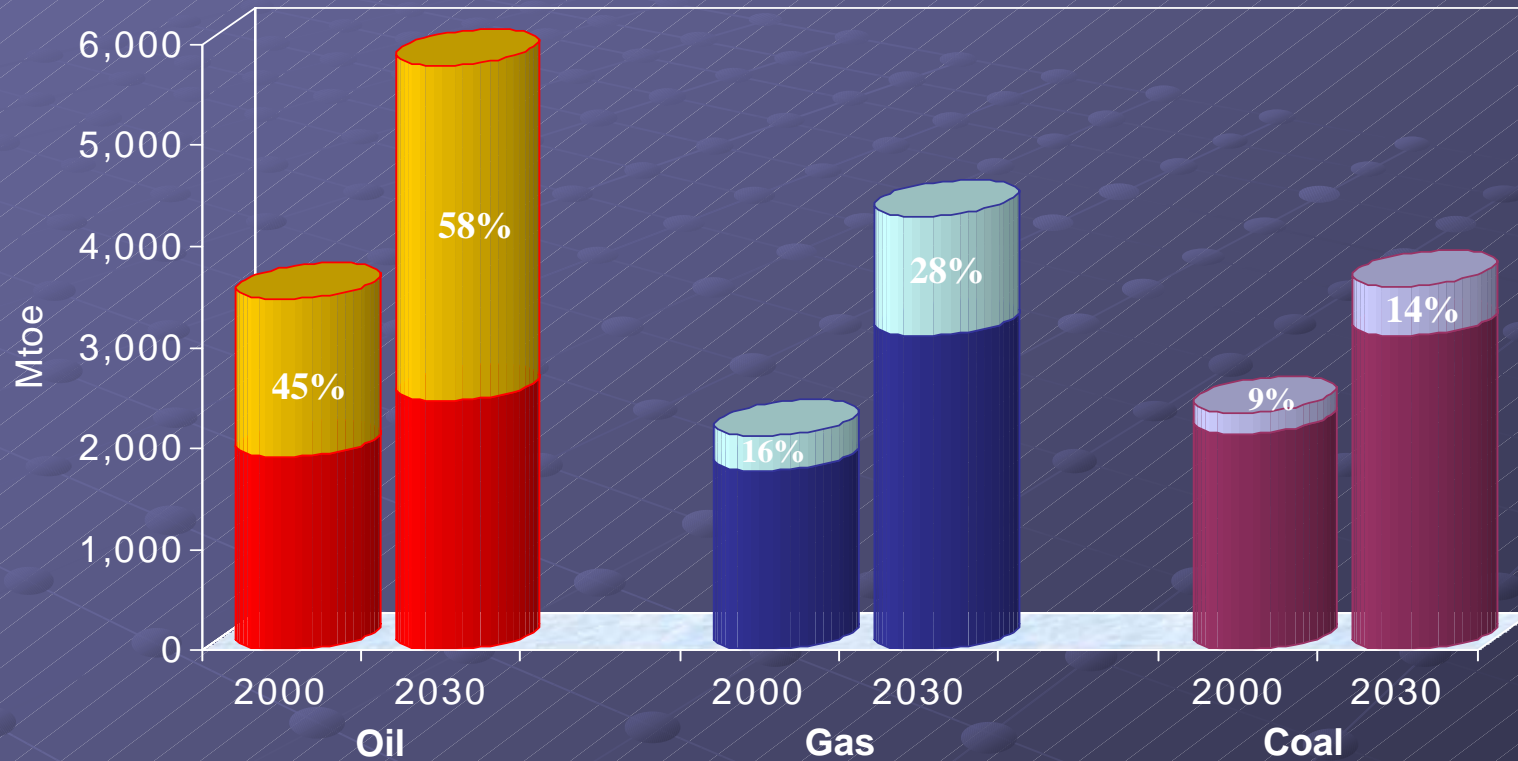
Shifting environmental burdens



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?

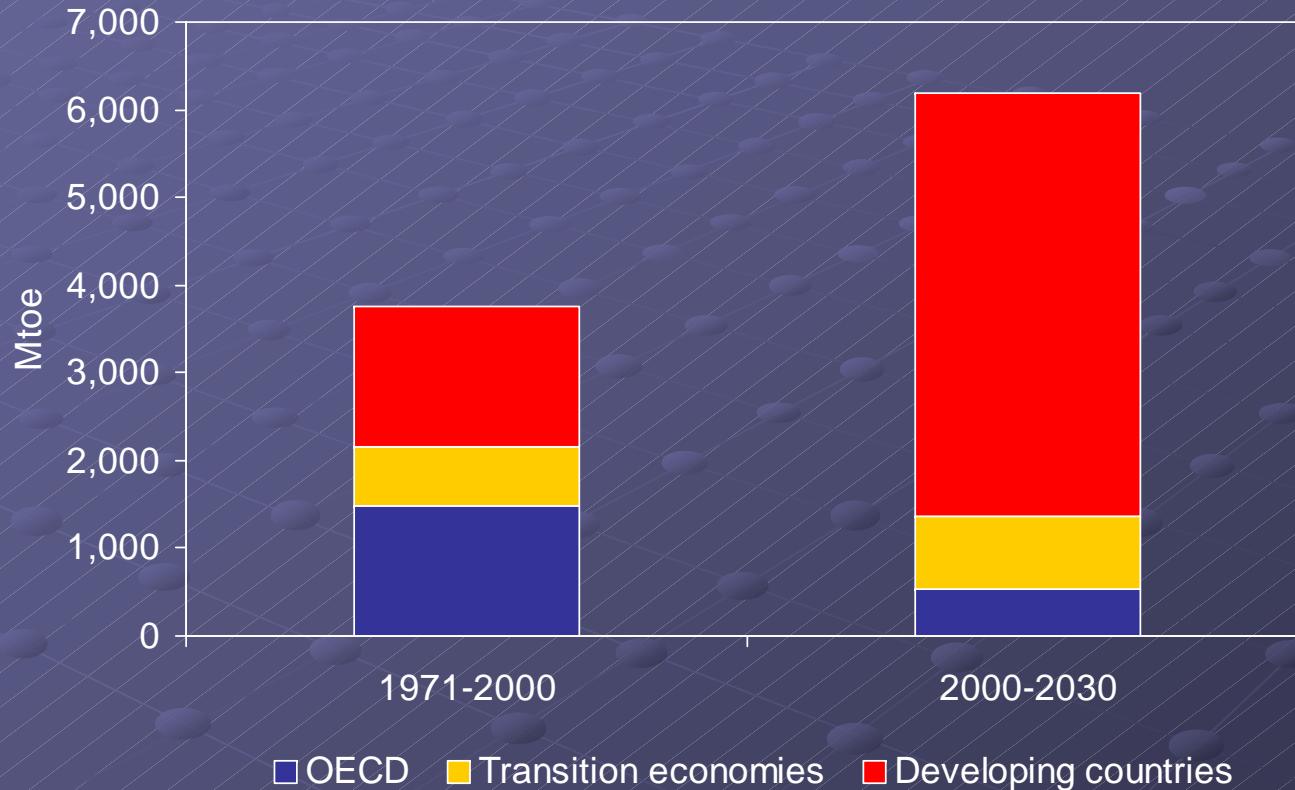
Increase in World Primary Energy Production (WEO 2002, IEA)



Share of inter-regional trade (%)

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

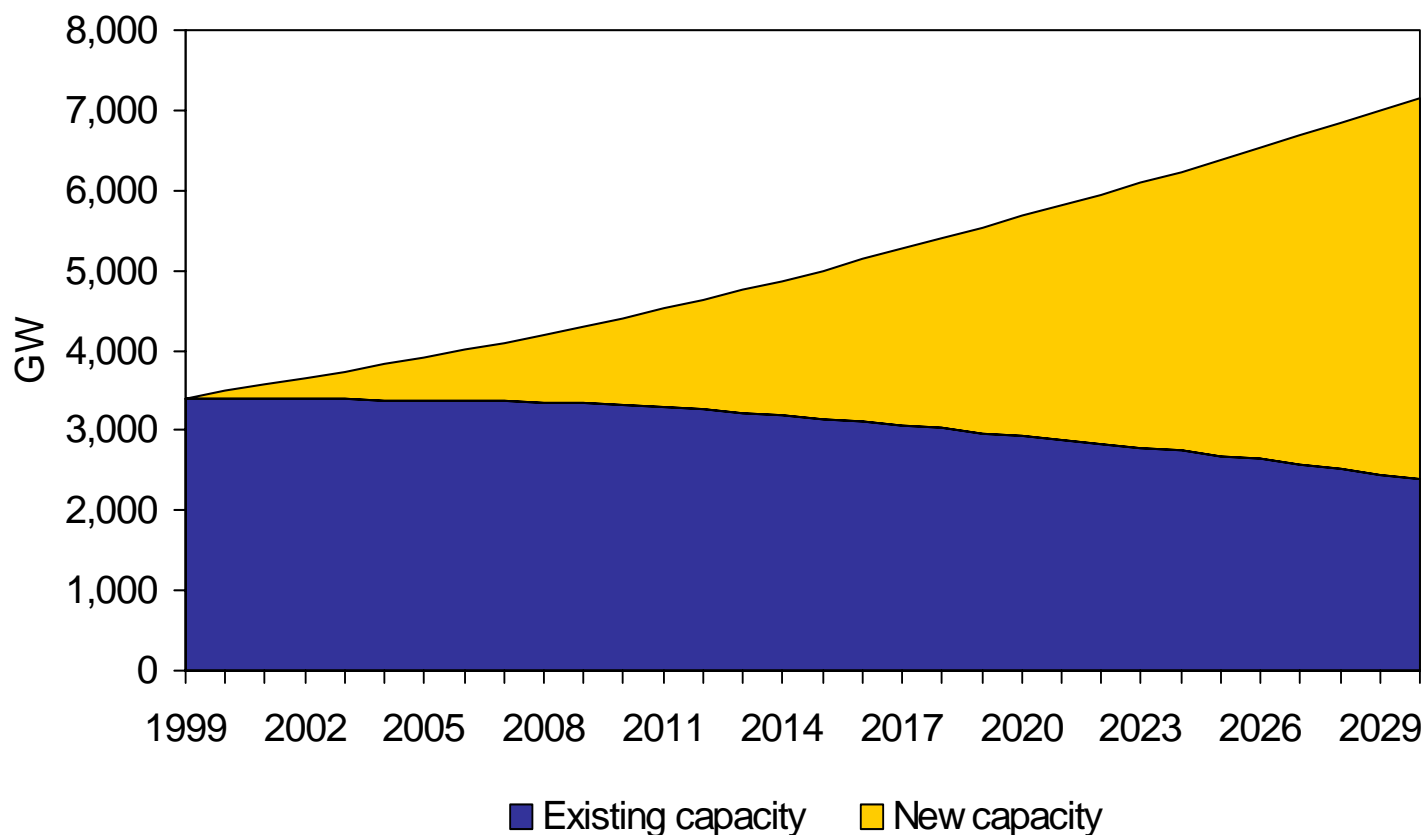
Increase in World Primary Energy Production (WEO 2002, IEA)



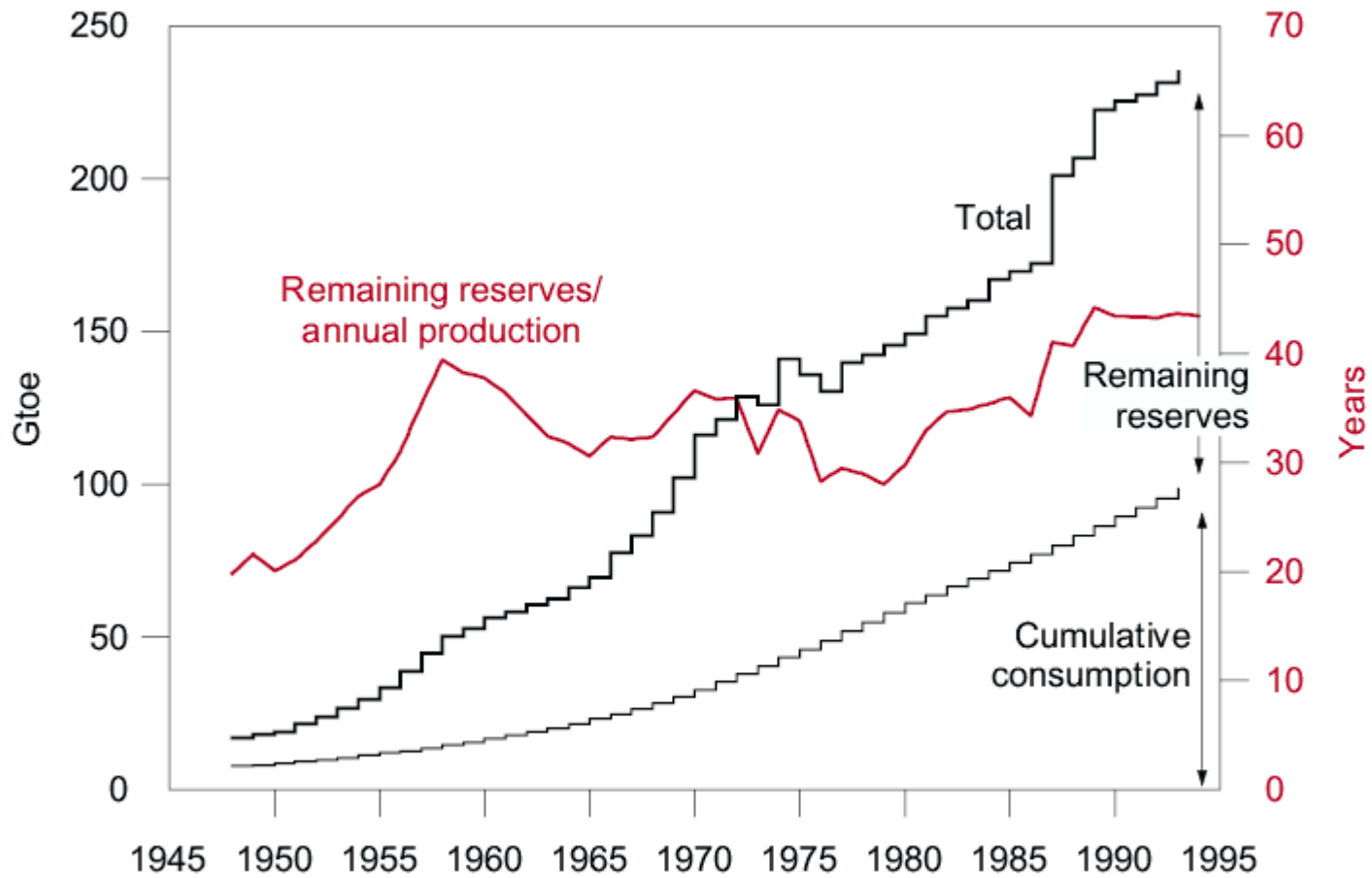
Almost all the increase in production occurs outside the OECD, up from 60% in 1971-2000



World Installed Power- Generation Capacity



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



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
 - CO₂ emission reduction
- Long term global and international studies
 - International Organizations (IEA, WEC, ...)
 - Availability of reserves
 - Environmental pollution
 - CO₂ emission reduction and trade

Different Levels of Planning

common combinations (2)

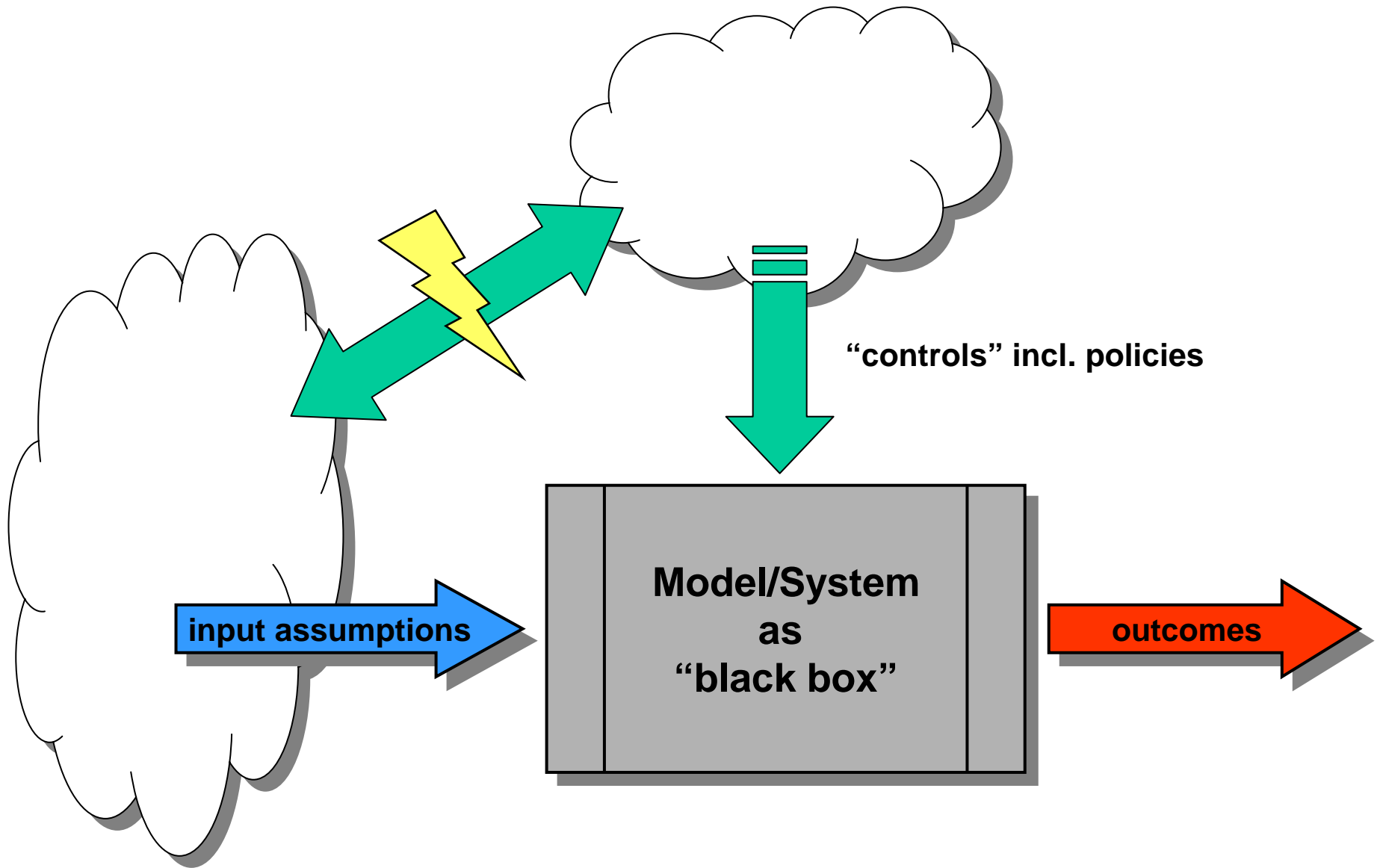
- Medium term national studies
 - National Research Institutions, Universities
 - Security of supply
 - Environmental pollution
 - Market mechanisms
- Short and ultra short term regional studies
 - Industry, Consultants
 - Capacity and operation planning
 - Cost of production
 - Adherence to legal restrictions

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!



Analysis Goal

- Demand side modeling
- Supply side modeling
- Equilibrium modeling

Demand side modeling

Approaches

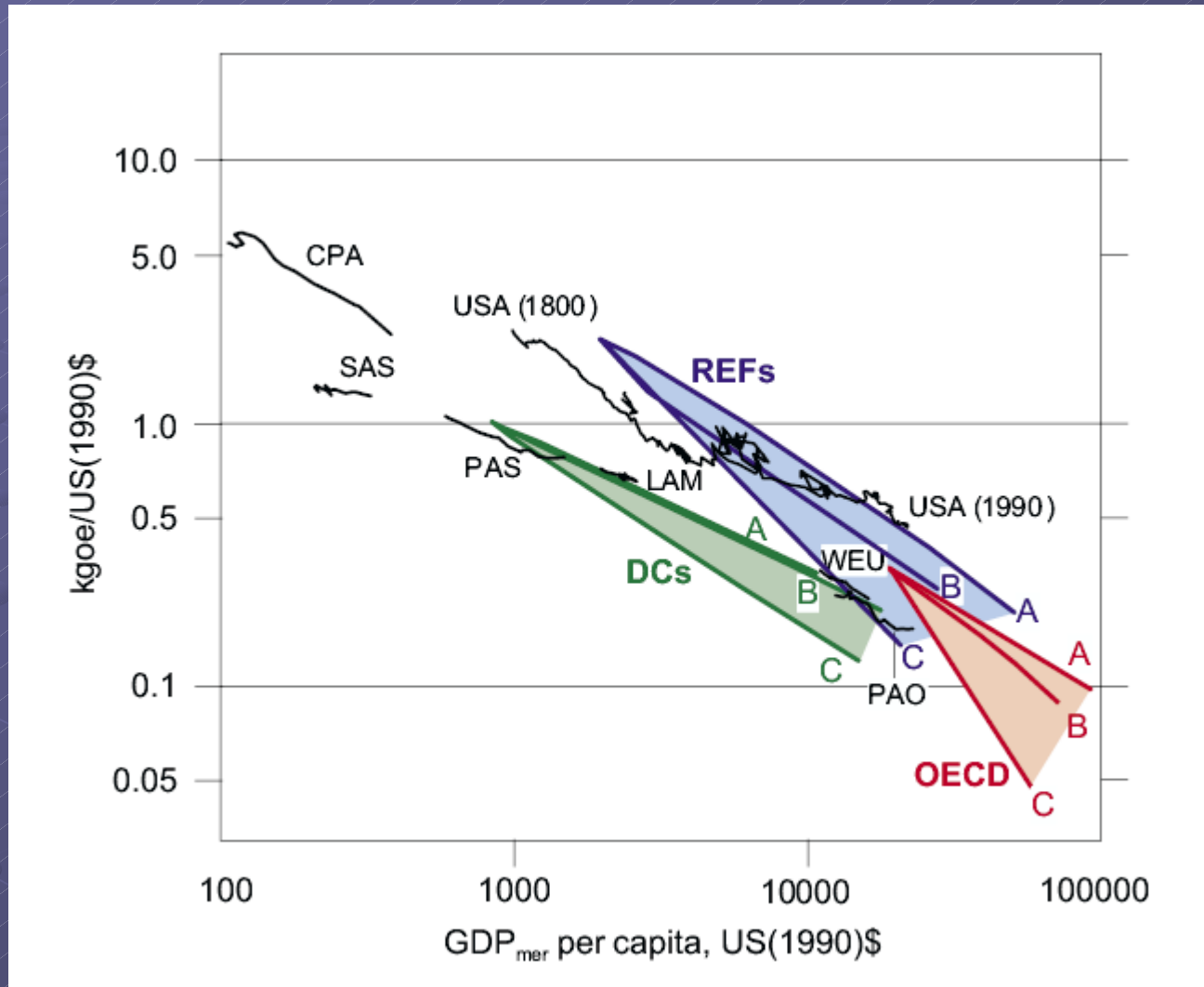
- Top down
- Bottom up
- Scenario writing
- Scenario generation

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

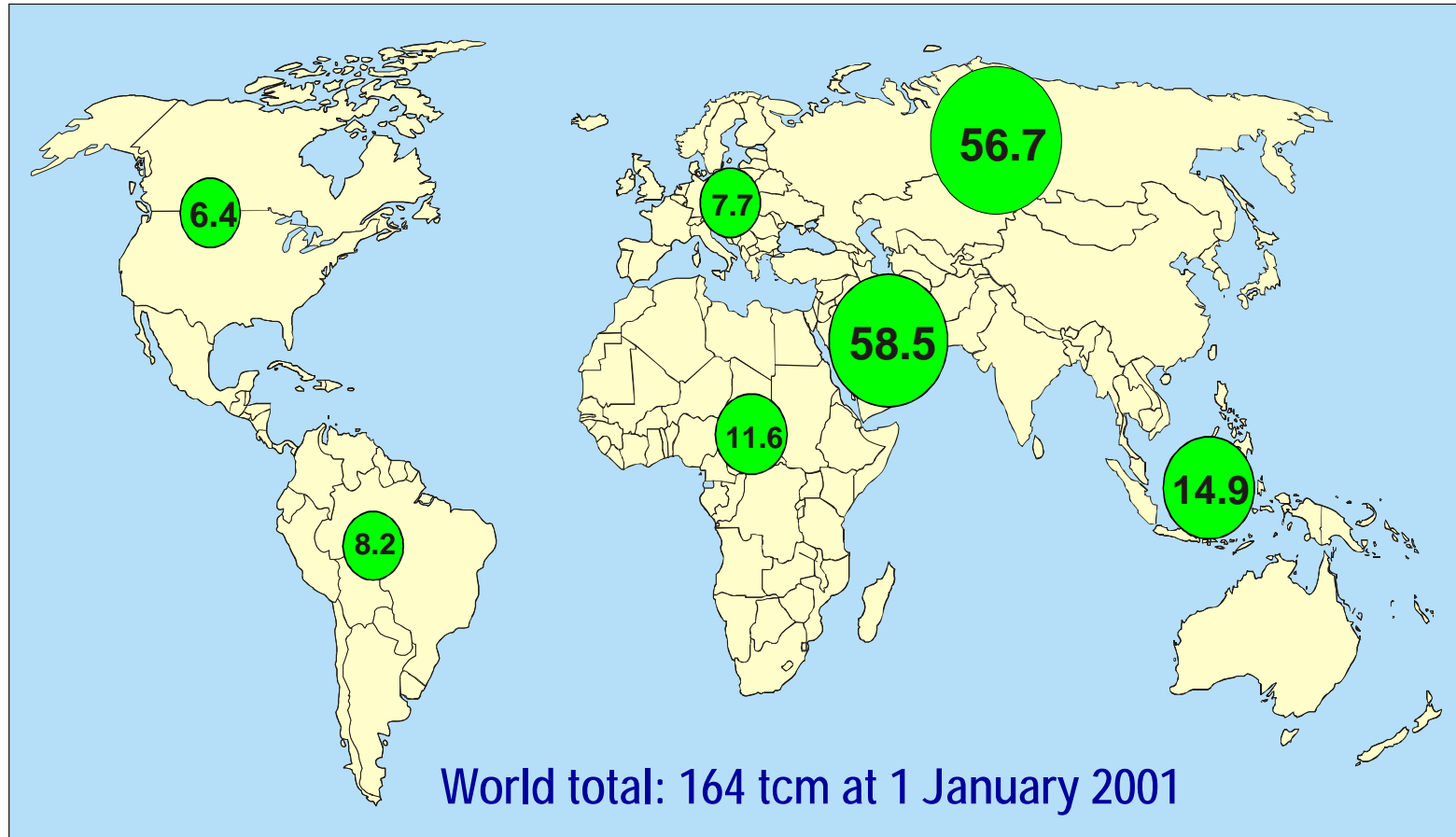
- Societal questions
- Environmental considerations
- Trade considerations
- Central vs. decentral supply
- Sustainability of supply

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**

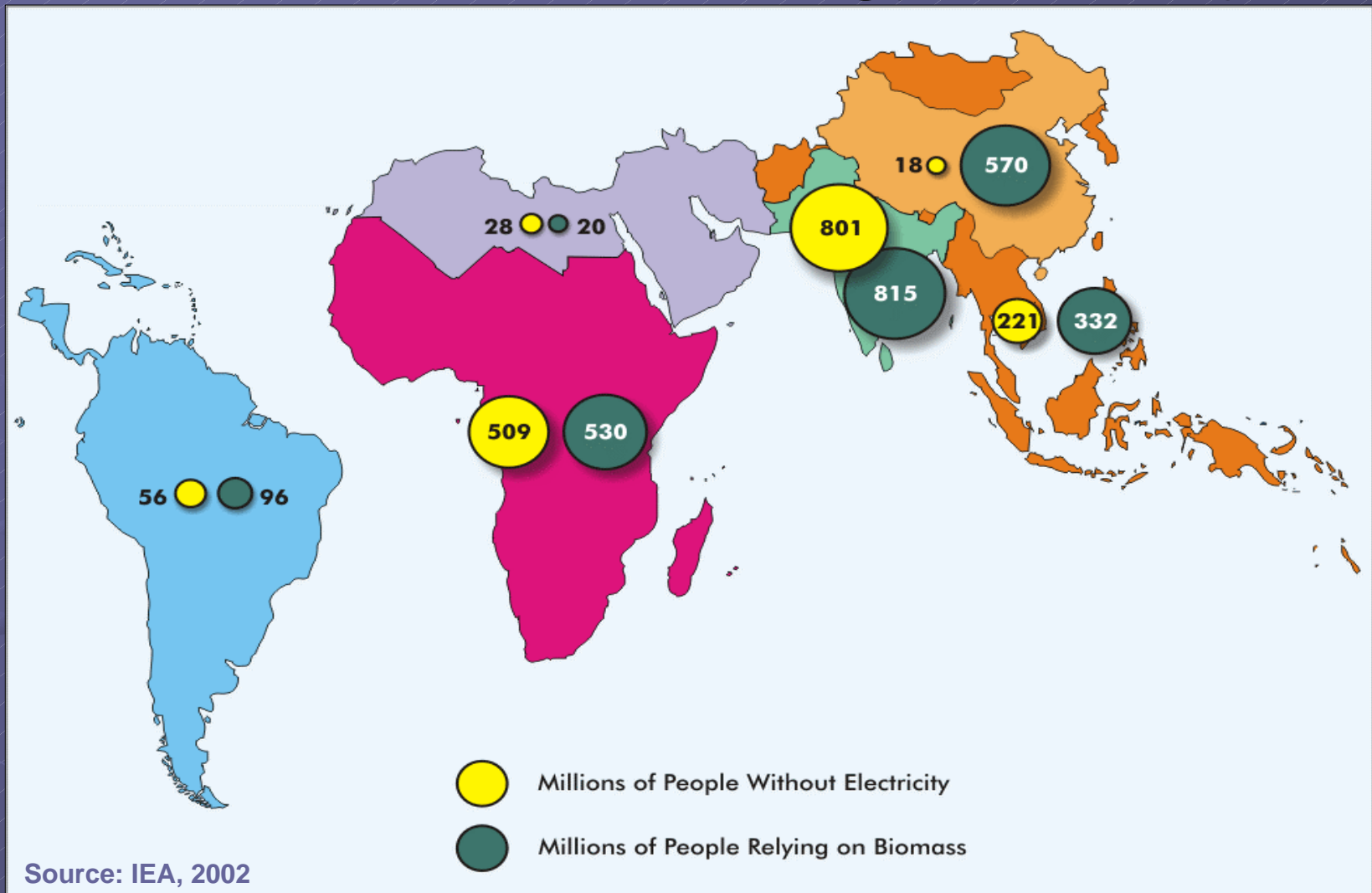


Proven Gas Reserves



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**