



WWF South Africa

Living Planet Unit

Climate Change Programme

transformation to a climate-safe future
through people-centered development

The Energy Report (2011)





The Energy Report

Pathway to a fully sustainable global energy system by 2050





The Energy Report

100% Renewable Energy by 2050

A VISION

A world powered by 100% renewable, sustainable energy by mid-century

A SCENARIO

Extensive electrification of transport; enhanced energy conservation; smart grids; sustainable energy for all

CHALLENGES

Conserving energy & reducing demand; electrification; equity; investment; land/water/sea-use implications; governance; lifestyle choices - behaviour changes & public attitudes; innovation and R&D

SOLUTIONS

In all of our hands - policy-makers, investors, corporate leaders, communities and individuals.

BENEFITS

Stop fossil fuel pollution; save money; address climate change; improve health; no nuclear risks; new jobs; innovation; protect nature





Why 100% Renewable Energy?

1. Climate

- at least 80% less Greenhouse Gas globally by 2050

2. Conventional oil/gas scarcity

- we need “4 times Saudi Arabia and 4 times Russia for 2030”

3. Threats of unconventional fuels

- CTL, GTL, deep water oil, shale gas, tar sands - more impacts than just carbon

CTL: Coal To Liquid GTL: Gas To Liquid

4. Nuclear development

- What to do with 100,000 tonnes toxic waste for next 10,000 years?

5. Equity

- 1.4/2.7 billion people lack access to electricity/safe cooking energy

6. Costs

- No-regret technologies, easy to implement, hardly any fuel, and no adaptation costs



Context

Jobs per \$1 million invested				
Industry	Direct	Indirect	Induced	TOTAL
Solar	5.4	4.4	3.92	13.72
Biomass	7.4	5.0	4.96	17.36
Smart Grid	4.3	4.6	3.56	12.46
Coal	1.9	3.0	1.96	6.86
Oil and gas	0.8	2.9	1.48	5.18
Nuclear	1.2	1.8	1.2	4.2

*Source: Heidi Garrett-Peltier and Robert Pollin,
University of Massachusetts Political Economy and Research Institute.*

Note: Multipliers derived using IMPLAN 2.0 with 2007 data. Infrastructure multipliers and assumptions are presented in "How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth," Political Economy Research Institute, January 2009, <http://www.peri.umass.edu/236/hash/efc9f7456a/publication/333/>



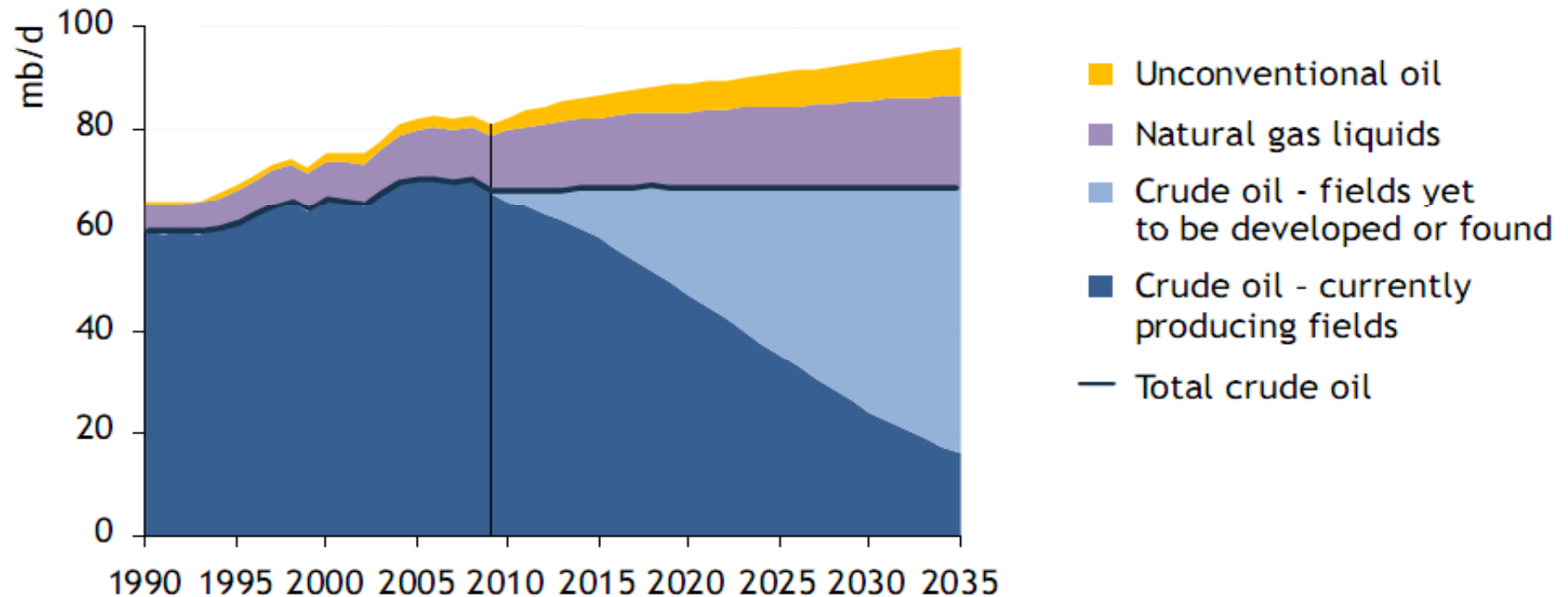


We're Running Out of Oil – We Have No Other Choice

The Energy Report

(IEA, 2010)

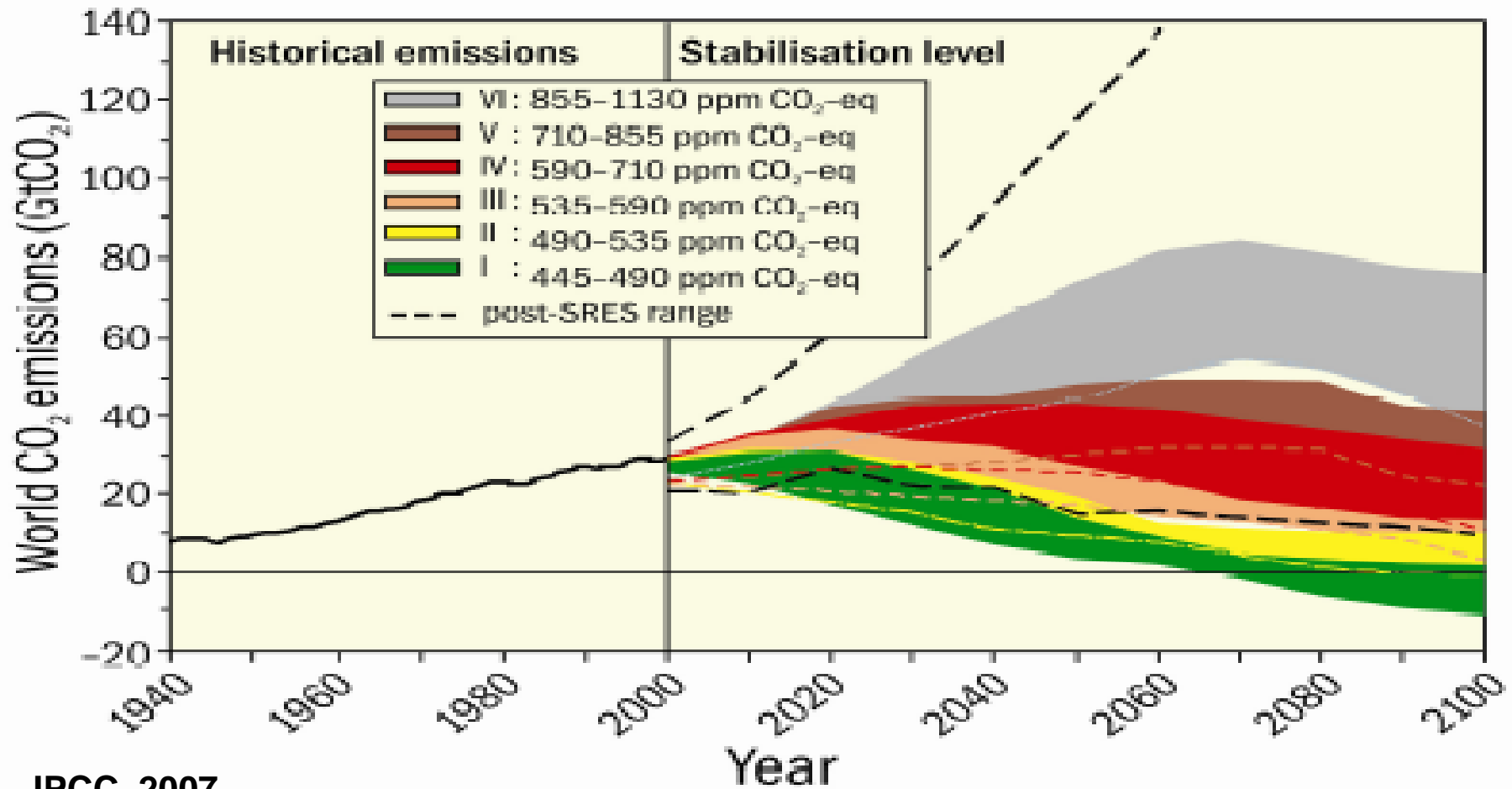
World Oil Production by Type in the New Policies Scenario



Global oil production reaches 96 mb/d in 2035 on the back of rising output of natural gas liquids & unconventional oil, as crude oil production stagnates



atmospheric concentration requires net zero emissions world before end 21st Century





Carbon Budget

Results from a long-term GHG emissions budget approach by WWF/ECOFYS

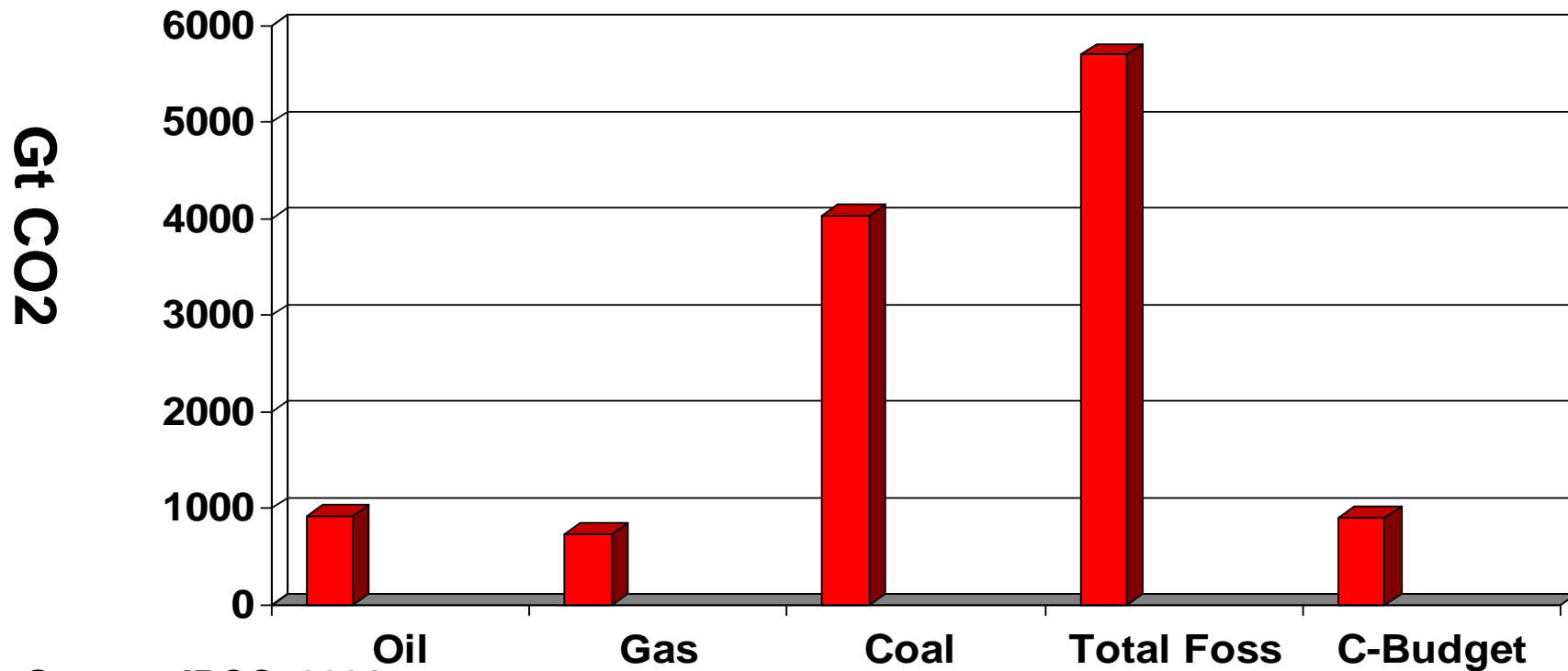
To stabilise global emissions at 400 ppm CO₂e
Very roughly 33% probability of overshooting 2°C

International Energy Agency (IEA): 450 parts per million (CO₂e) for a 50% chance to keep below the crucial 2°C global threshold.





Global carbon budget requires not burning a significant proportion of total known fossil fuel *recoverable reserves*



Source: IPCC, 2001





The Key Question ...

Is a fully renewable global energy system possible by 2050?





The Scenario - Principal Assumptions

1. Conservation/efficiency – with Best Available Technology
2. Material efficiency – with Best Available Technology
3. Only materials, products “on shelf” today
4. Electricity highest priority – used as much as possible
5. Renewables growth rates below ‘realisable’ potential
6. Need to end energy poverty/traditional biomass
7. No nuclear, no CCS (NB: Not addressing process emissions)
8. All bioenergy must be based on sustainable practices – cropland minimized, no undisturbed forests, no protected areas
9. Free technology transfer, free electricity trade
10. Accept ‘BAU’ for: Population growth, GDP, ‘activity levels’, fuel prices
11. Change ‘BAU’ for: Modal shift, diets

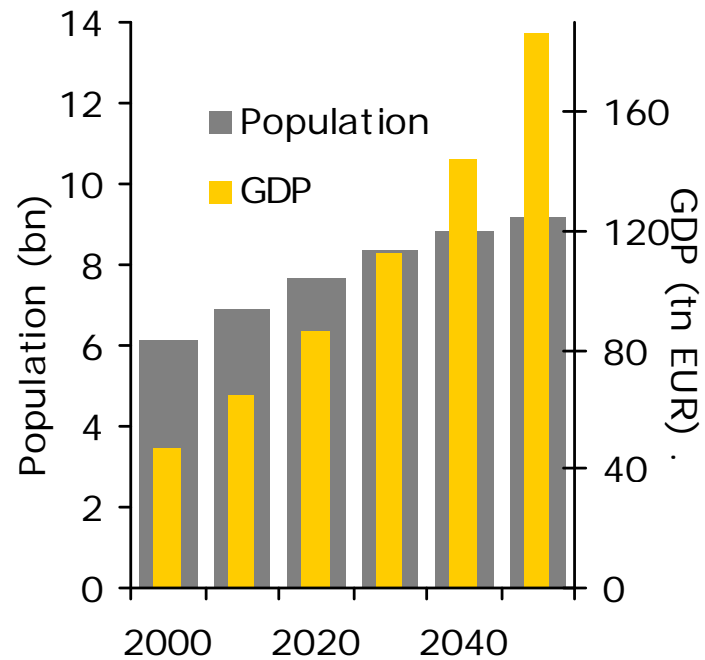
CCS: Carbon Capture & Storage
BAU: “Business-As-Usual”
GDP: Gross Domestic Product



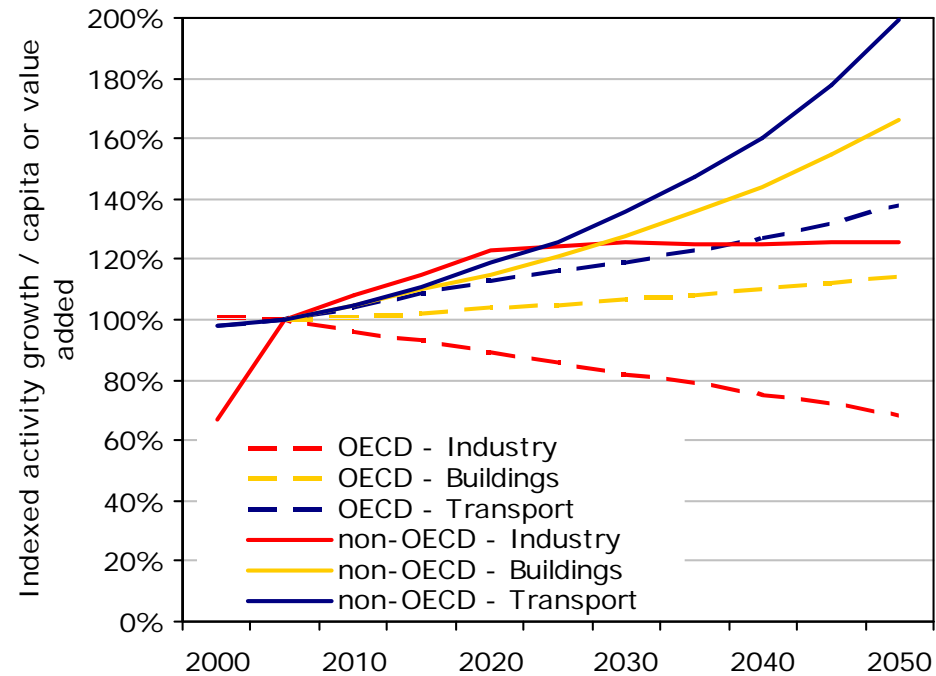
Key Trends

Activity increases, most strongly in non-OECD regions

GDP and Population Forecast



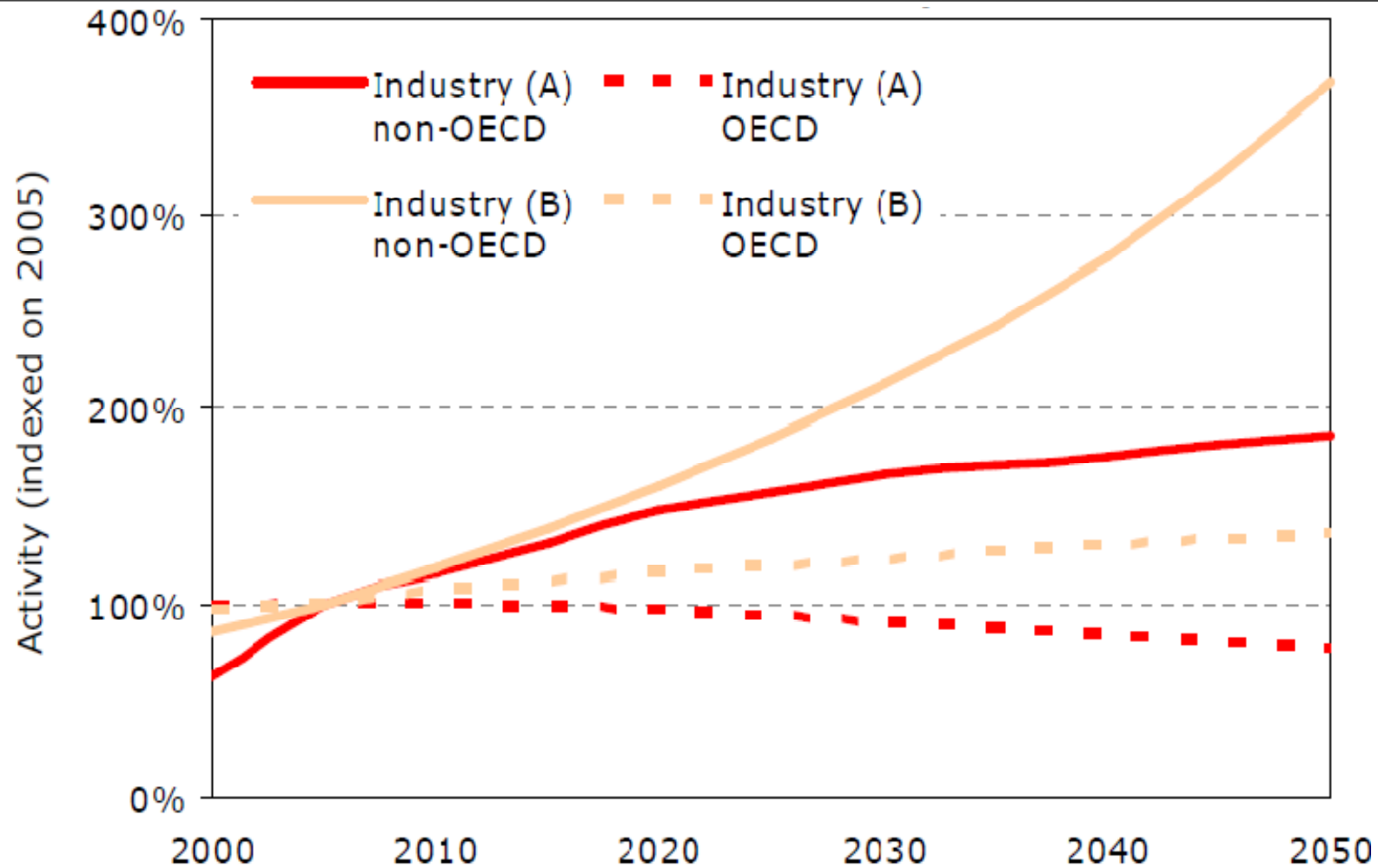
Per-capita Activity growth Indexed on 2005



SOURCE: Ecofys Energy Scenario, 2010



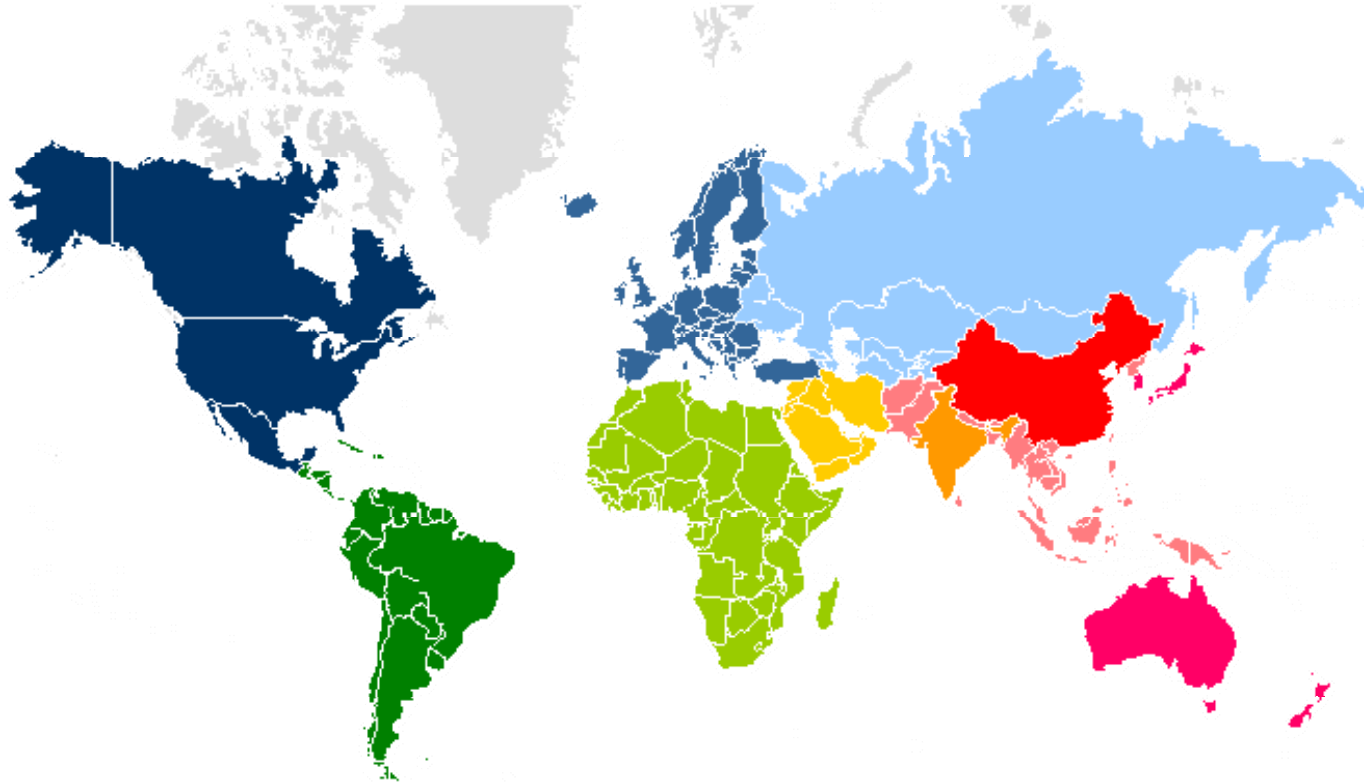
Indexed Absolute Activity Levels



SOURCE: Ecofys Energy Scenario, 2010

Scope of the Scenario

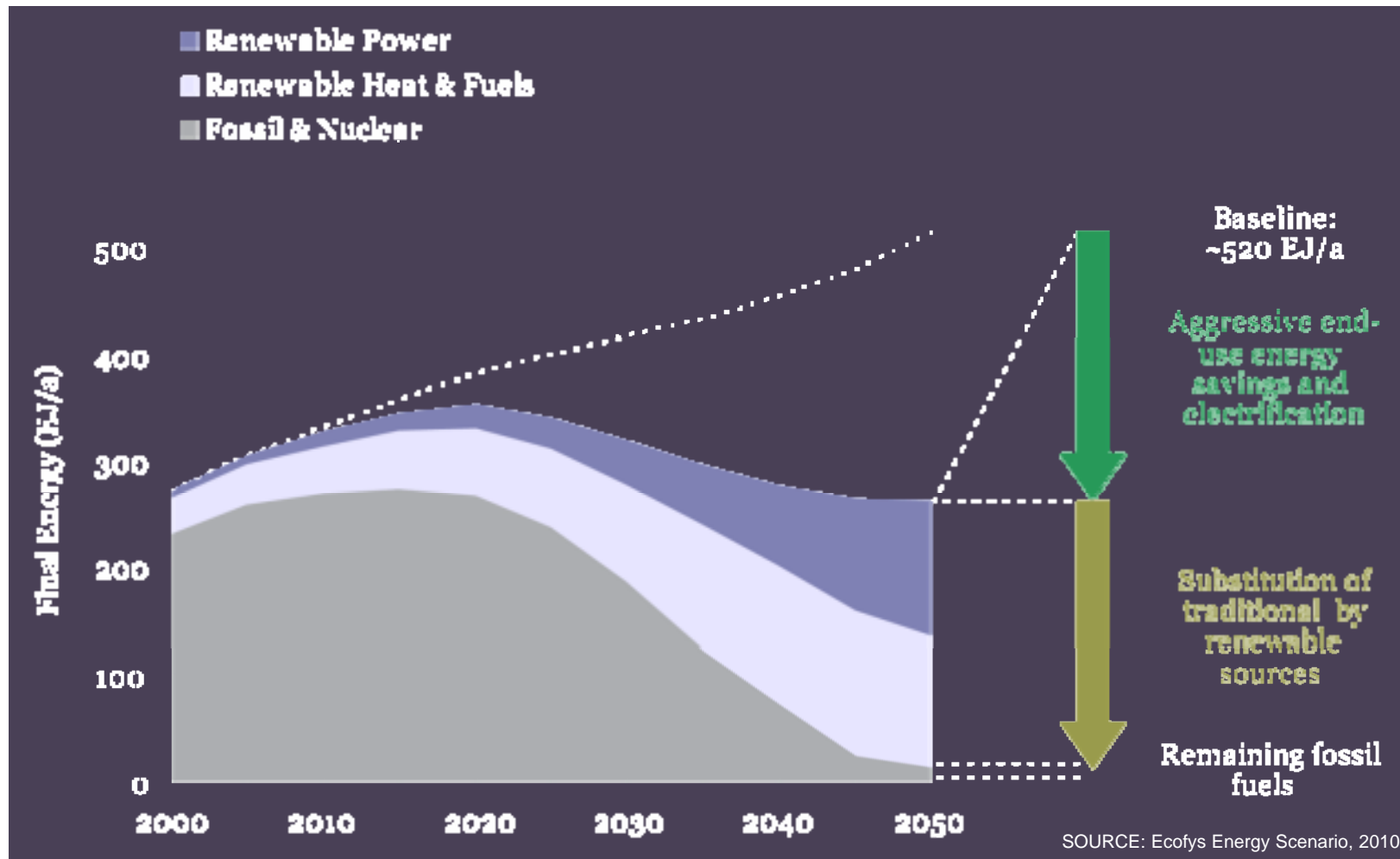
Demand and supply examined in 10 world regions



**Currently, the Scenario is only valid at the global level,
but future regional studies are possible**



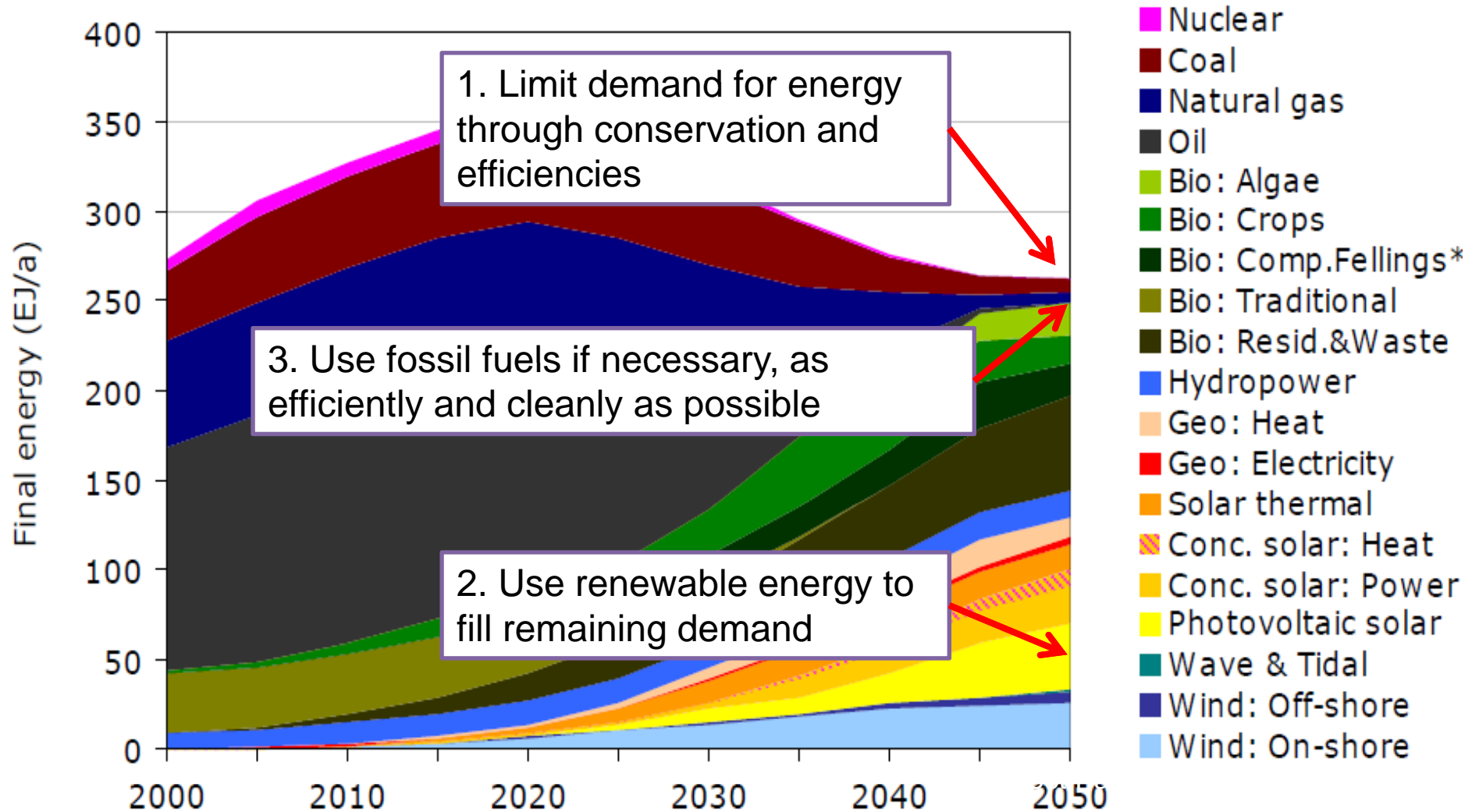
The Scenario – Key Elements





The Scenario

The Energy Report
The Ecofys Scenario



SOURCE: Ecofys Energy Scenario, 2010



The Ecofys Scenario

“imaginative, challenging, encouraging”

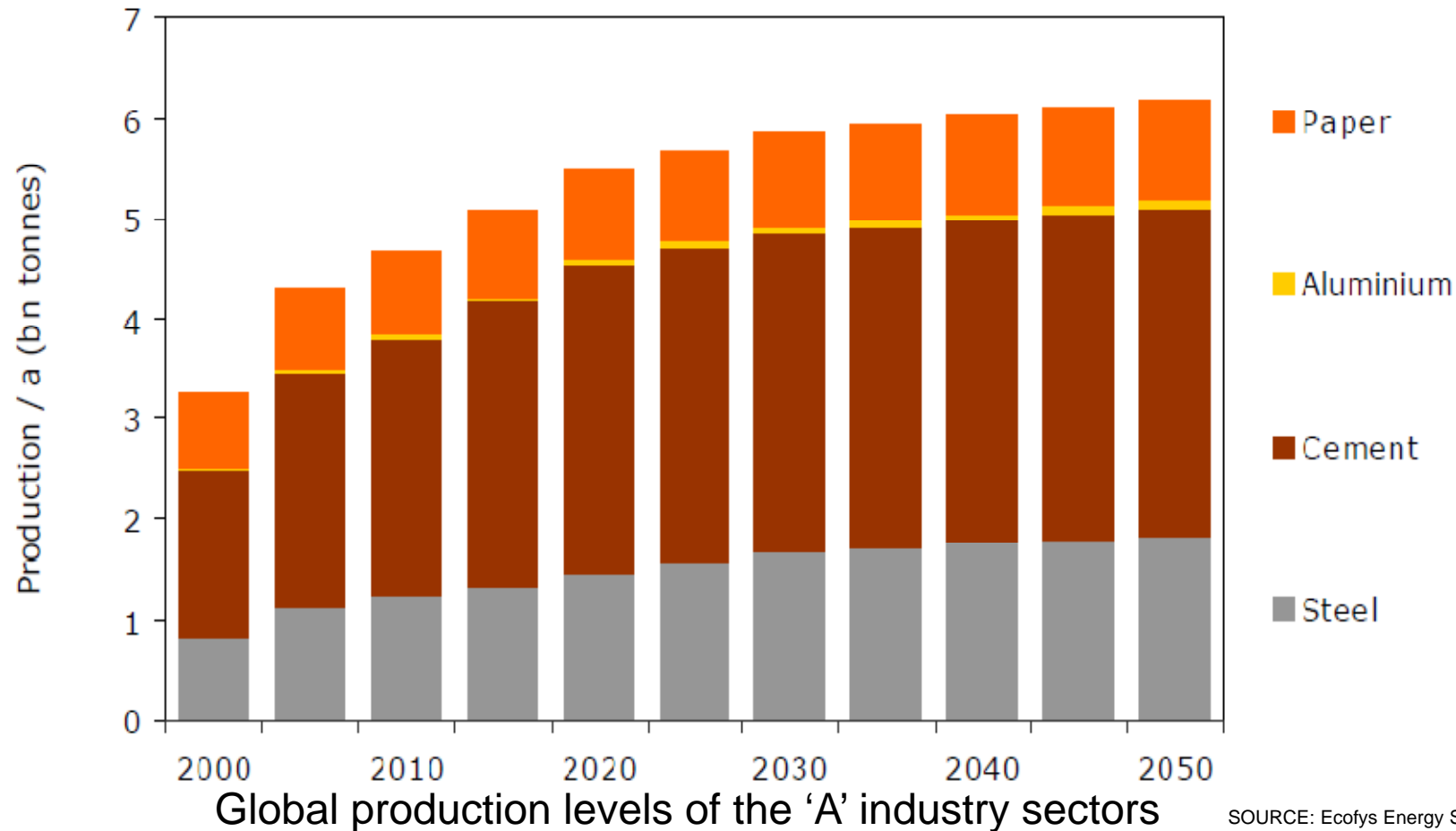
Key elements:

- End energy poverty and inequity
- Technically possible (“can do”)
- Energy efficiency is critical
- Electrification is critical
- Grid expansion and smart grids
- Buildings – retrofit and ‘minergize’
- Phase-out “old-fashioned” biofuels
- Source bioenergy sustainably
- Huge long-term financial benefits



Projected Activity Levels

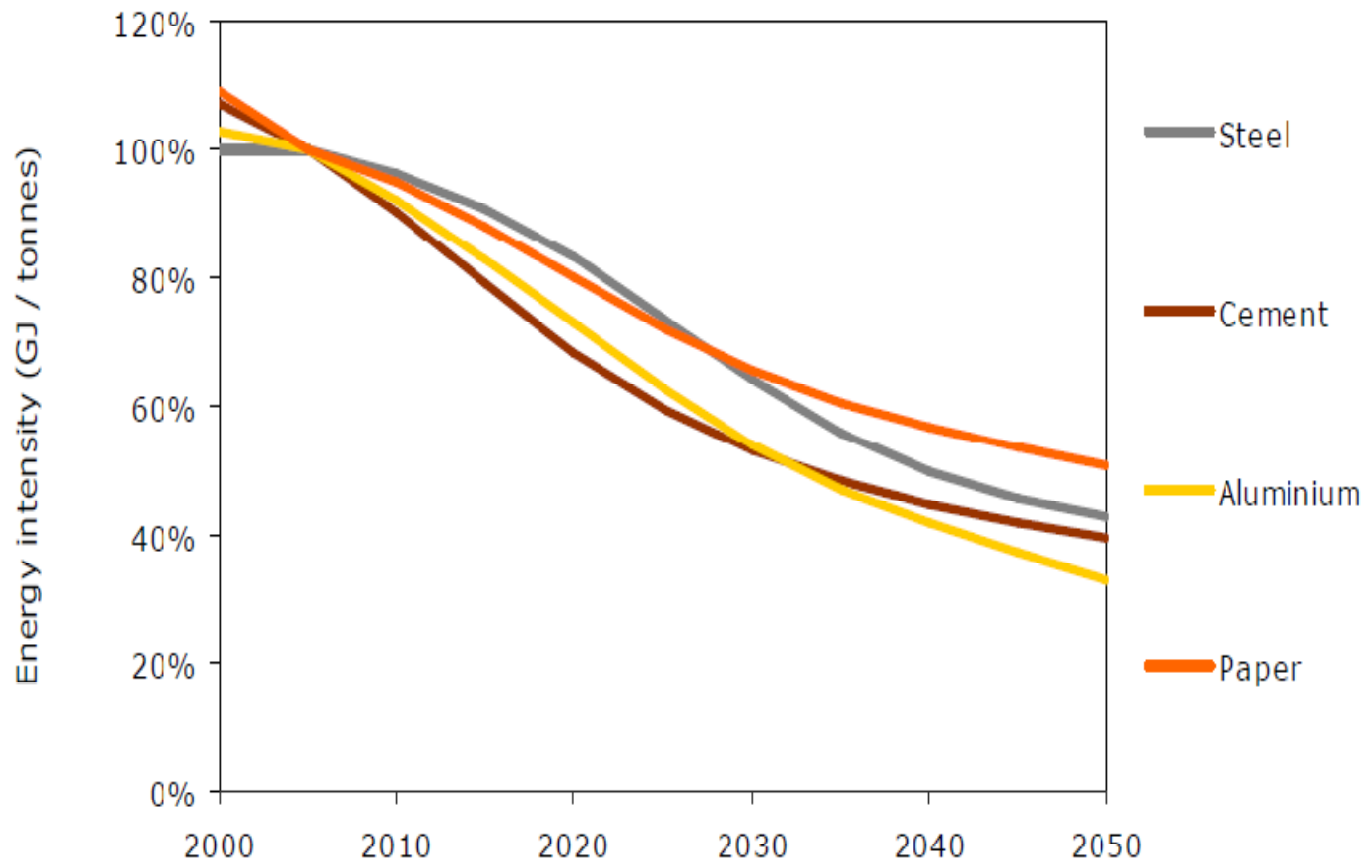
Projected activity levels of energy-intensive industries





Reduced Energy Intensity

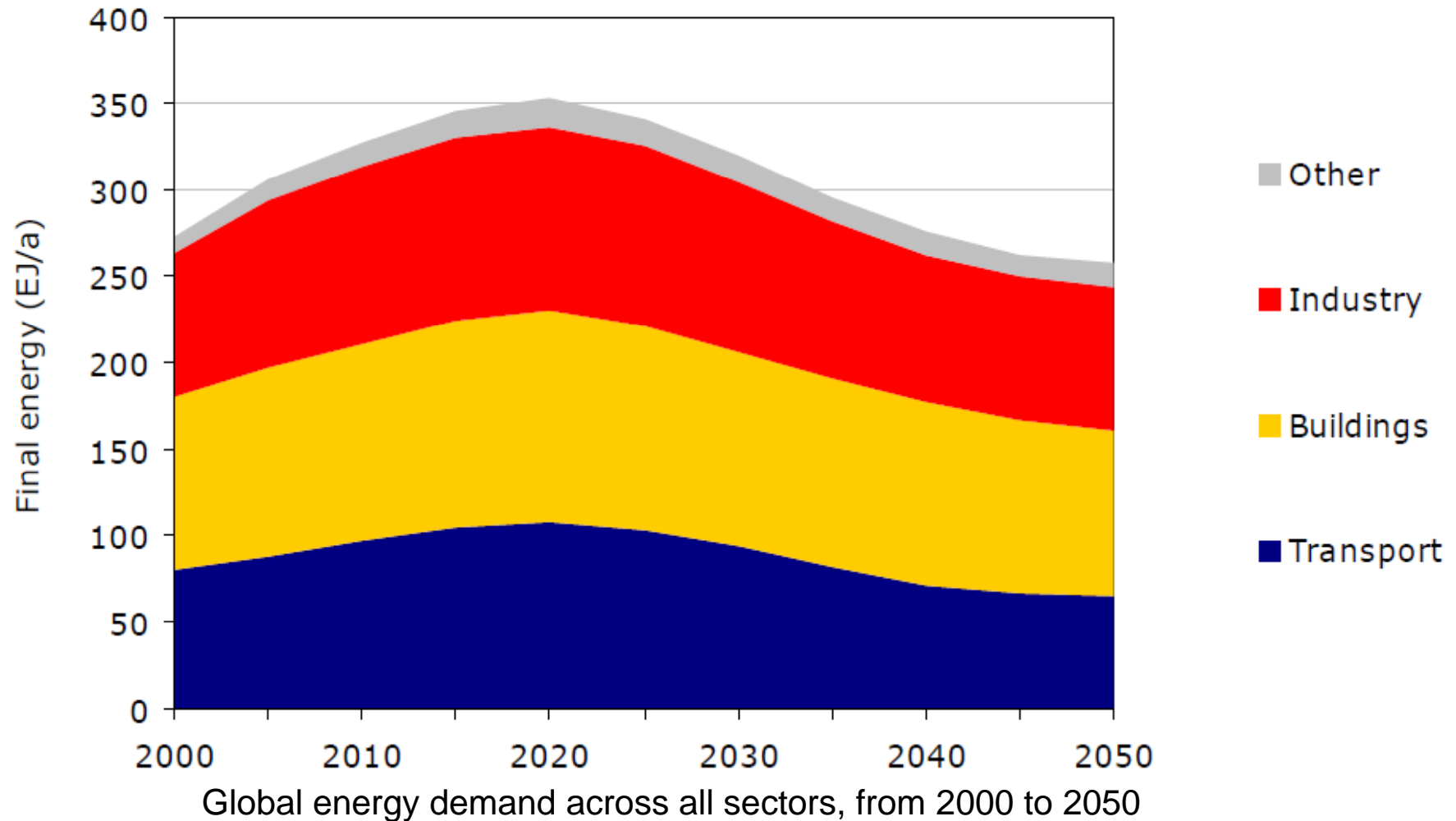
Reduced specific energy intensity of key industries



SOURCE: Ecofys Energy Scenario, 2010



World Energy Supply

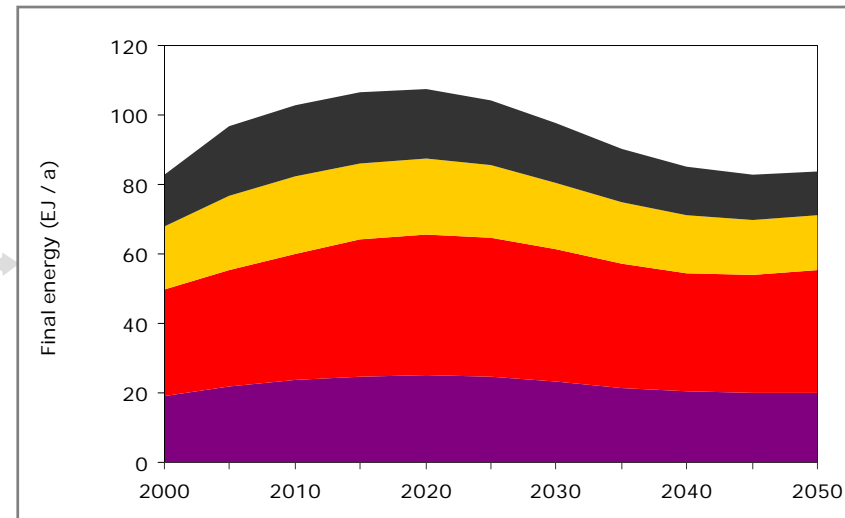
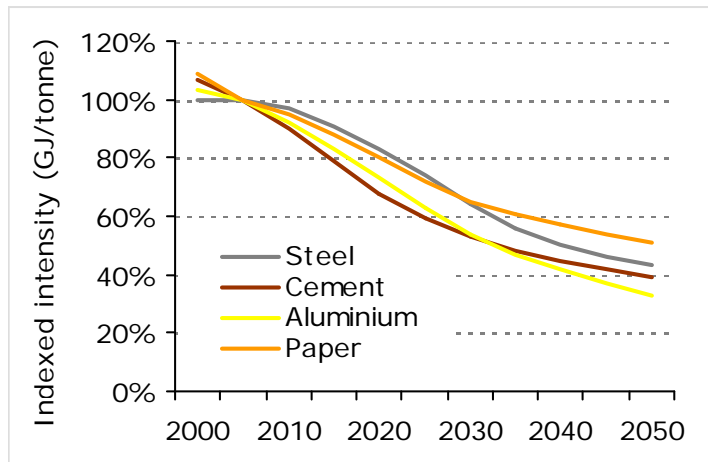
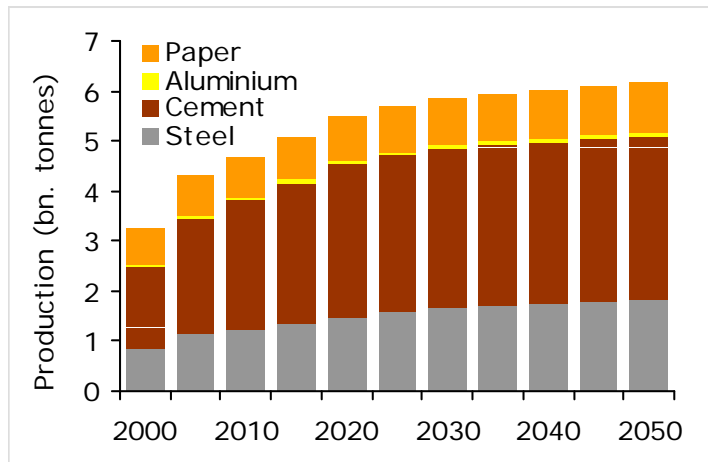


SOURCE: Ecofys Energy Scenario, 2010



Energy Demand in Industry

Stabilisation in energy demand in industry results from ambitious efficiency improvements



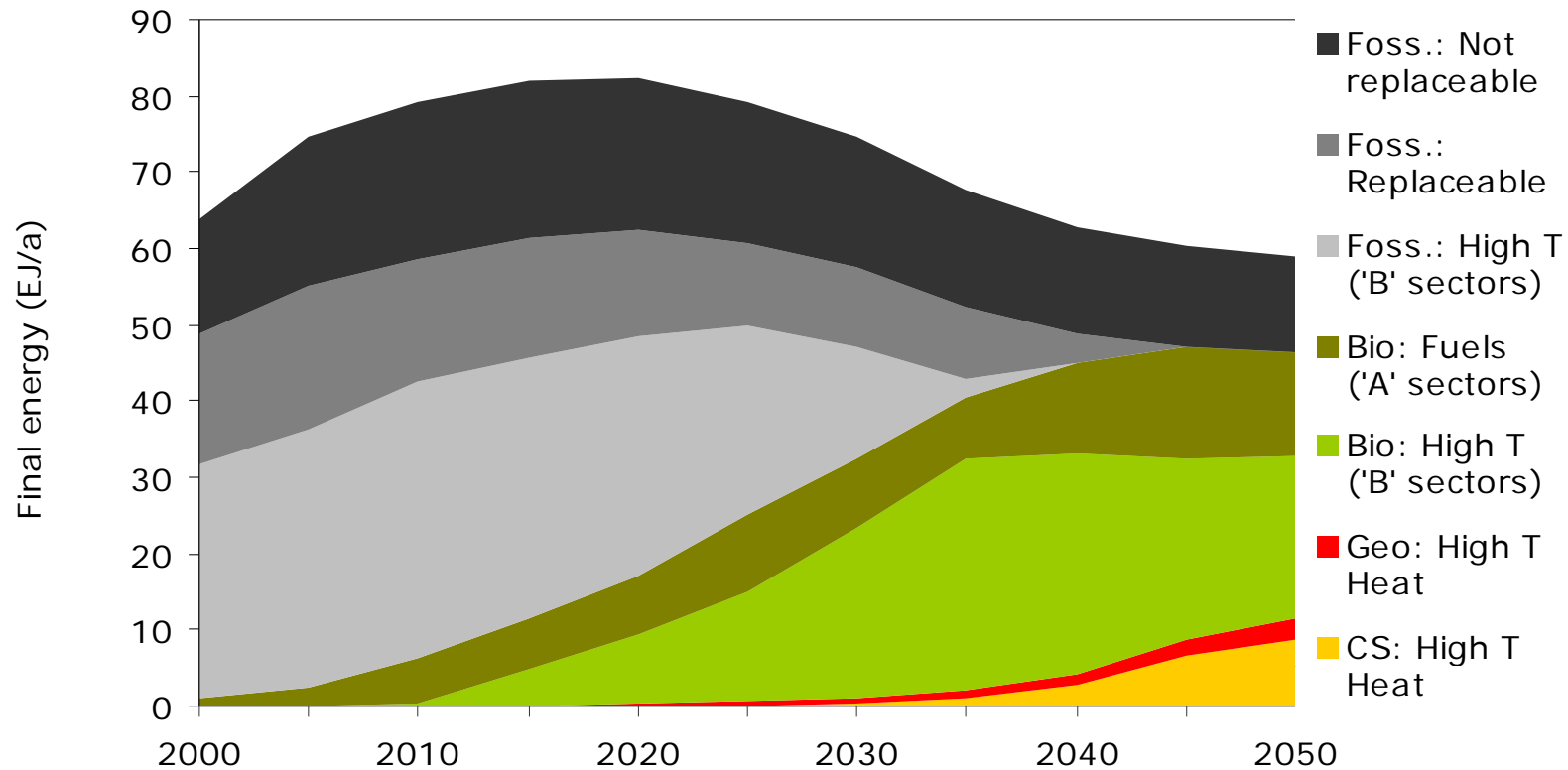
Activity and intensity graphs are only shown for Steel, Cement, Aluminium and Paper sectors for illustration. Other sectors are based on GDP growth projections

SOURCE: Ecofys Energy Scenario, 2010



Role of Biomass

Biomass can provide a large share of industry energy needs

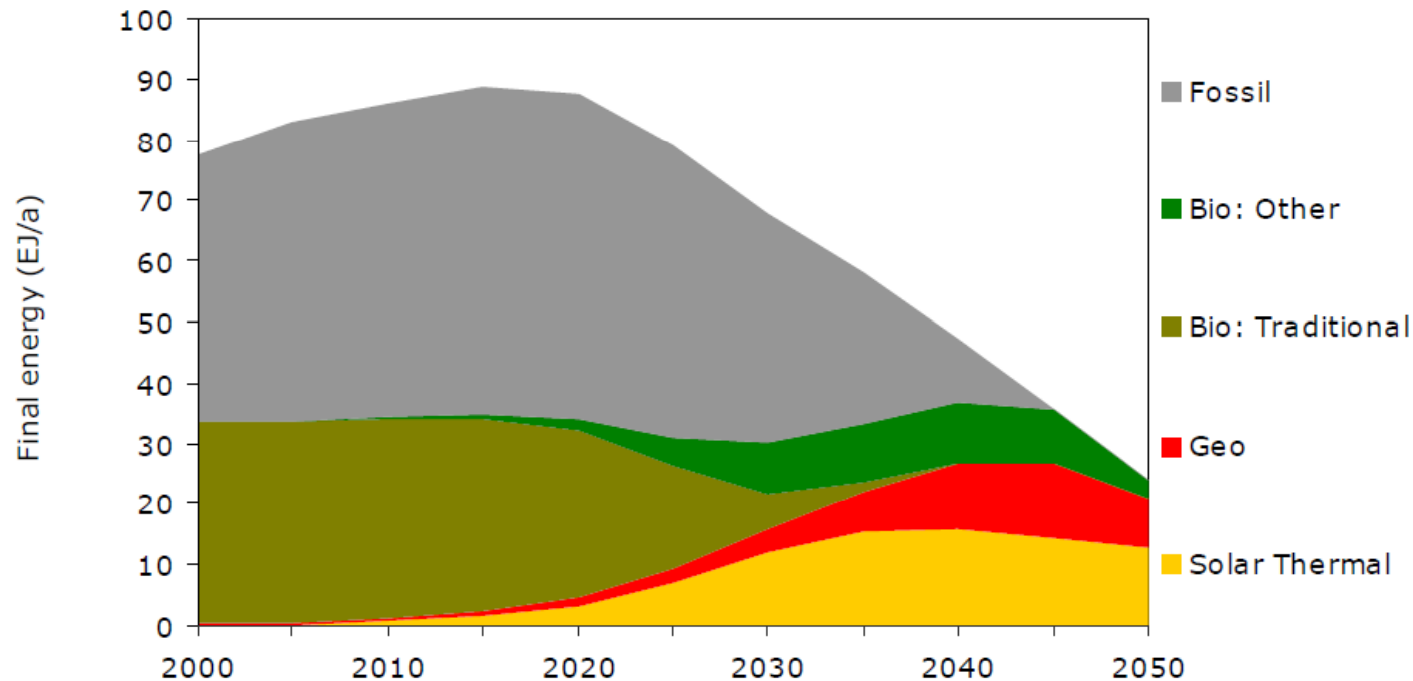


SOURCE: Ecofys Energy Scenario, 2010



Building Heat Supply

Split of supply options in the global Buildings sector (excluding electricity)



Renewables to provide all building heat needs

Space heating from:

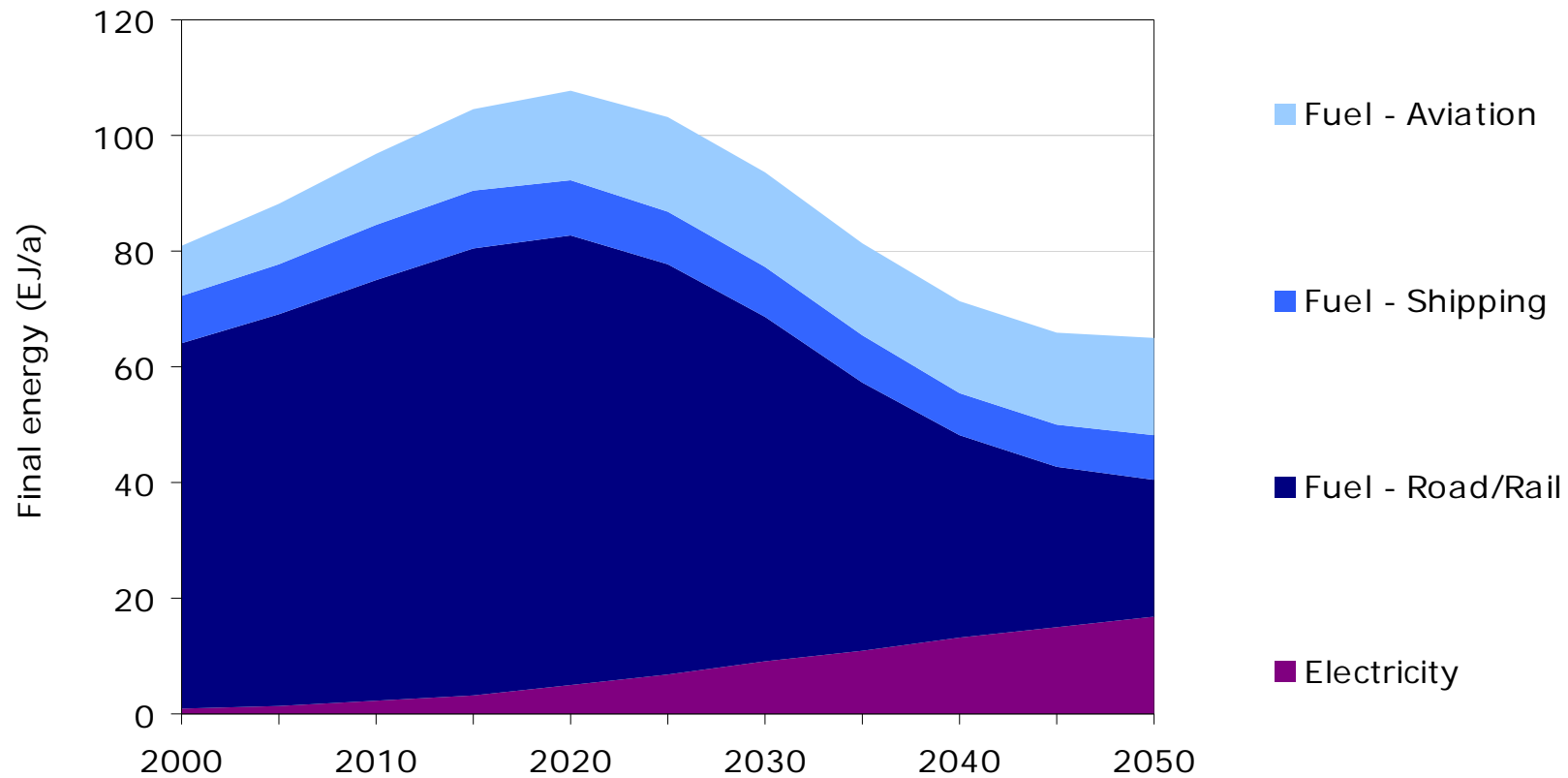
- Decentralized solar heating
- Centralized or district-level renewable sources

SOURCE: Ecofys Energy Scenario, 2010



Electrification for Transport

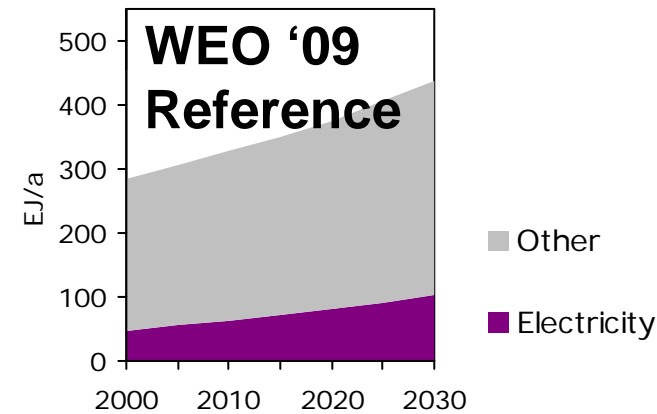
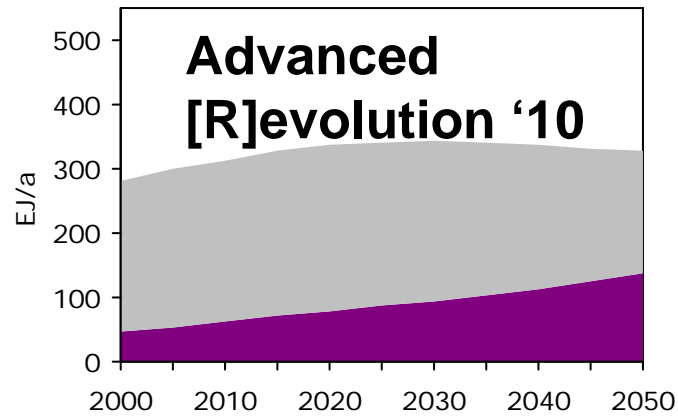
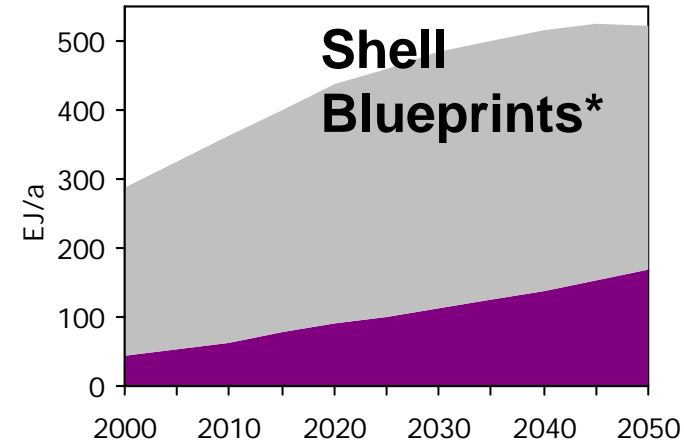
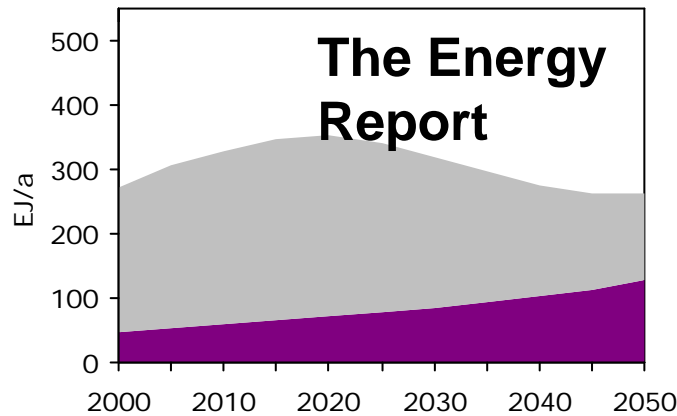
Electrification is key to sustainability in transport



SOURCE: Ecofys Energy Scenario, 2010



Electrification is Key



Other
Electricity

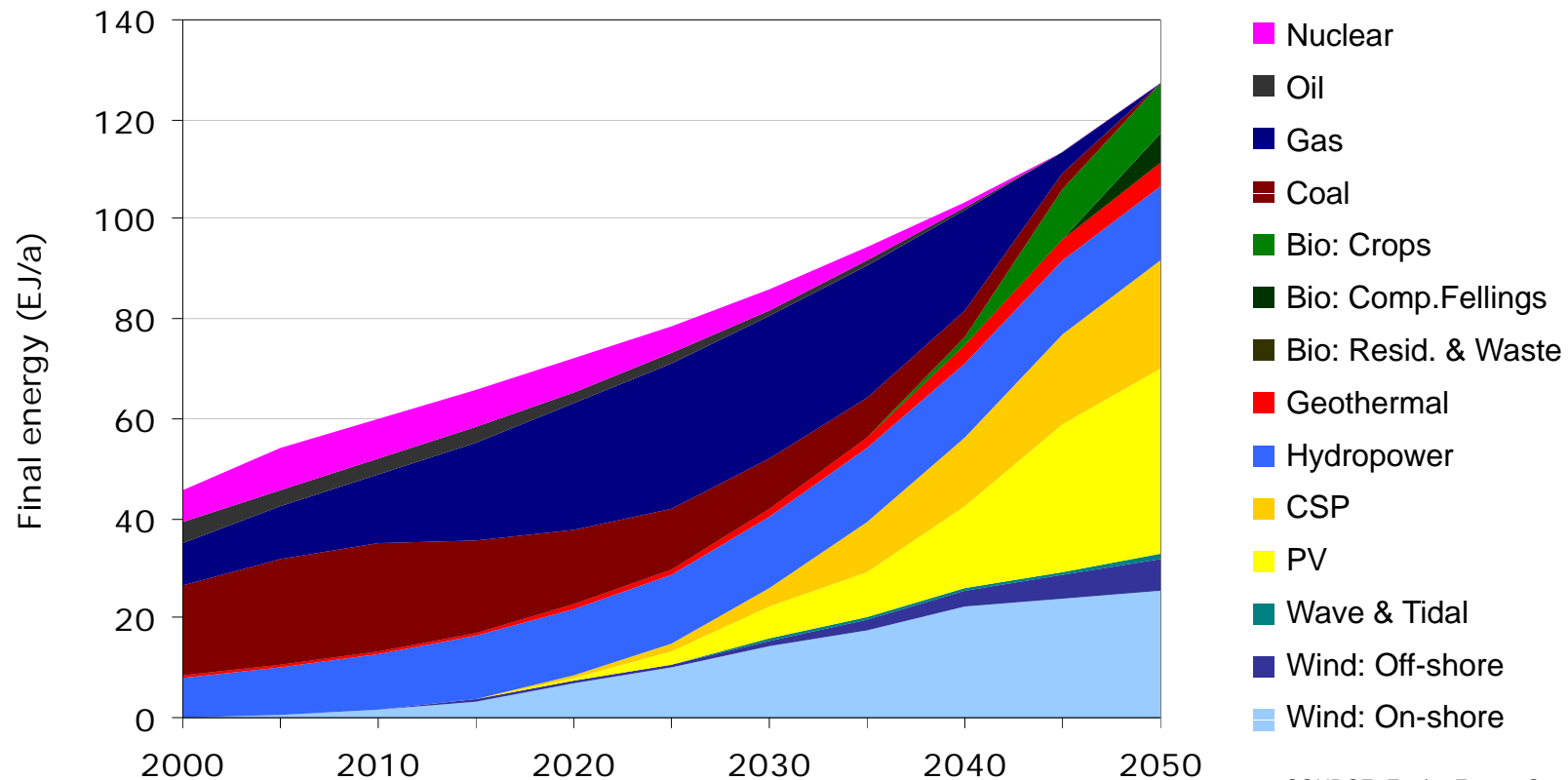
All values in final energy; *approximation

SOURCE: Ecofys Energy Scenario, 2010



100% Renewable Electricity

Renewable electricity will be so abundant that options will compete against each other even before 2050

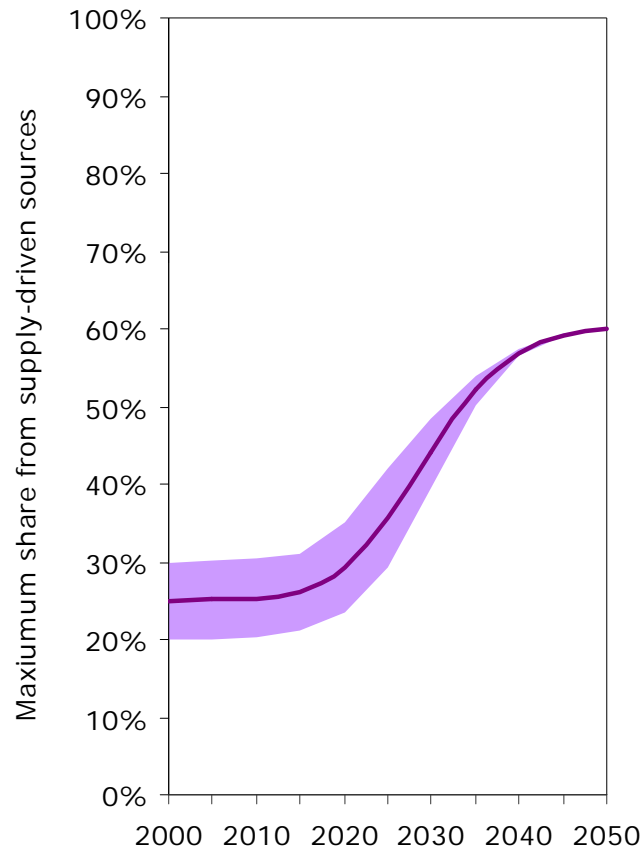


SOURCE: Ecofys Energy Scenario, 2010



Electricity Grids

Regional electricity grids need to be upgraded and extended to be ready for RES power



- Electricity grids should be well-connected regionally

Remove bottlenecks by increasing capacity and increasing range of transmission lines

Efforts to start now for results by 2030

- Beyond 2020 may require better grid stability

Re-focus R&D now to prepare grids

For high RES shares beyond 2030 all of the following levers need to be employed:

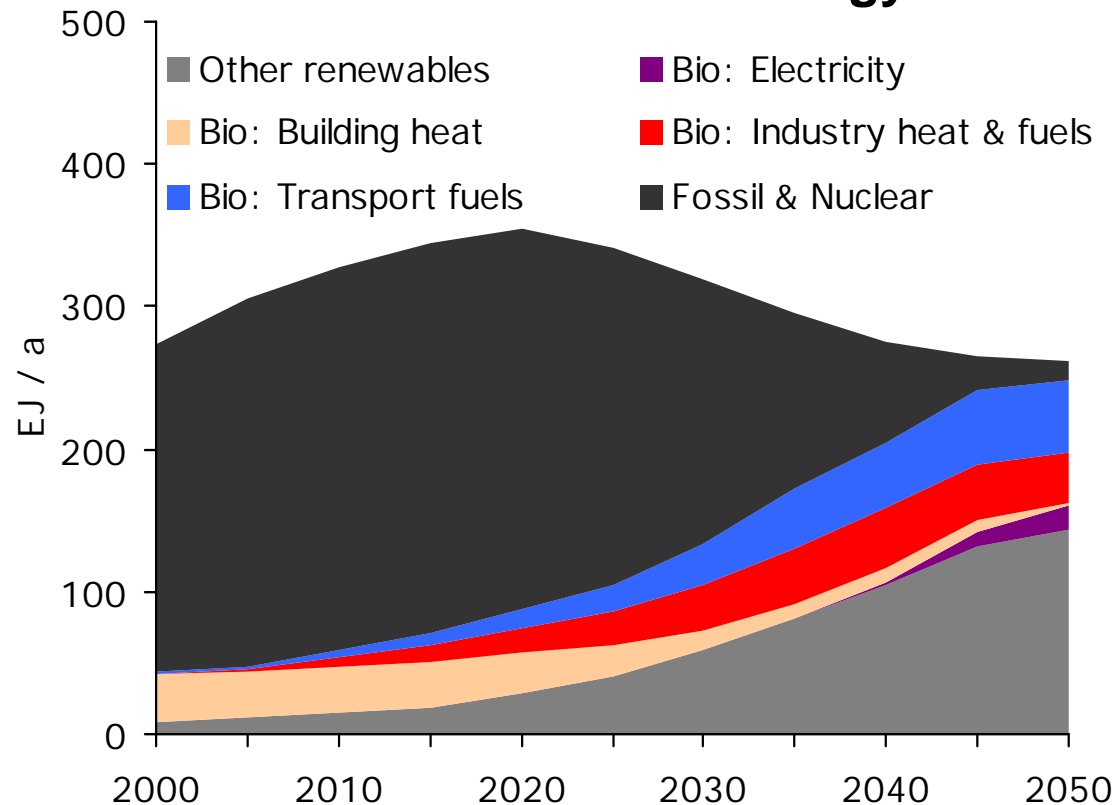
- Grid improvements
- Demand side management
- Storage

SOURCE: Ecofys Energy Scenario, 2010



Role of Bioenergy

Fossil and other renewable energy sources

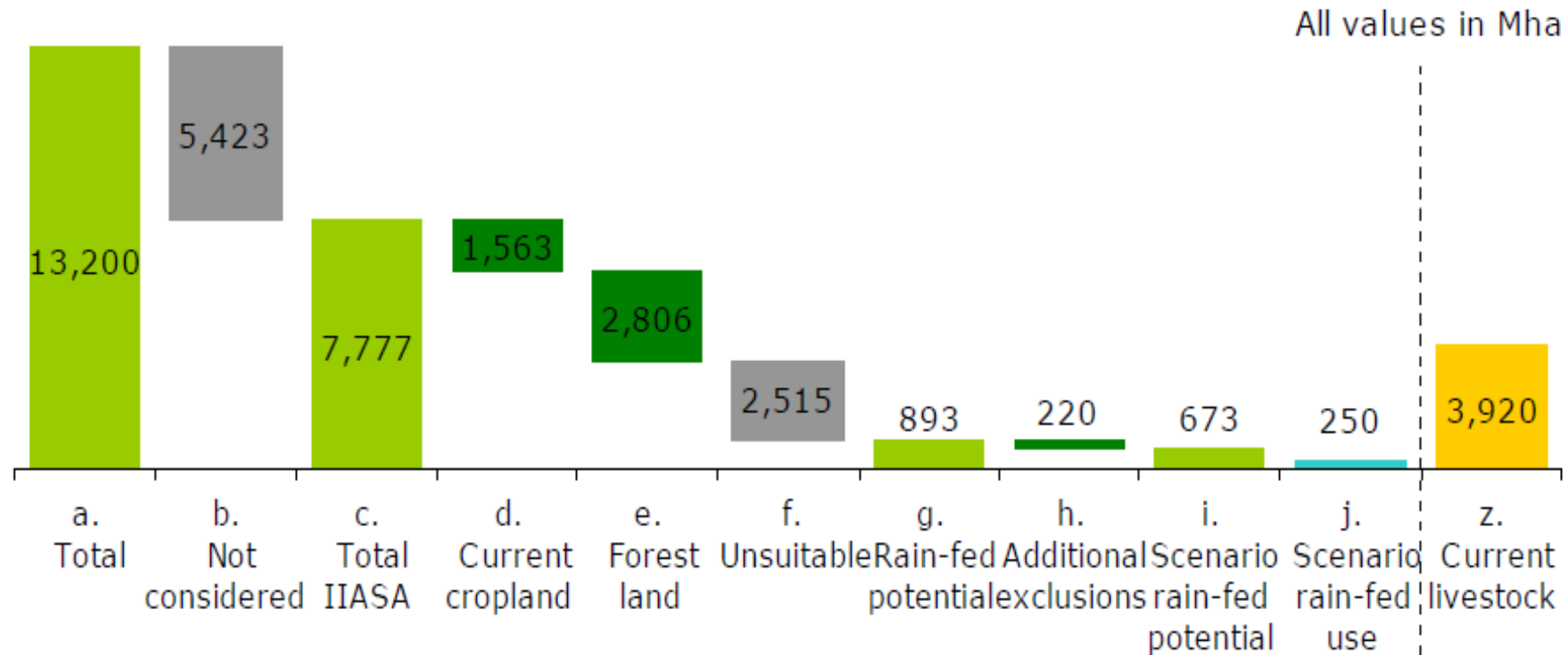


Bioenergy used where other renewables provide no alternative, or no complete alternative

SOURCE: Ecofys Energy Scenario, 2010



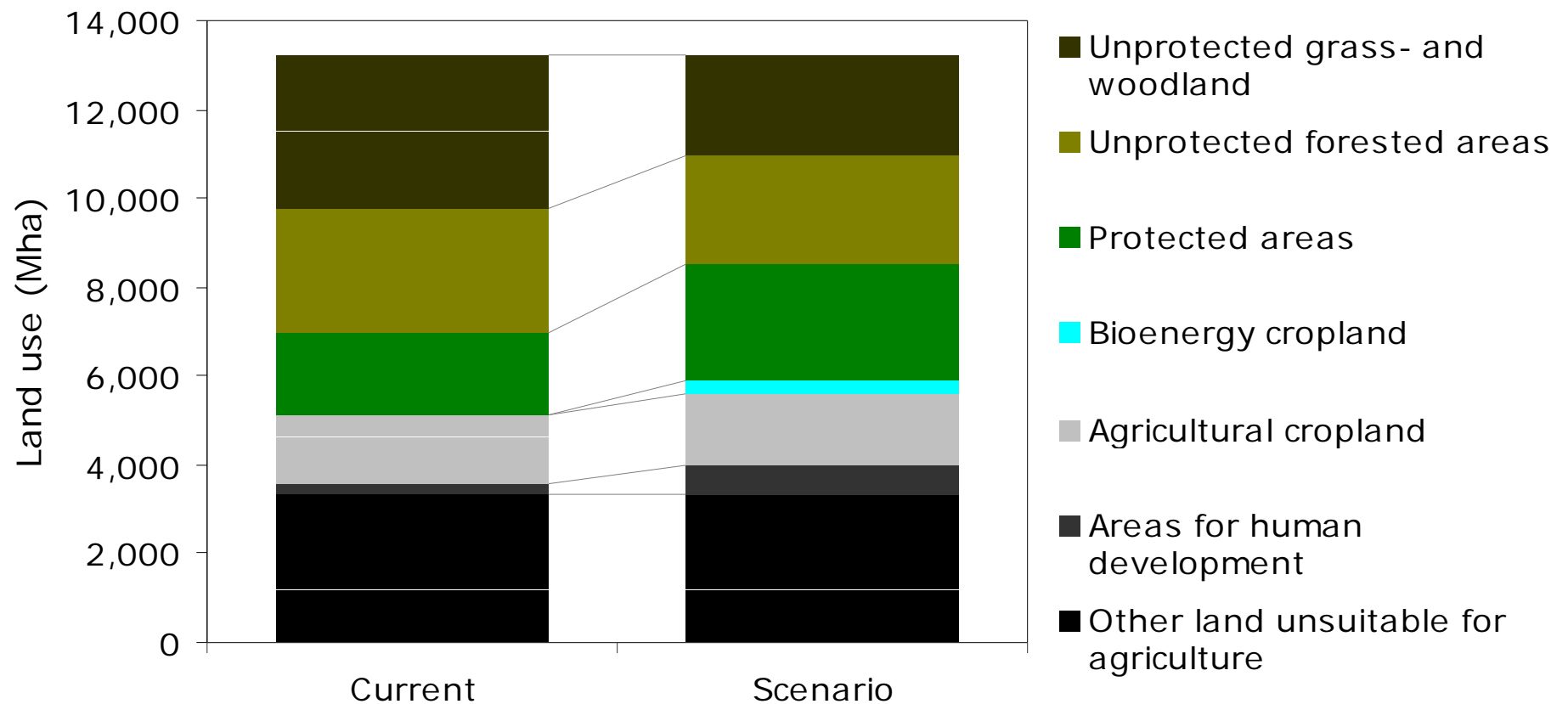
Land Distribution



SOURCE: Ecofys Energy Scenario, 2010



Land Use Development



SOURCE: Ecofys Energy Scenario, 2010



Bioenergy Impacts

The Energy Report
The Ecofys Scenario

Minimize use of bioenergy and manage impacts:

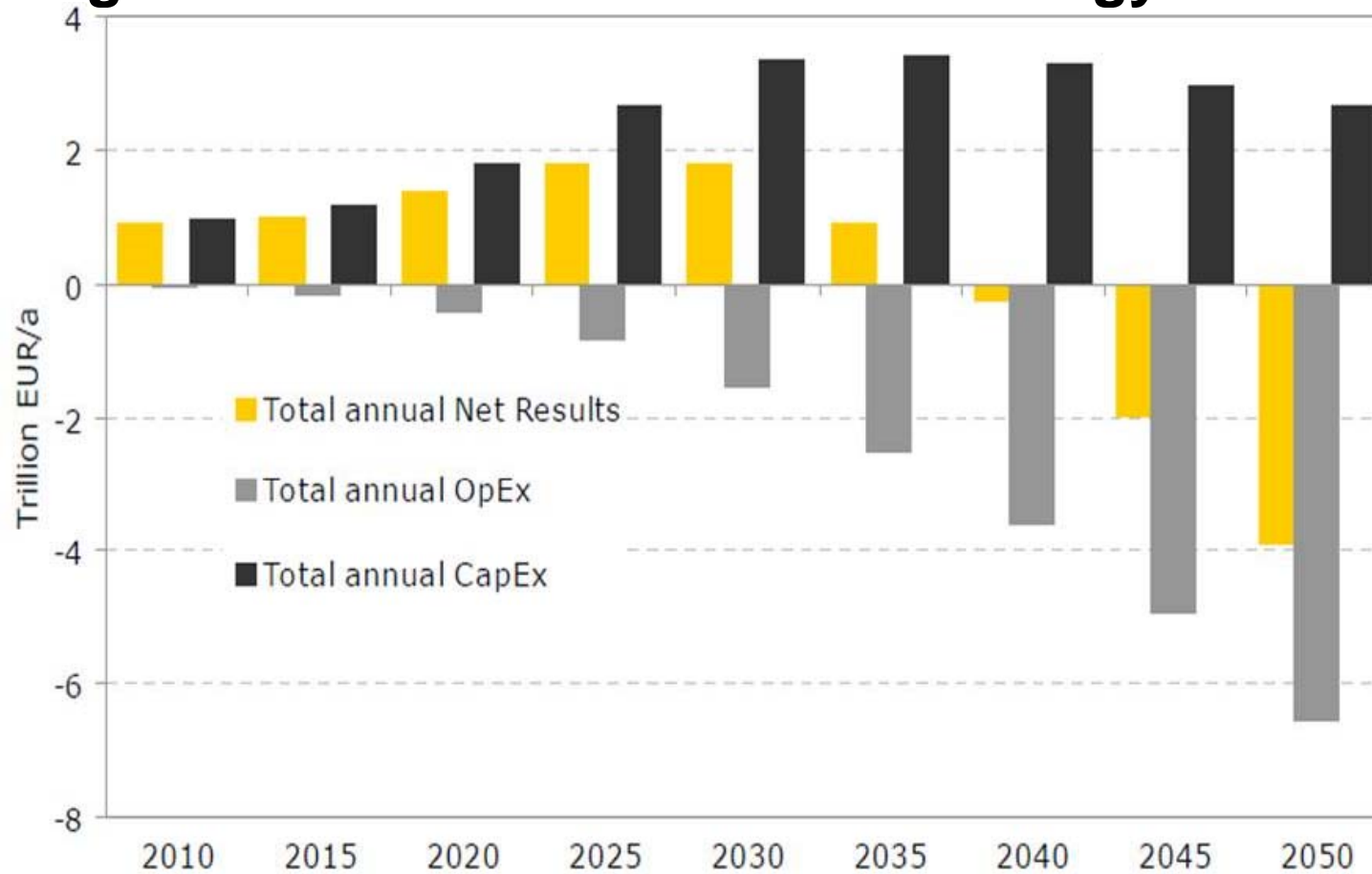
- **Every other alternative used first - wherever possible**
- **Sustainability criteria utilized**
- **Maximum use of organic waste, sustainable level of residues, and algae**
- **Phase-out of traditional bioenergy**
- **Forest residues and “complementary fellings” only**
- **“Freeing up” of land critical – dietary shifts important**

Note: Less bioenergy than in previous WWF Climate Solutions reports



Total Investments and Savings

Total global annual cost results for Energy Scenario



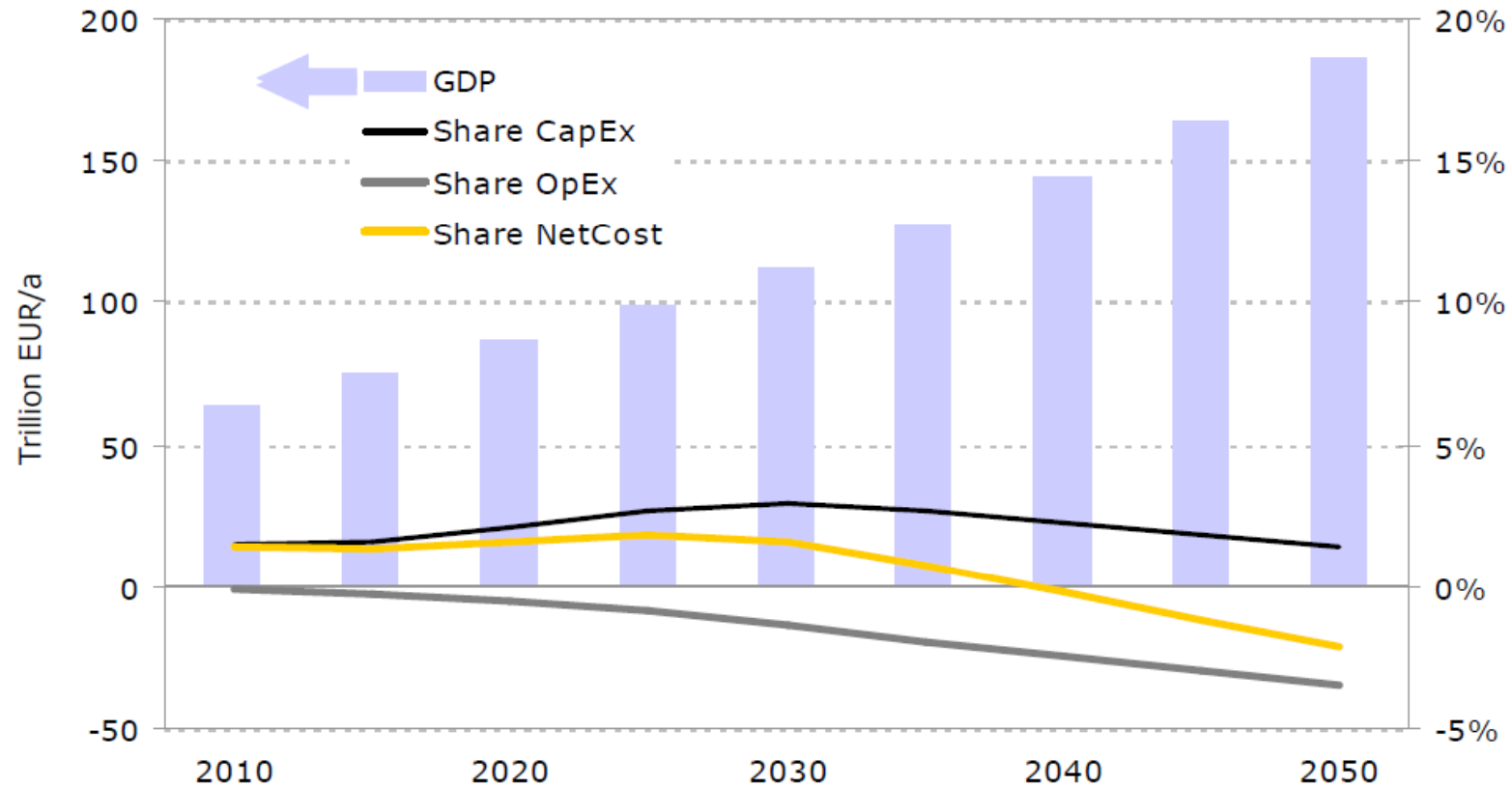
SOURCE: Ecofys Energy Scenario, 2010



Upfront Investment

The Energy Report
The Ecofys Scenario

High upfront investments needed, Saving money long term



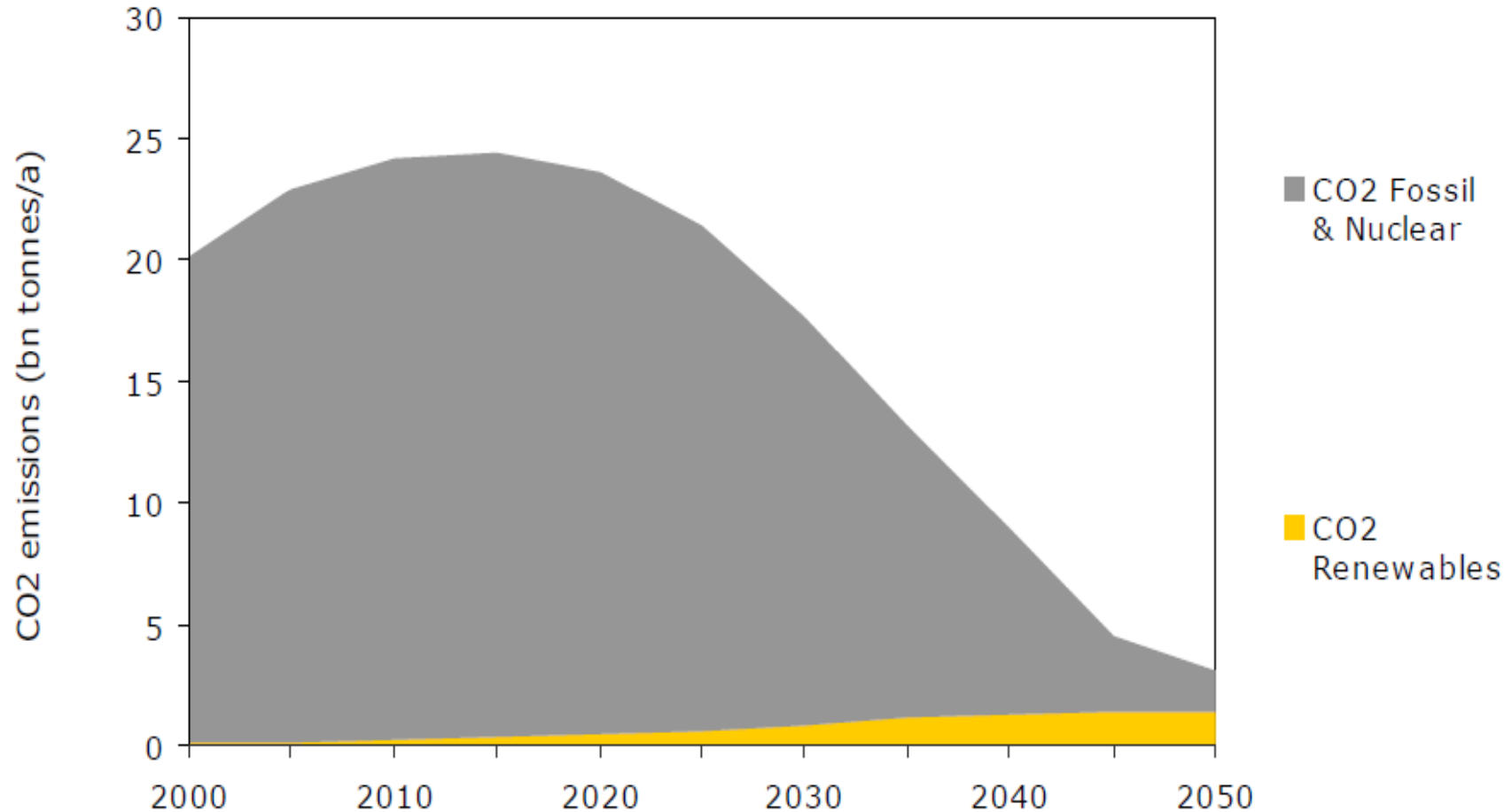
Comparison of cost results with global GDP

SOURCE: Ecofys Energy Scenario, 2010

NB: Cost savings do NOT include avoided damage costs from climate change, reduced health costs and other monetary environmental impacts from using fossil fuels



Reducing CO₂ Emissions from Energy Sector by >80%



Global CO₂-eq GHG emissions from the energy system in the scenario

SOURCE: Ecofys Energy Scenario, 2010



Key Issue: Scaling Efforts

“Total investment for energy-efficient technologies currently estimated to be €60 billion per annum” (REEEP, 2009)

“In 2009, more than \$US150 billion was invested in new renewable energy capacity....more money than in new fossil fuel capacity” (REN 21, 2010)

“Annual CAPEX costs are.... around €1 trillion /year initially [in 2010/11] and grow until 2035 - to almost €3.5 trillion/year [before declining to about €2 billion/year by 2045/2050]” (WWF, 2011)



EROEI of electricity generation

by Jamie Bull

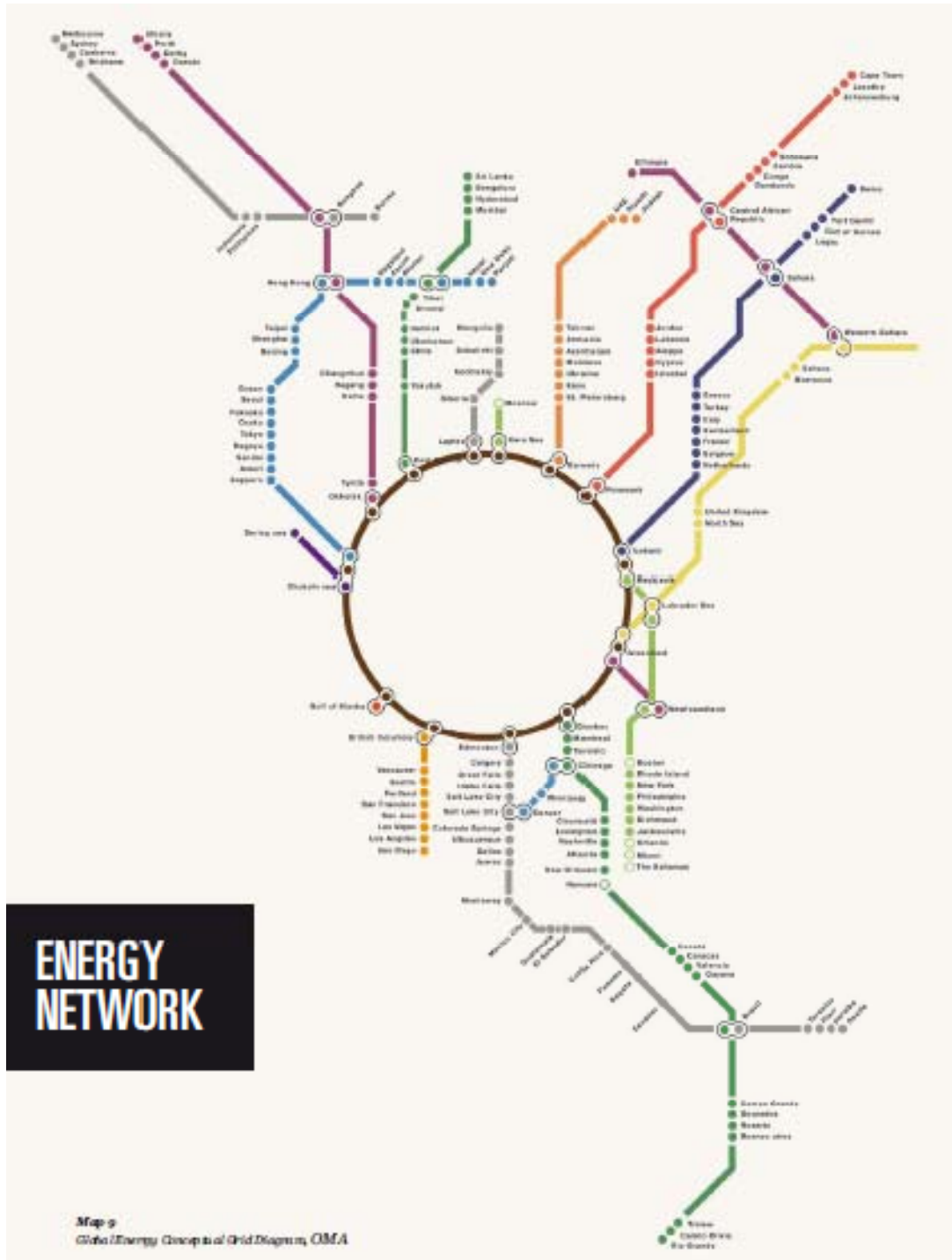
Technology	Average EROEI	Average EIRR	Average lifespan	Number found
Coal no CCS	5.5	17%	31	11
Coal w. CCS	1.5	8%	23	2
Solar thermal elec.	9.9	40%	25	7
Gas no CCS	3.5	11%	32	5
Gas w. CCS	2.2	13%	23	2
Nuclear	10.9	36%	29	50
PV	8.3	34%	24	46
Tidal range	115.9	97%	120	1
Tidal stream	14.9	74%	20	2
Wind	25.0	125%	21	108
Wave	12.0	60%	20	2



Challenges and Solutions

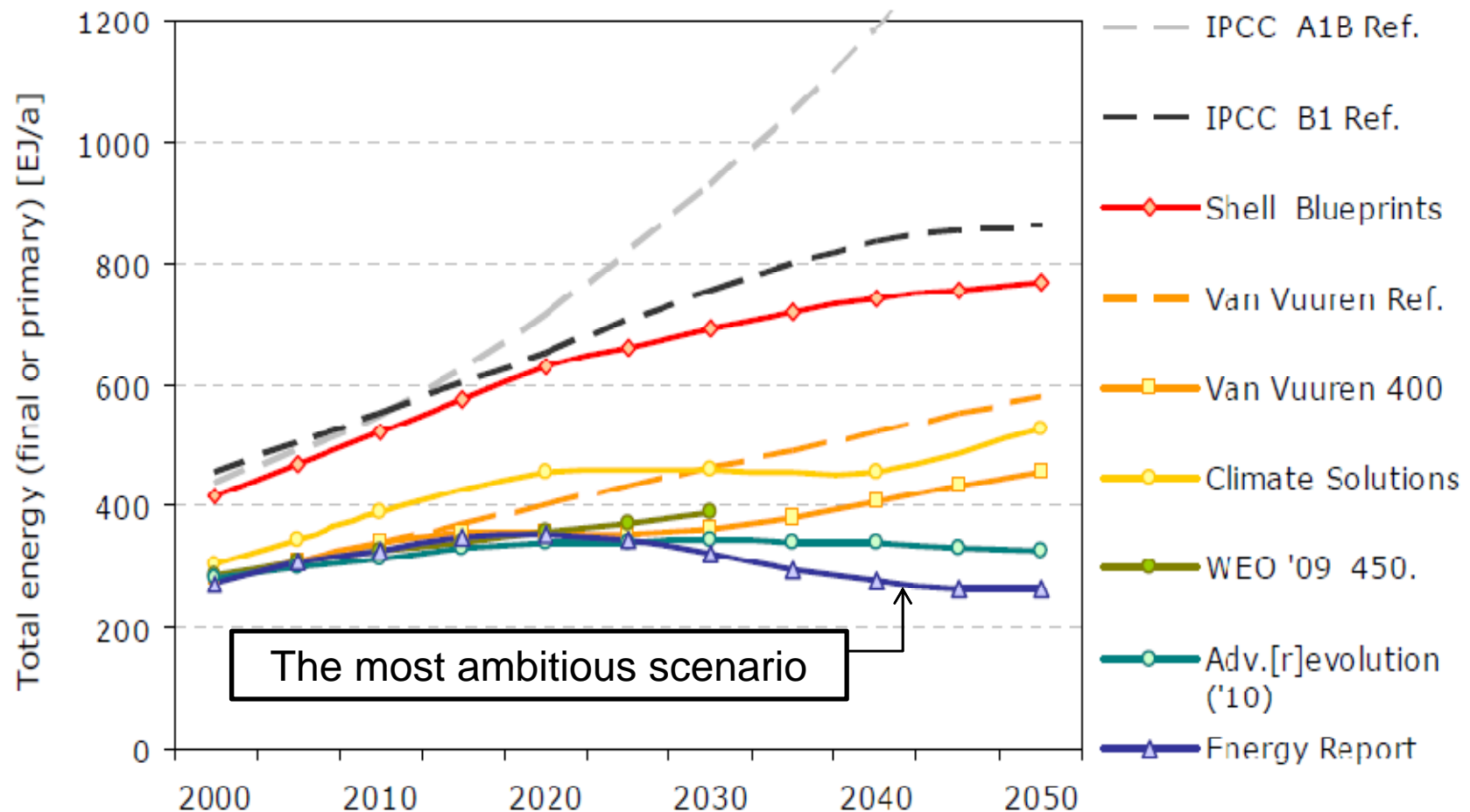
- **Energy conservation**
- **Electrification**
- **Land and sea use**
- **Equity**
- **Lifestyle**
- **Finance**
- **Innovation**







Global Energy Demand



Global energy demand evolution in *The Energy Report* compared to other energy scenarios. Top three lines are in primary, lower six lines in final energy SOURCE: Ecofys Energy Scenario, 2010



Meeting the Challenges 1

Power

- Electrification
- Grid expansion & “Smart grids”

Efficiency

- Best available technology

Society

- Global co-operation - policies, standards
- Institutional behavioural change
- Individual behavioural change

Equity

- Ending Energy Poverty

Financing

- Leverage CAPEX, change ROI expectations

Research

- New, efficient, long-enduring materials



Meeting the Challenges 2

Need to address “barriers”

Political

- Policies, Investments
- Legislation, targets, agreements

Financial

- Fossil Fuel subsidies
- Upfront capital needs

Infrastructure

- Gap in efficient infrastructure

Training

- Demand for skilled personnel

Cultural

- Lifestyle and footprint impacts



WWF Priorities for Action

- **Ambitious energy efficiency legislation**
 - **Reliable renewable support schemes**
 - **Strengthened R & D and innovation**
- **Comprehensive electrification**
 - **Speedy expansion of new and smart grids**
 - **Predictable policy and financial framework for investors**
 - **Unlimited clean technology exchange and clean energy trade**
- **Sustainable land use policies**
 - **Increased lifestyle changes by global rich and middle classes**

A = 'easy'
B = laborious
C = difficult

Enhanced alliance building is key for all interventions



The 10 Recommendations

The Energy Report

CLEAN ENERGY: Promote only the most efficient products. Develop existing and new renewable energy sources to provide enough clean energy for all by 2050.

FOOD: Stop food waste. Choose food that is sourced in an efficient and sustainable way to free up land for nature, sustainable forestry and bio fuel production. Everyone has an equal right to healthy levels of protein in their diet – for this to happen, wealthier people need to eat less meat.

MONEY: Invest in renewable, clean energy and energy-efficient products and buildings.

MATERIALS: Reduce, re-use, recycle – to minimize waste and save energy. Develop durable materials. And avoid things we don't need.

GRIDS: Share and exchange clean energy through grids and trade, making the best use of sustainable energy resources in different areas.

TRANSPORT: Provide incentives to encourage greater use of public transport, and to reduce the distances people and goods travel. Promote electrification wherever possible, and support research into hydrogen and other alternative fuels for shipping and aviation.

ACCESS: End energy poverty: provide clean electricity and promote sustainable practices, such as efficient cook stoves, to everyone in developing countries.

TECHNOLOGY: Develop national, bilateral and multilateral action plans to promote research and development in energy efficiency and renewable energy.

SUSTAINABILITY: Develop and enforce strict sustainability criteria that ensure renewable energy is compatible with environmental and development goals.

AGREEMENTS: Support ambitious climate and energy agreements to provide global guidance and promote global cooperation on renewable energy and efficiency efforts.

Facts

that have yet to permeate public consciousness,
or relevant boardrooms

- There is more than enough renewable energy (RE) for all human needs
- Inefficient resource use is destroying our life-support systems
- Decreasing energy return on energy invested in fossil fuels
- Can't afford to burn currently available fossil hydro-carbon ***reserves***

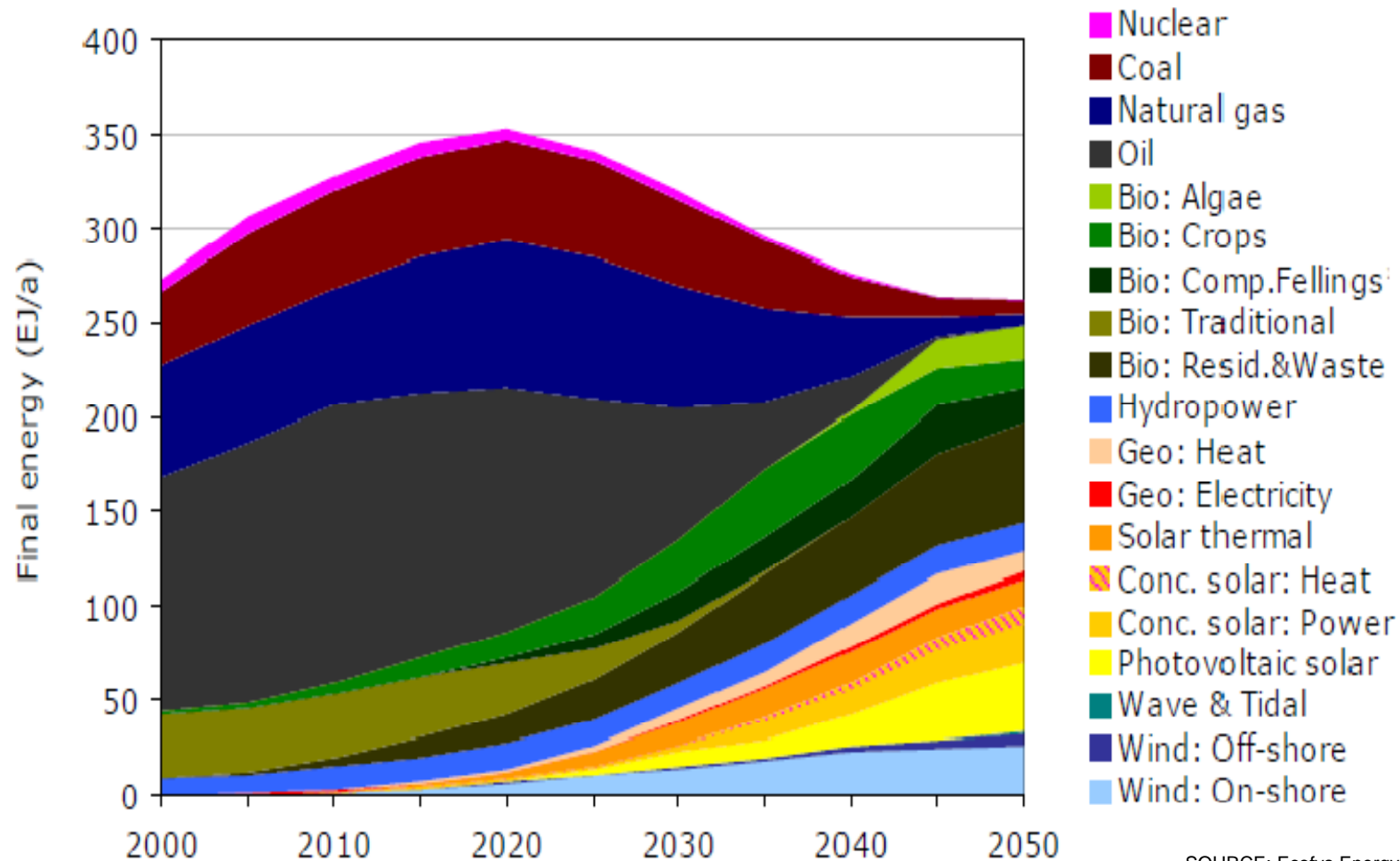
(the portion of known resources considered economically viable under recent market conditions)

Fossil hydro-carbons are not cheap, but cost-deferring

Energy from burning fossils fuels should not be our benchmark



A Global Scenario



SOURCE: Ecofys Energy Scenario, 2010

