Realise Forum

Milano 15-16 December 2005

Scenarios, policies and measures to accelerate renewables

Roberto Vigotti
Chair of the IEA Renewable Working Party

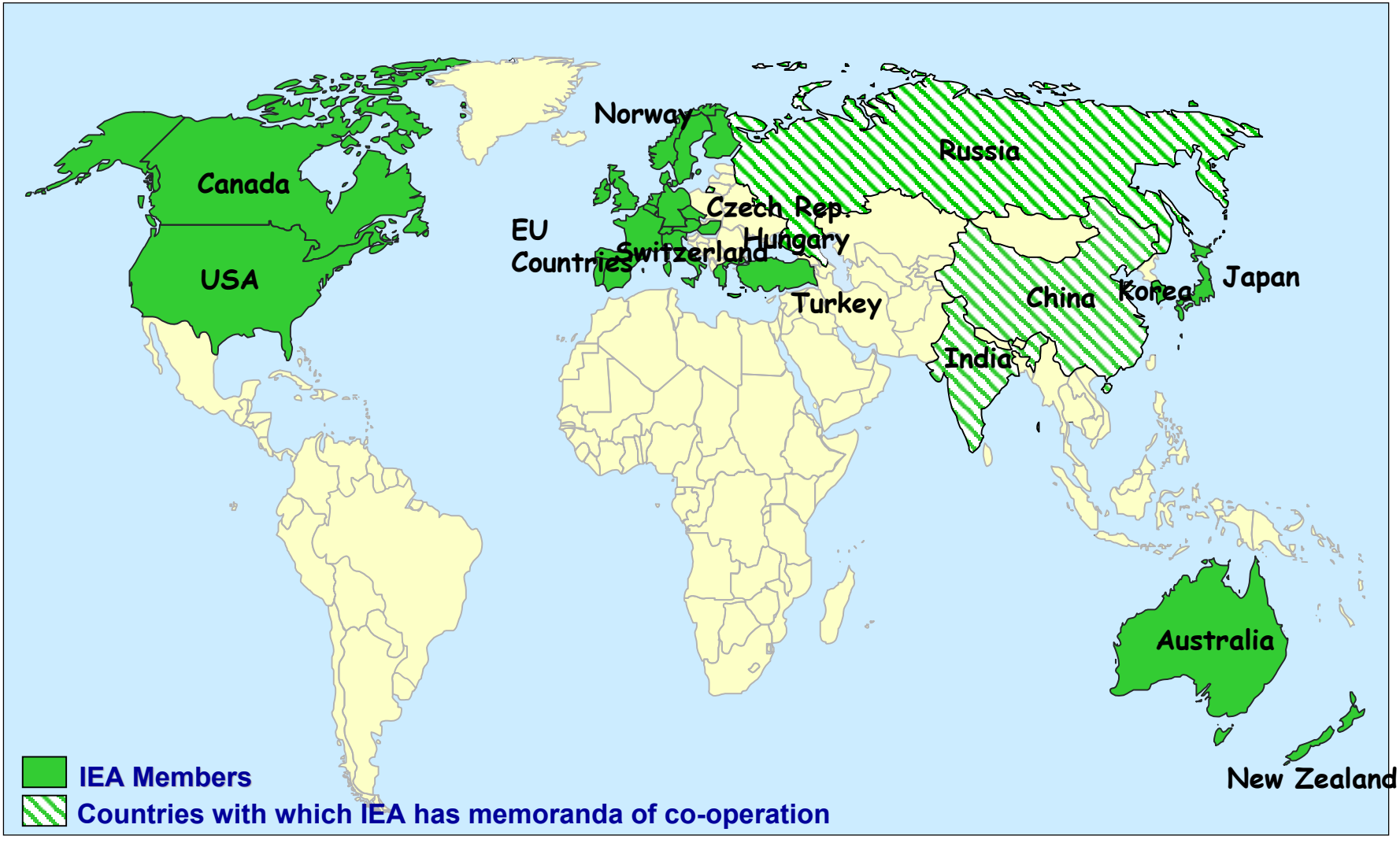
Topics

- The International Energy Agency
- World Energy Outlook reference and alternative scenarios
- Implications and role of Renewable Energy Technologies
- Policies and measures for RE deployment

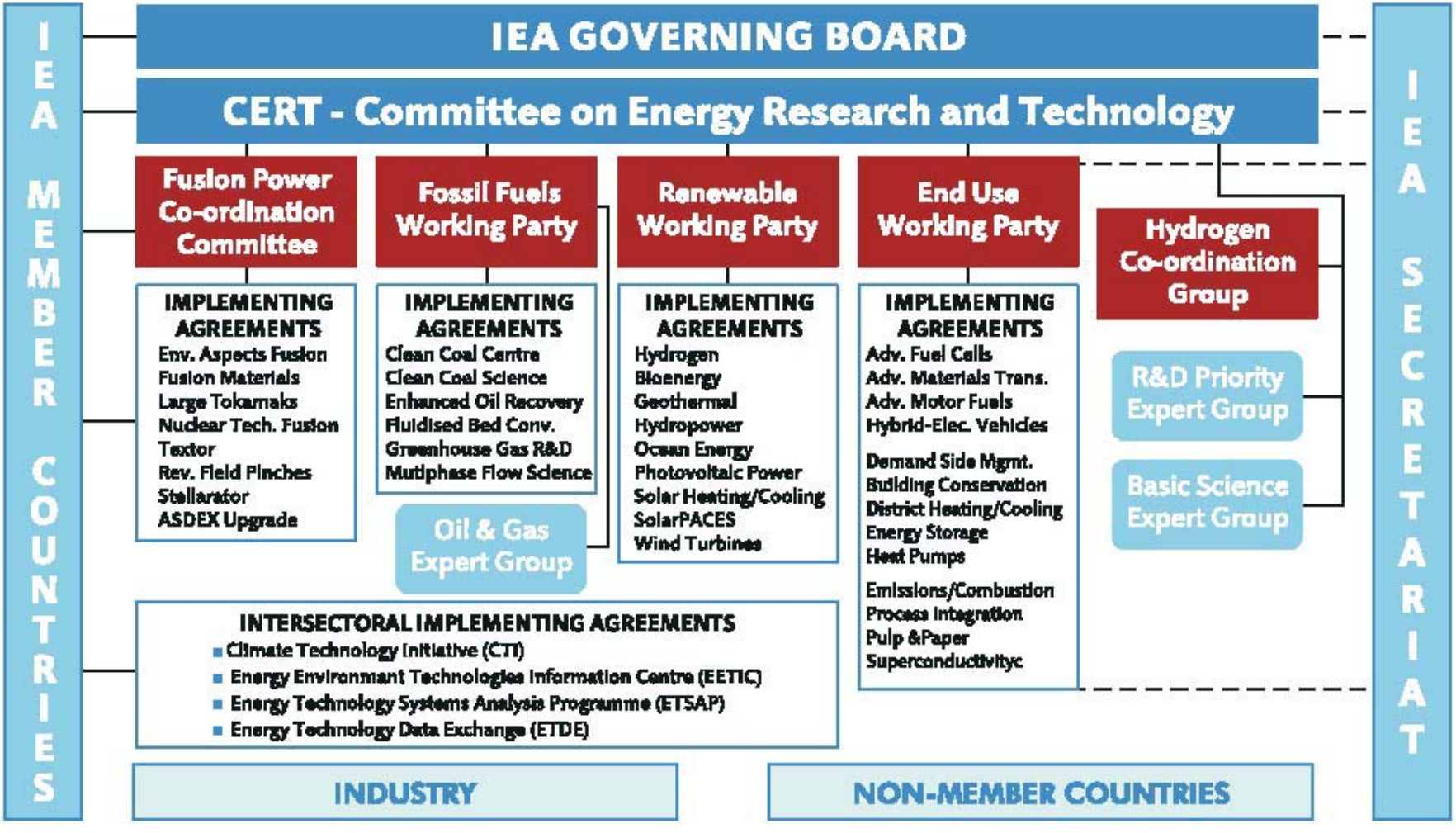
IEA International Energy Agency

- International treaty founded as an autonomous body within the OECD countries in 1974, in the wake of the first oil shock.
- Initial objectives were to represent major energy-consuming nations and to work for stability in world energy markets
- **Today mission: Energy Security, Environmental protection, Economic development**
- **Strategic Challenges**
  - ✓ **Secure energy supply**
  - ✓ **Reduce growing energy-related greenhouse gas emissions**
  - ✓ **Overcome lack of access to modern energy for more than a quarter of the world' s population**
  - ✓ **Create framework for investment**

IEA Member Countries

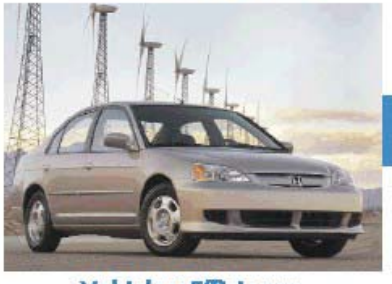


IEA Energy Technology Network



No single solution....a portfolio of technologies is required

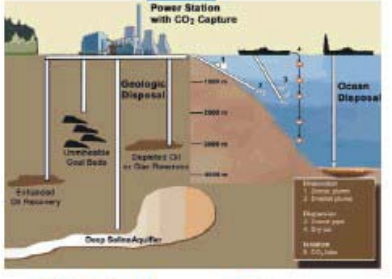
Efficiency in Buildings, Industry and End-Use Products



Vehicles: Efficiency, Hydrogen Fuel Cells

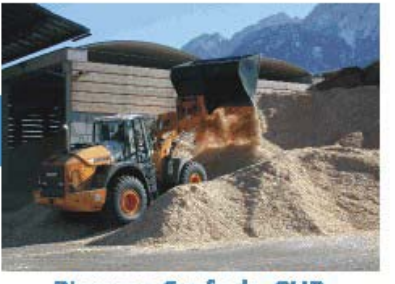
Advanced Power Generation and Grids

Solutions depend on...
Regions,
Resources,
Needs,
Choices,
Markets,
Scale-up,
Timing,
Infrastructure...

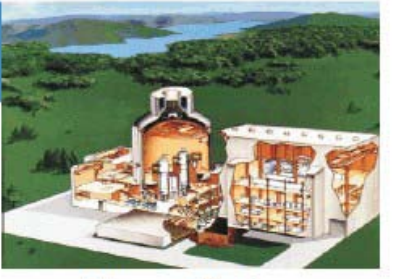


CO_2 Capture and Storage

Renewable Energy Technologies



Biomass, Synfuels, CHP



Advanced Nuclear Fission and Fusion

Why IEA proposes scenarios?

- neither *predictions* nor *forecasts*
- "images" of how alternative futures could unfold
- useful tools for investigating alternative future developments and their implications (what if…)

Scenarios: a vision for the future and guidance to decision makers

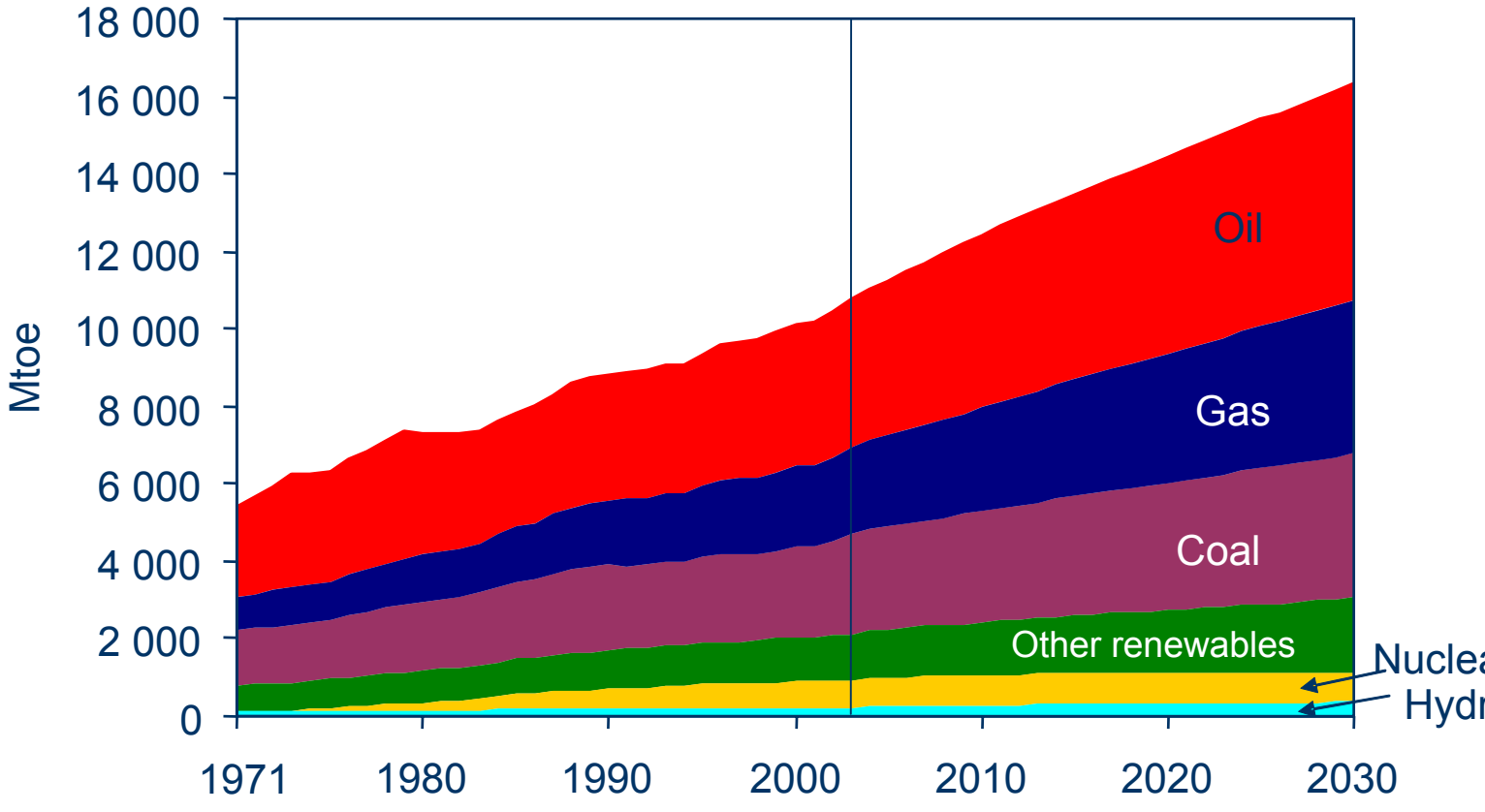
World Energy Outlook the leading analysis and publication which updates IEA Scenarios.

WORLD ENERGY OUTLOOK 2004

Global Energy Trends - Reference Scenario:

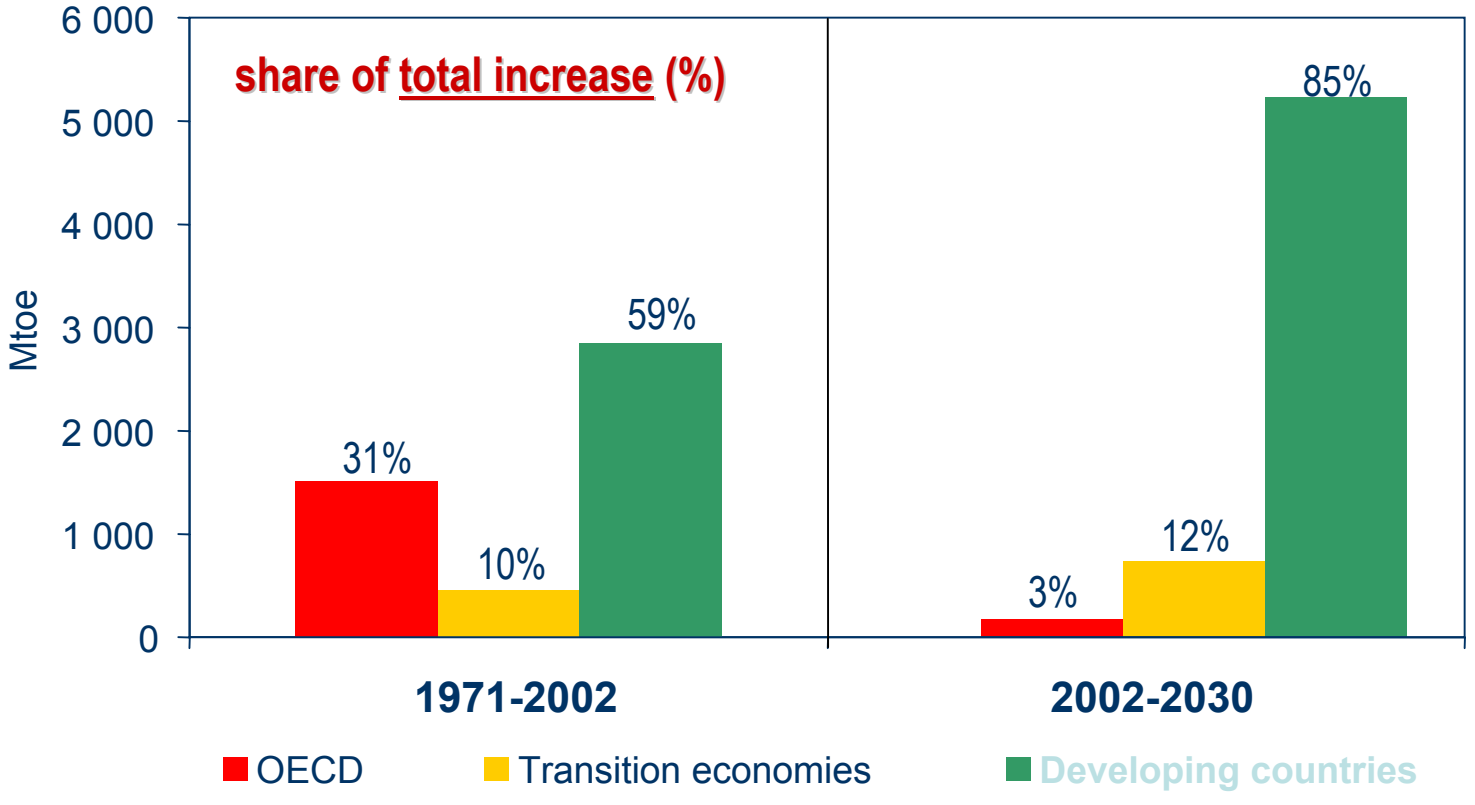
-no major energy policy change
-fossil producing countries *meet* consumer needs
-oil price remain high at 45$/b
-primary demand from 10.3 today to 16.5 billion TOE in 2030
-internally consistent scenario, rigorous modeling framework

World Primary Energy Demand



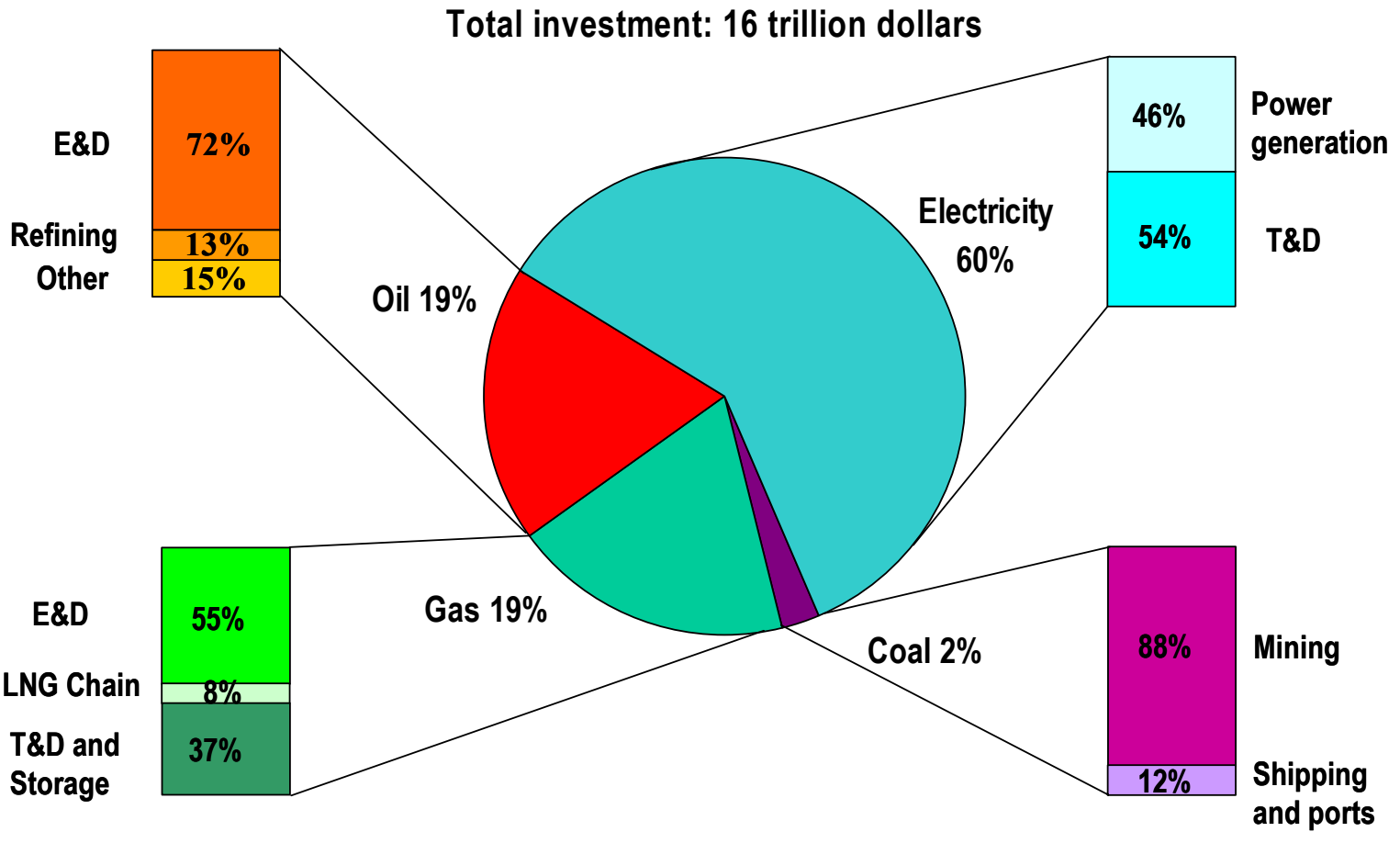
Oil and gas together account for more than 60% of the growth in energy demand between now and 2030 in the Reference Scenario

Increase in World Primary Energy Production by Region



Almost all the increase in production to 2030 outside the OECD
MENA countries from 25 to 44% oil production…

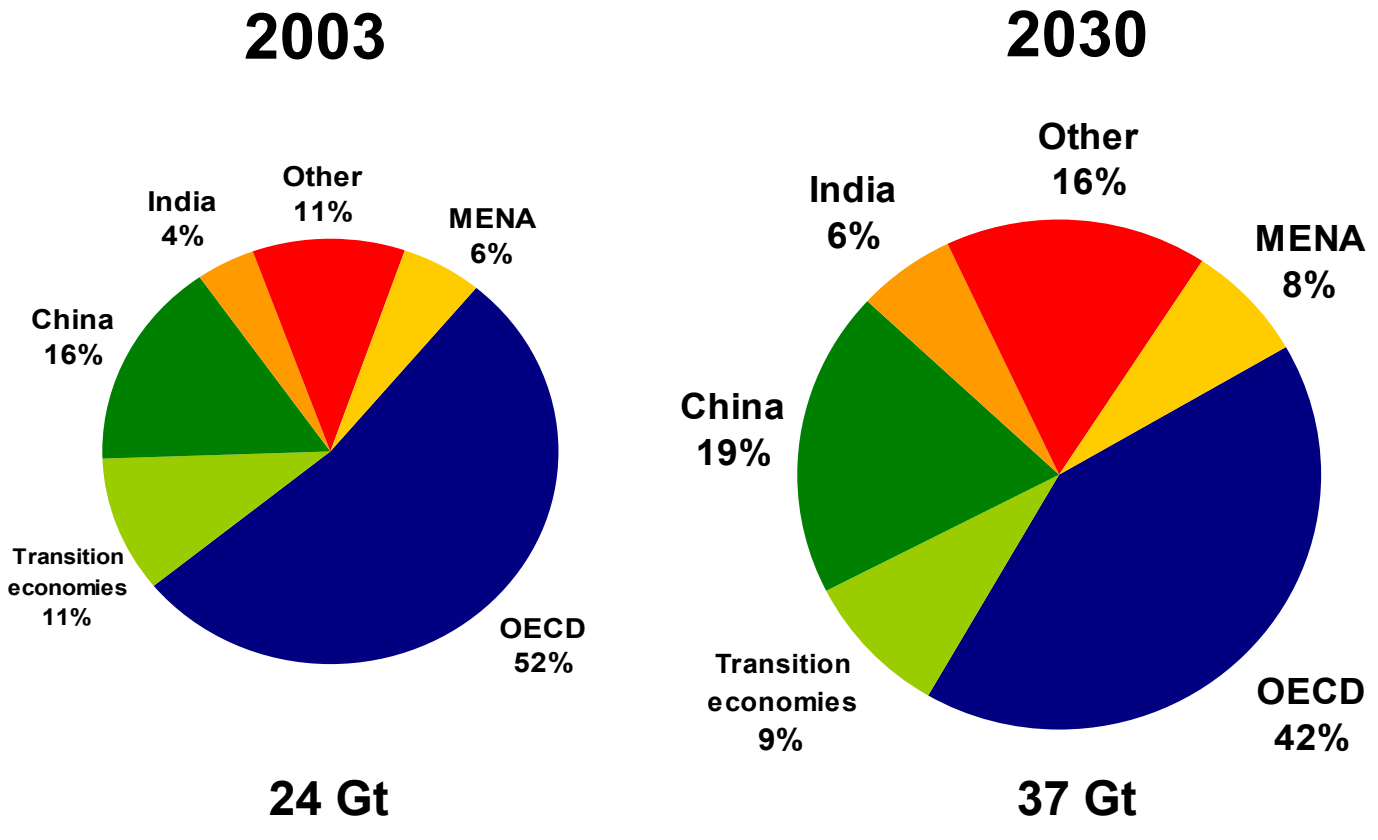
World Energy Investment



Cumulative 2001-2030

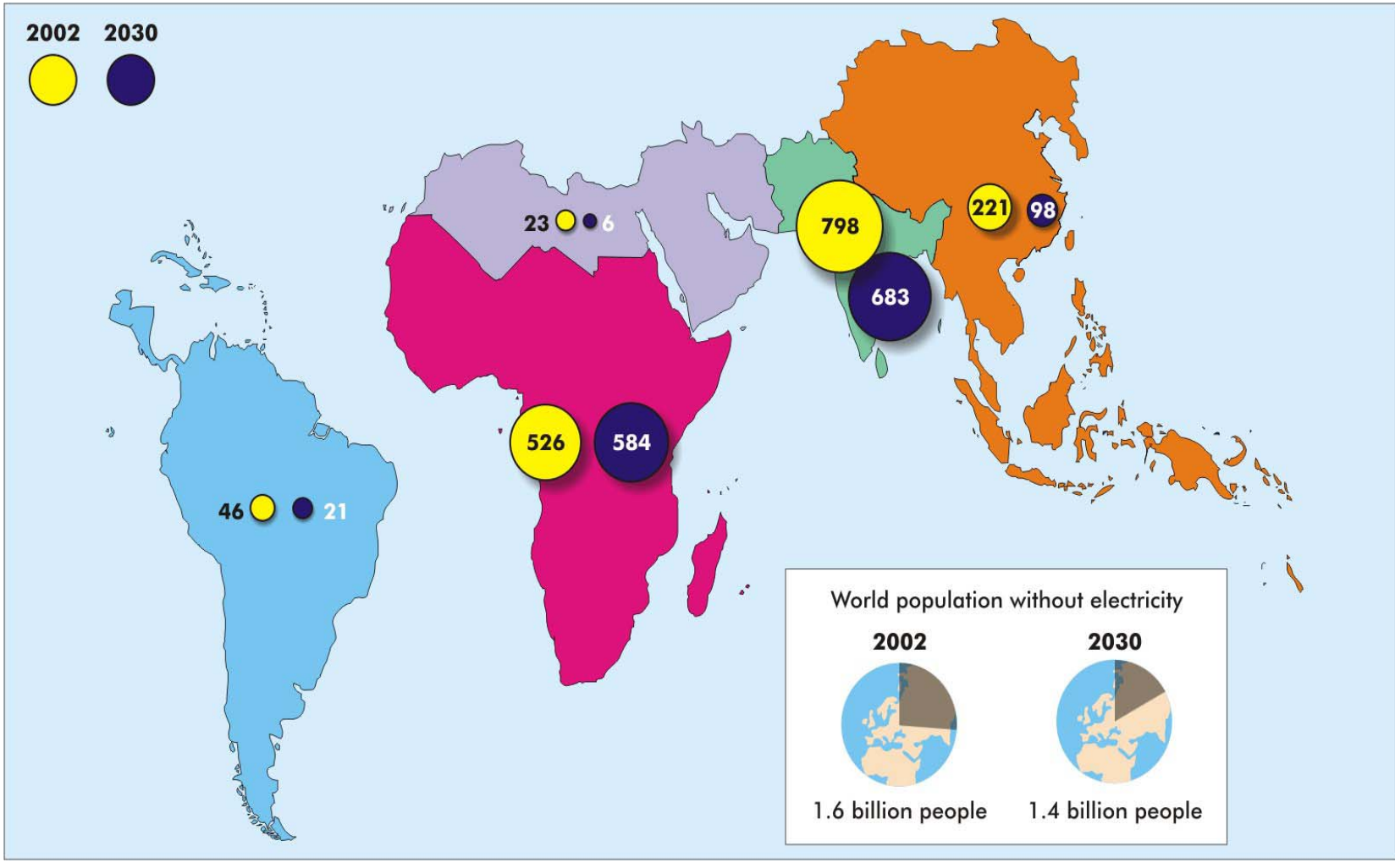
Source: *IEA World Energy Investment Outlook 2003*

Energy-Related CO_2 Emissions by Region



Global emissions grow by just over 50% between now and 2030, with the bulk of the increase coming from developing countries

Lack of access to electricity



In 2030 -even if 2 billion people gain access- because of population increase there will still be 1.4 billion people without electricity

Why an Alternative Policy Scenario.

WEO 2005, pg 268, in commenting Reference case:

"In no sense such vision of the energy future be considered sustainable.

G8 leaders meeting in July 2005 **in Gleneagles** acknowledged as much when they **called for stronger action to combat rising fossil fuel consumption and GHG emissions.**

Alternative Policy Scenario attempts to project the energy future which may result if those intentions are given concrete effects through new policy measures."

WEO 2004 introduced Alternative Scenario after page 440…..

World Alternative Policy Scenario.

Analyses impact of new environmental & energy-security policies worldwide

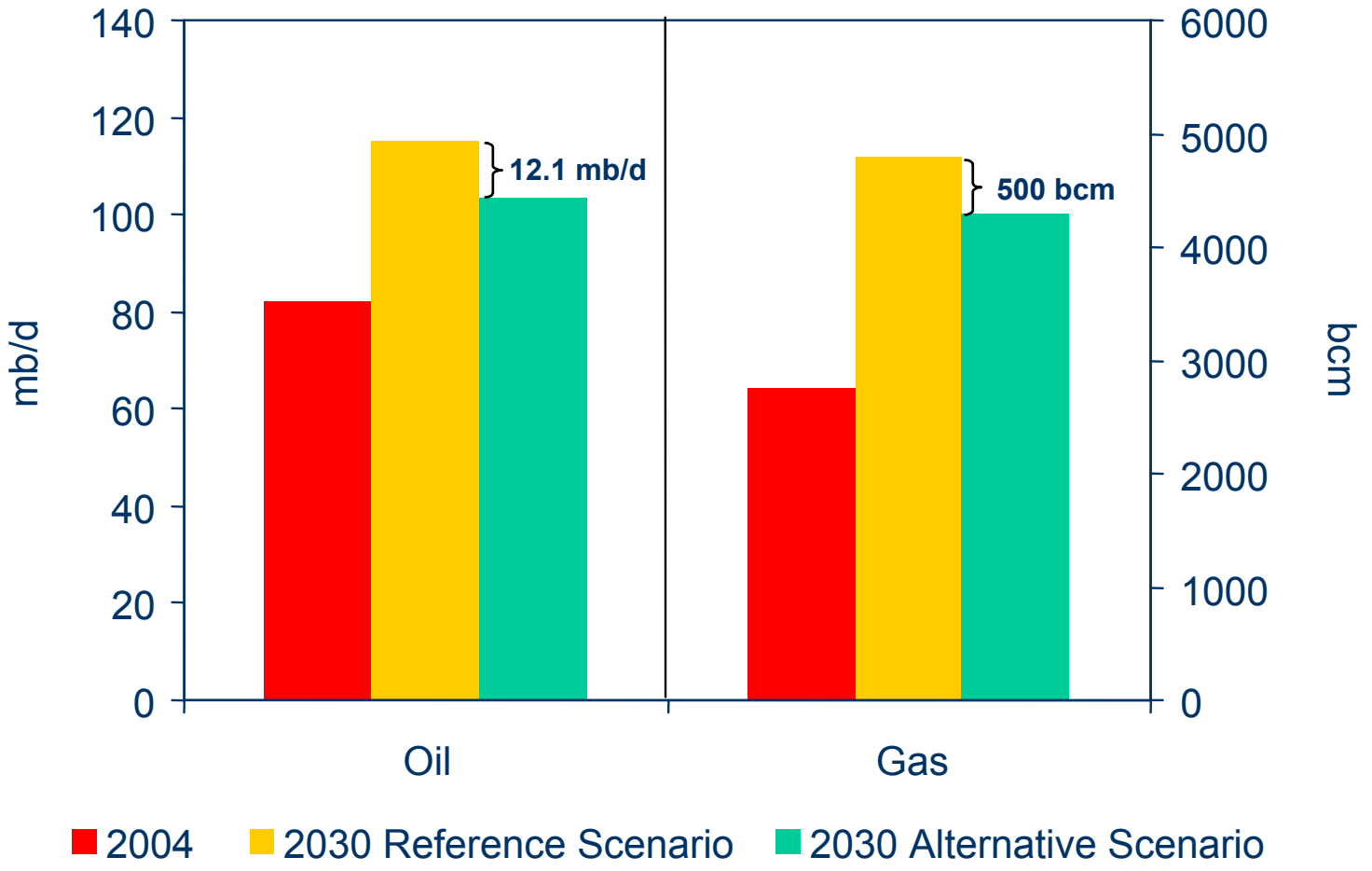
- ✓ ***OECD:*** **Policies currently under consideration**

- ✓ **Example of EU policies:**

× **Power generation**
✓ Renewable energy directive met and extension to 2020
✓ CHP directive
× **Transport sector**
✓ Tightening of Voluntary Agreement with car manufacturers
✓ Biofuels target met
× **Emission trading scheme for power generation and industry**

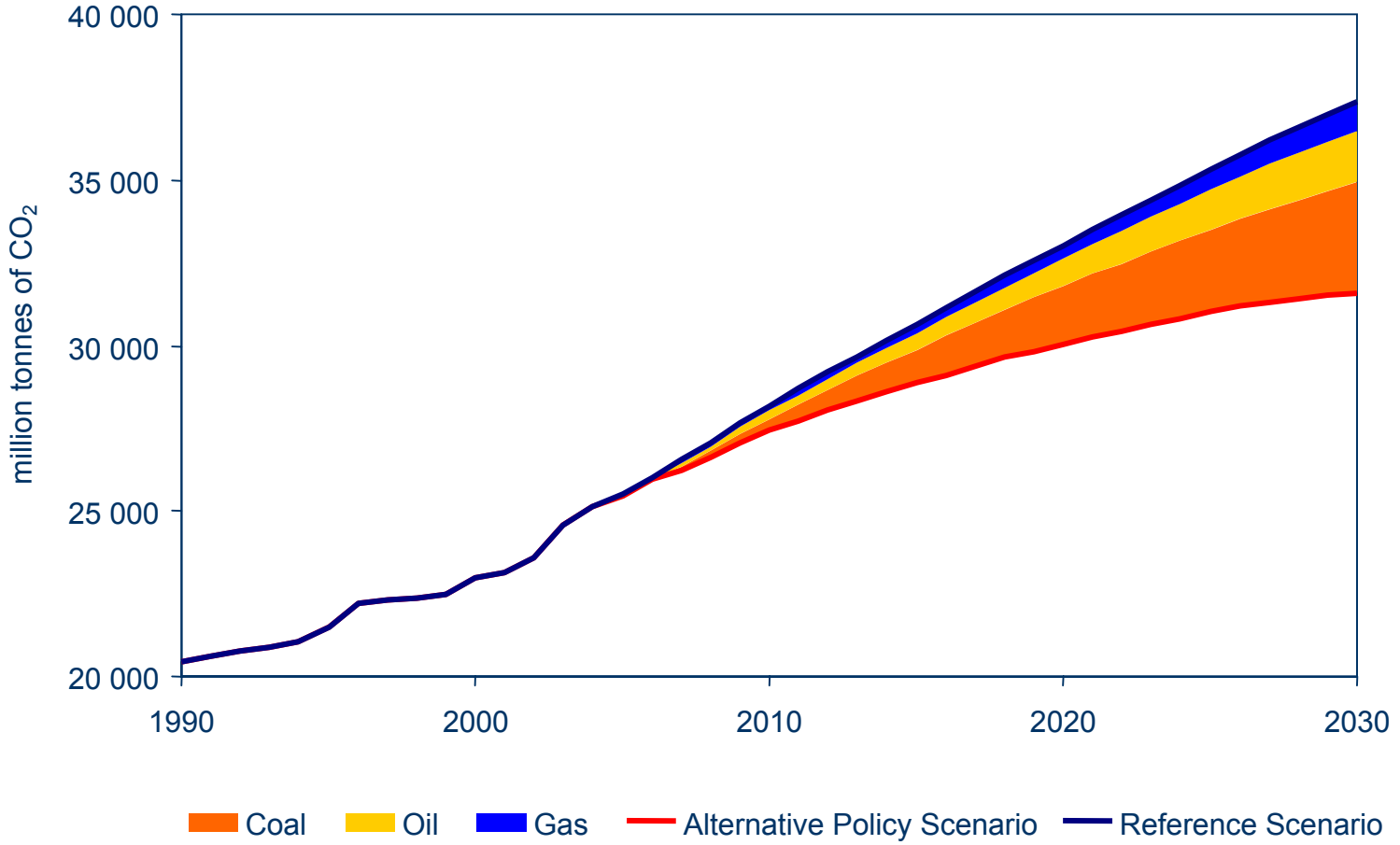
- ✓ ***Non-OECD:*** **Same and includes more rapid declines in energy intensity**

Oil/Gas Demand
in the Reference and Alternative Scenarios



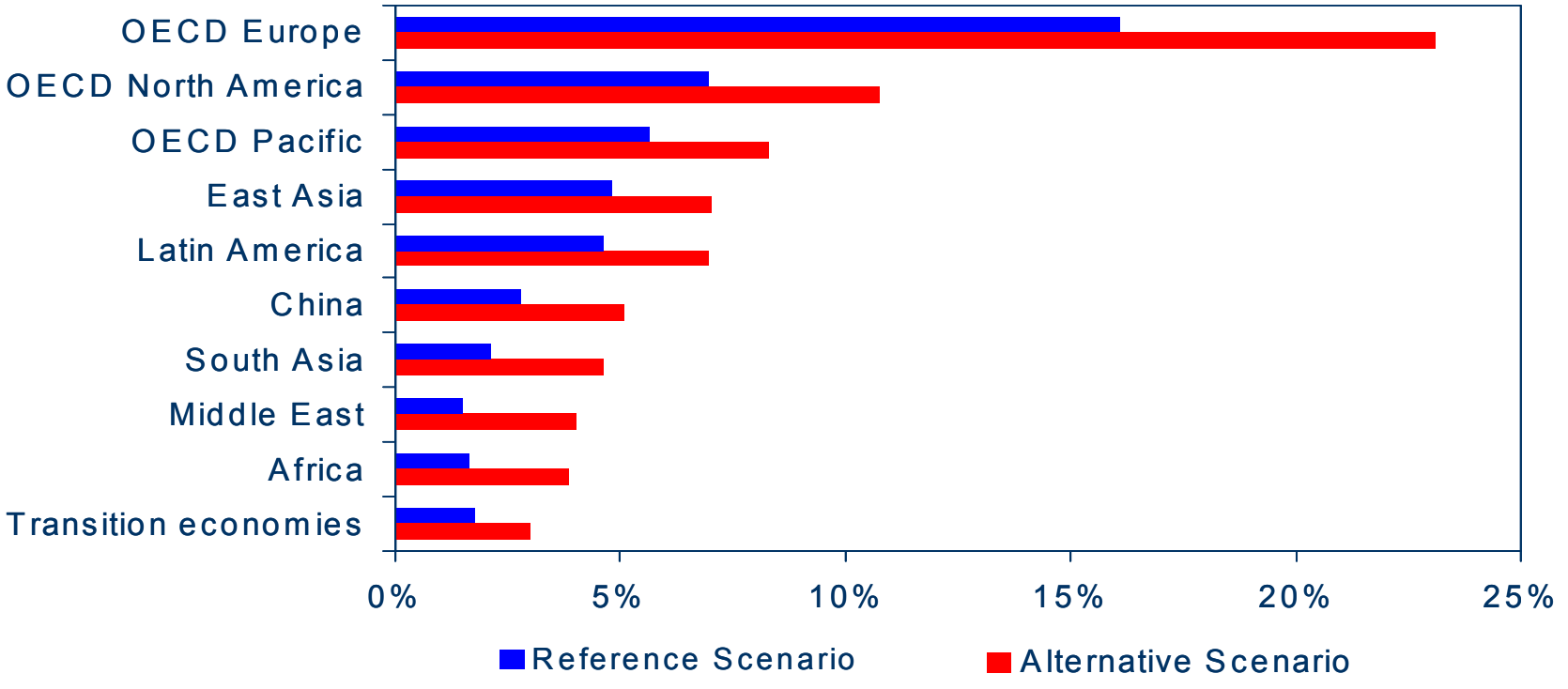
Oil & gas demand in the Alternative Scenario are both 10% lower in 2030 due to significant energy savings and a shift in the energy mix

Global Energy-Related CO_2 Emissions in Reference and Alternative Scenarios



In 2030, CO_2 emissions are 16% lower than in the Reference Scenario- equivalent of today USA+CND- but are still more than 50% higher than 1990

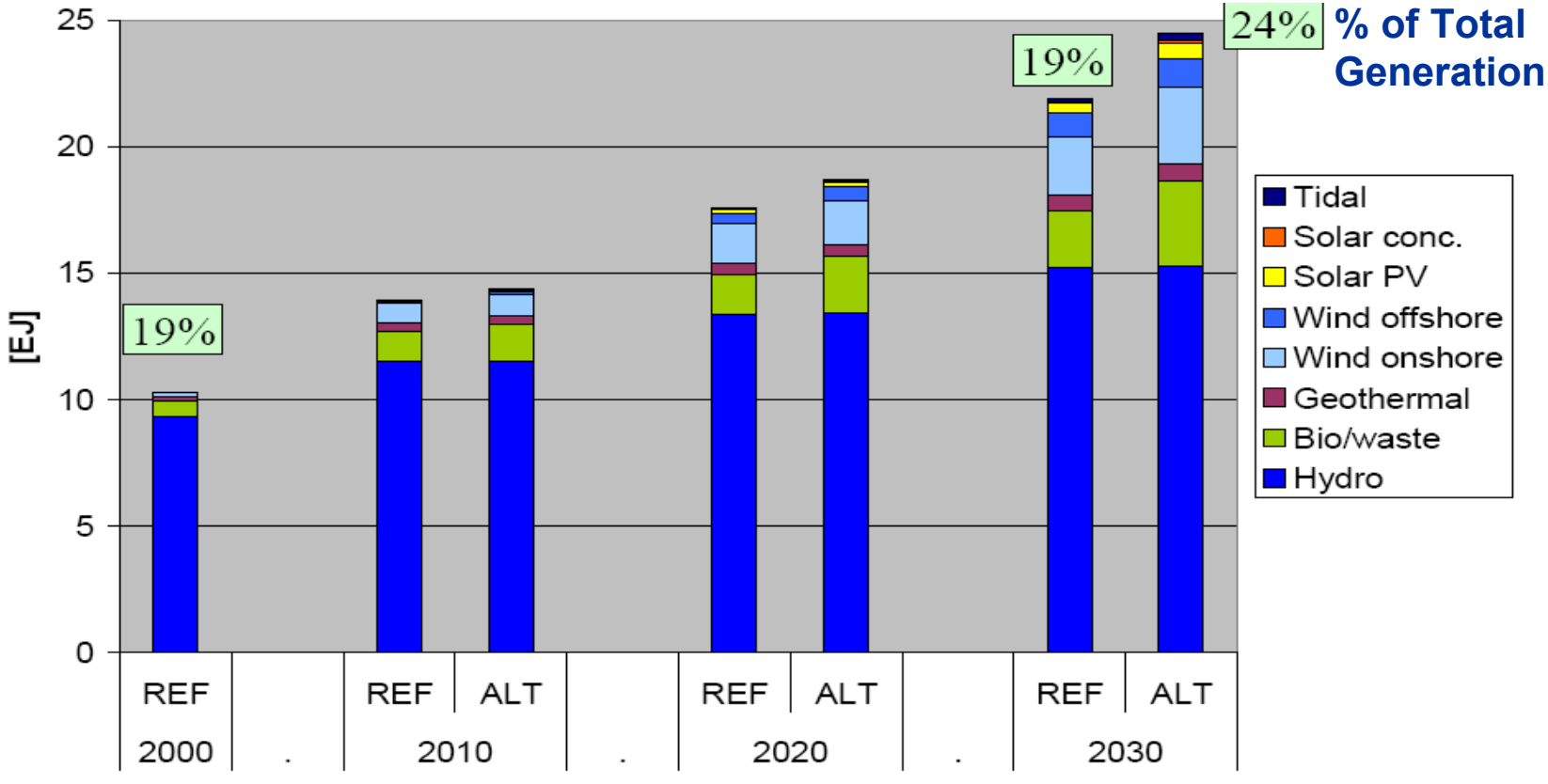
New Renewables in Electricity Generation, 2030



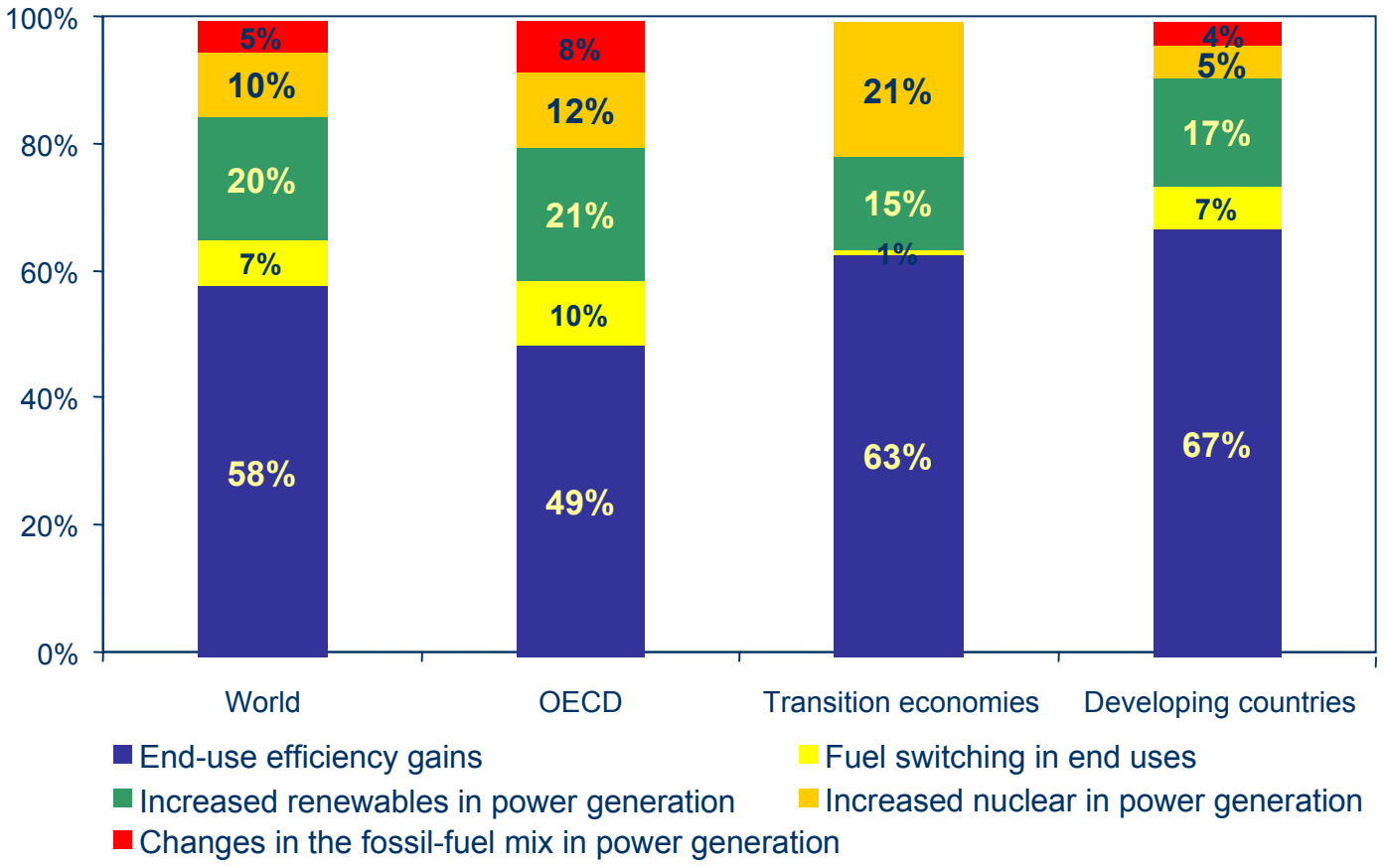
New policies would boost the share of non-hydro-renewables in all regions – most in the EU in absolute terms

Global Renewable Electricity Generation

in the Reference & Alternative Scenarios



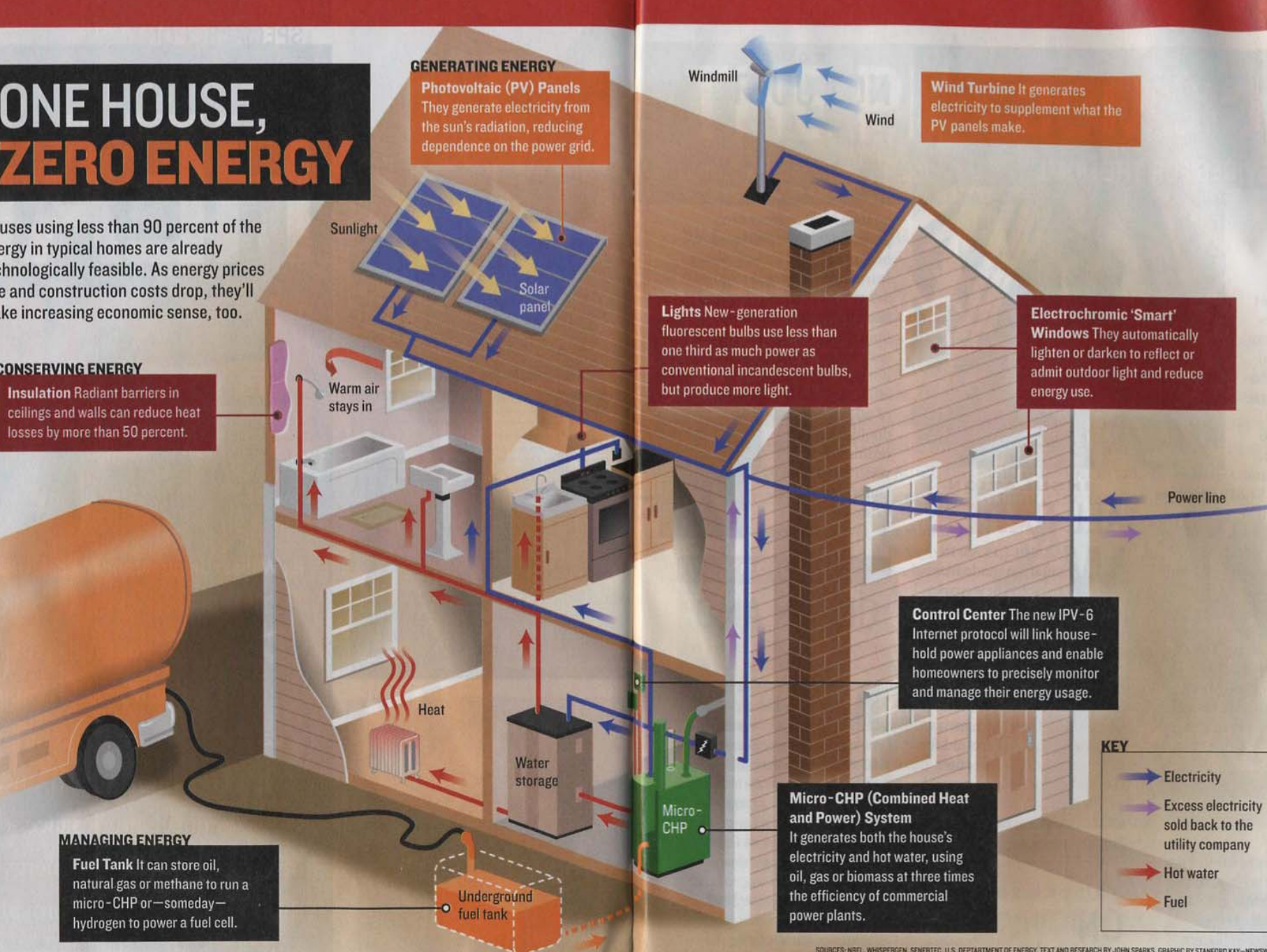
Contributory Factors in CO_2 reduction for 2030



Improvements in end-use efficiency like better vehicles, processes and appliances, contribute for more than half of decrease , and renewables use for 20%

ONE HOUSE, ZERO ENERGY

uses using less than 90 percent of the ergy in typical homes are already chnologically feasible. As energy prices e and construction costs drop, they'll ke increasing economic sense, too.



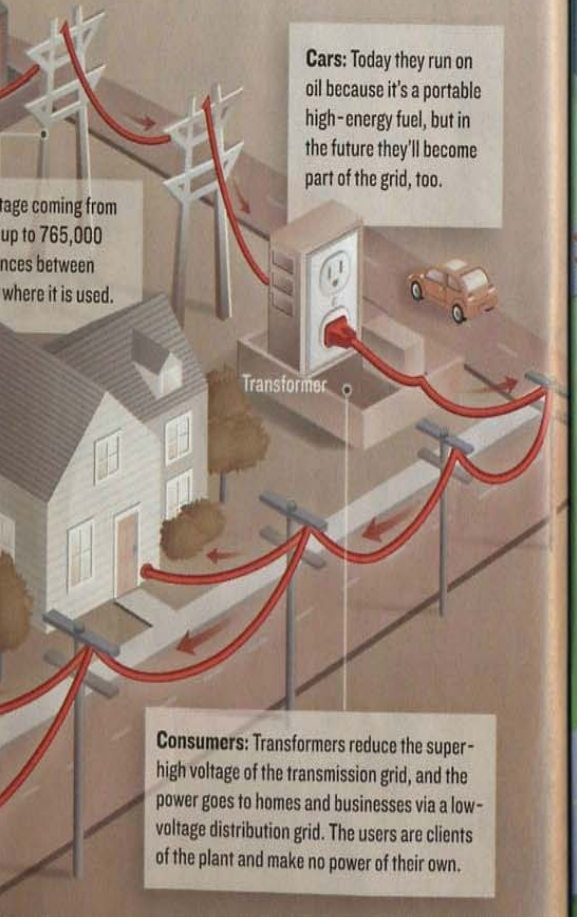
SOURCES: NREL, WHISPERGEN, SENERTEC, U.S. DEPARTMENT OF ENERGY. TEXT AND RESEARCH BY JOHN SPARKS. GRAPHIC BY STANFORD KAY—NEWSWEEK

TING THE POWER GRID

ure, the systems that we use to make and move energy will change
transmission hardware may look the same as it does today, but it
gies that link electricity generation, heating and automobiles.
wer in the future, and how we'll pass it around.

TODAY

Most electricity flows outward from remote generating plants fueled by oil, coal or natural gas. Typical plants use less than 40 percent of the energy in their fuel.



Cars: Today they run on oil because it's a portable high-energy fuel, but in the future they'll become part of the grid, too.

tage coming from
up to 765,000
nces between
where it is used.

Consumers: Transformers reduce the super-high voltage of the transmission grid, and the power goes to homes and businesses via a low-voltage distribution grid. The users are clients of the plant and make no power of their own.

TOMORROW

The future grid won't rely solely on distant power plants. Instead, consumers will become producers, using microgeneration technologies that harness the sun, wind, hydrogen and fossil fuels to feed the grid with surplus power.

Key:
Power from the grid:
Power to the grid:

Wind Farms: Most fossil-fuel power plants will be gone, but clusters of wind generators will supplement the grid, especially when solar power is hindered by night or clouds.

Industrial Generation: Factories with solar panels could sell surplus power back into the grid.

Information Technology: New information systems will turn the grid into a data network as well. The improved power-monitoring capability will make two-way power transmission possible.

Opting Out: Microgeneration systems may enable some people to go off the grid entirely.

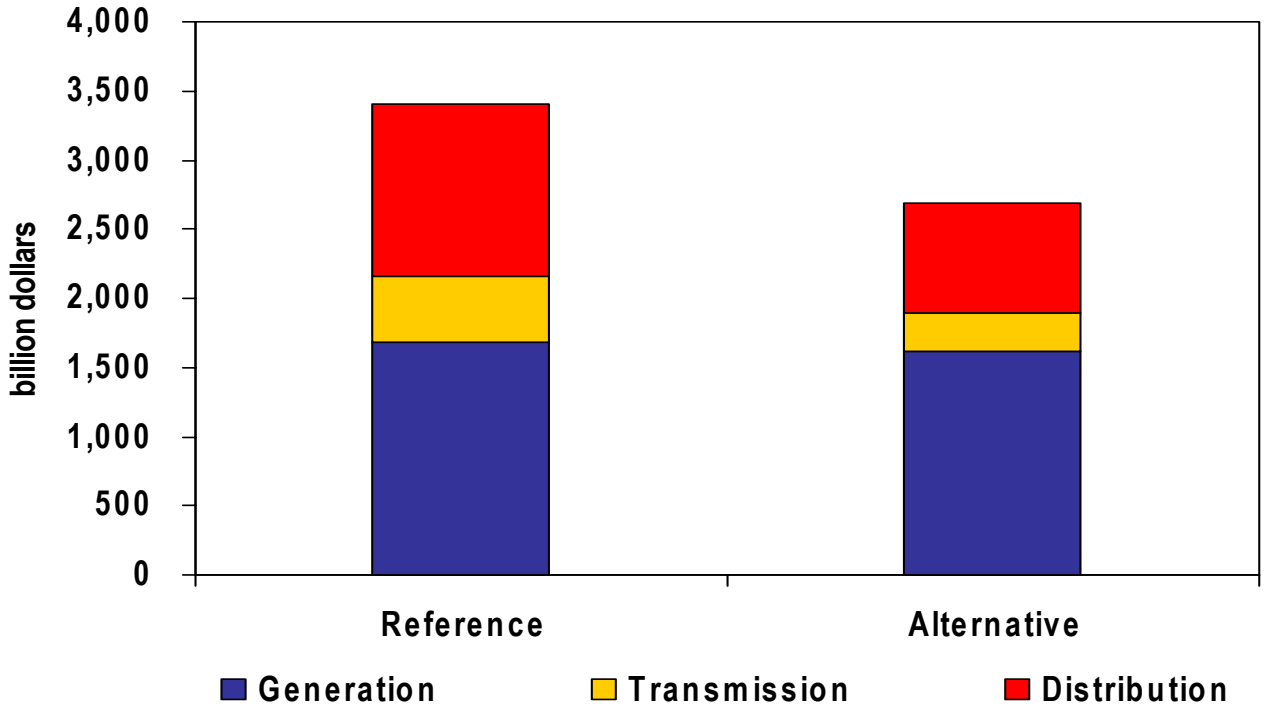
Hydrogen: Some of the power generated by solar panels will be used by electrolyzers to make hydrogen from water. The hydrogen will run fuel cells in cars and houses.

PV Power: During the sunniest part of the day, roof-mounted photovoltaic (PV) panels will produce more power than a home needs. The surplus could flow back out to the grid.

Microturbines: Driven by wind or fossil fuels, these systems provide another way for homes and businesses to lessen their reliance on the grid—or make power to sell back to power companies.

SOURCES: JOSH TURNER, NATIONAL RENEWABLE ENERGY LAB, US DOE
TEXT BY JOHN SPARKS, GRAPHIC BY JOSHUA KEAY—NEWSWEEK

OECD Investments in 2001-2030



Transmission and distribution investments are much lower in Alternative Scenario, but generation investment hardly falls...

Policy and measures for accelerated market introduction of renewables

Renewables can add new value to the energy mix by ....

… enhancing **security of supply** - both for geopolitical-concentrated in few countries in critical regions- and infrastructure-power plants, pipeline,sea straits…)

…allowing energy sources **diversification & reducing imports** for consumers/ **deferring production** for exporters

…mitigating risks in current energy portfolio and trends, due to **volatility and instability** of fossil prices**;**

…creating **framework for investment** enhancing **industrial competitiveness** **-** also for export

…creating **new jobs,** favouring **economic development**

…advancing **environmental targets;**

…providing unique **access to energy services;**

…increasing **public participation** in energy decision-making

Status of Renewables in IEA Countries

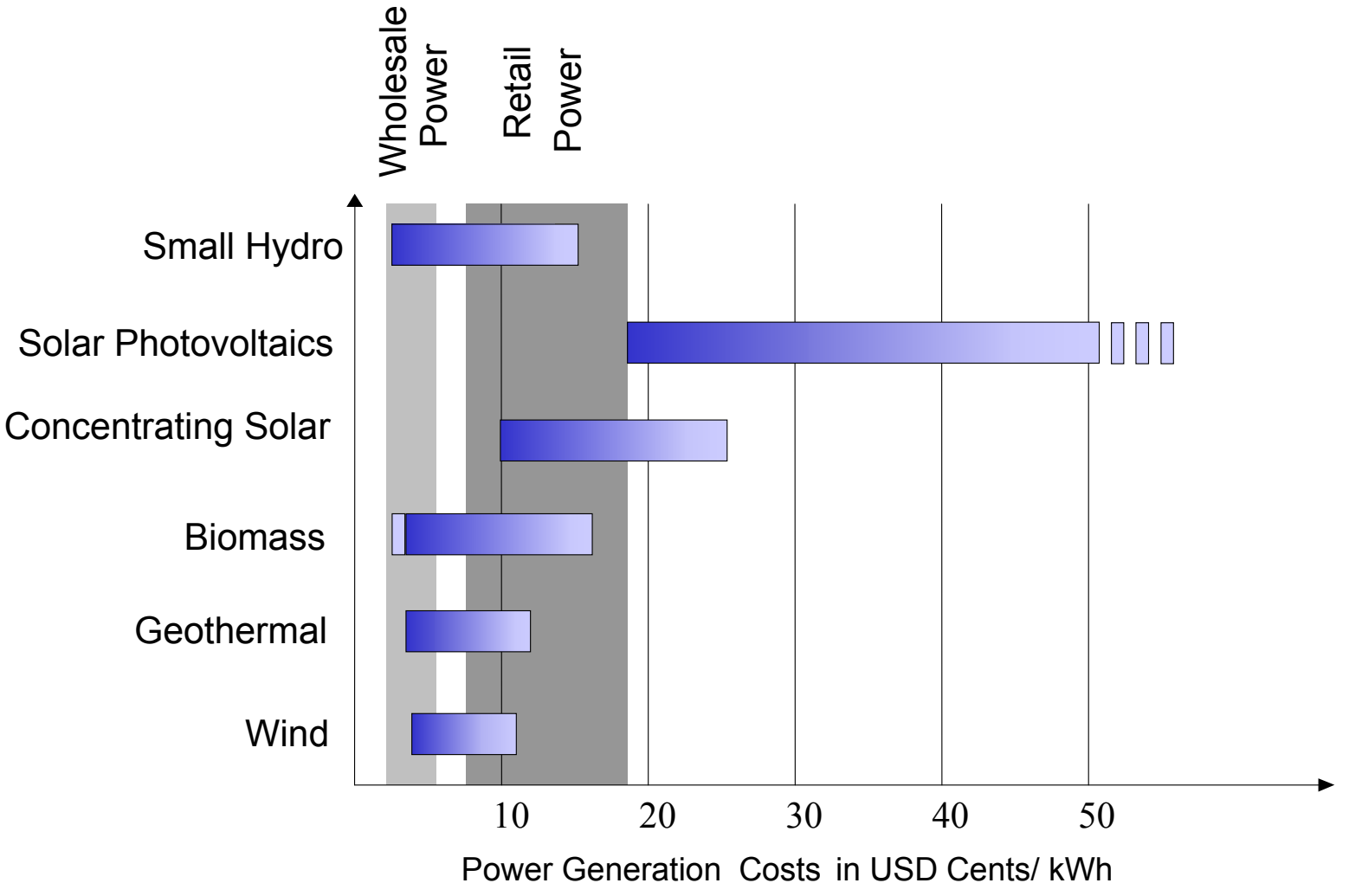
R&D

- ***Good news*:**
  R&D budgets set up after first oil price crisis have led **to remarkable technological progress**
- ***Bad news*:**
  After 1982 R&D budgets shrunk to 1/3
  → lack of availability of technologies close to market conditions

Market share

- **RES energy production doubled** from 142 Mtoe in 1970 to 281 Mtoe in 2003
- **But shares only rised from 4.6% to 5.5%** in the same period
- **86%** of installed capacity **of wind is limited to 4 IEA countries and 84%** of installed capacity **of PV is concentrated in 3 IEA countries – all leaders in RD&D spending**

Are RETs Competitive ?



RE cost reduction opportunities

Cost reduction opportunity areas

	R&D	Manu-facturing volume	Economy of scale
Bioelectricity	**	*	*
Geothermal	**	*	***
Small hydro	**	*	**
Solar photovoltaics	*****	****	*
Solar thermal	***	***	****
Wind onshore	**	*	***
Wind offshore	***	*	***

Each * means 4% - 6% of cost reduction within a decade.

Create fair market rules

Energy prices do not reflect the true costs of generation options - a market failure:

- the **social and environmental costs** of polluting energy **are not internalised**
- The **added values of RE** for diversification, reduced portfolio risk, job creation, industrial competitiveness **not accounted for**
- there are also **massive subsidies to 'conventional' energy** sources

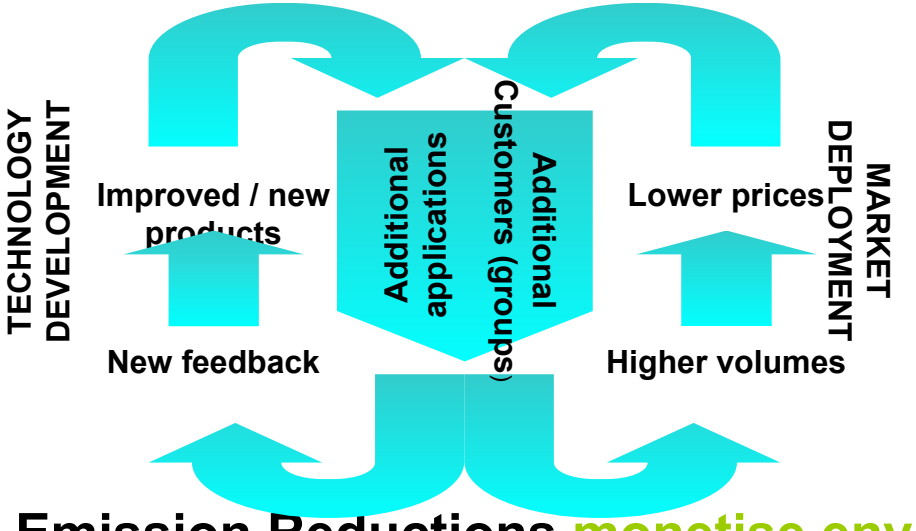
To acknowledge the benefits of Renewable Energy, **support frameworks should be established**

- They should be viewed as **compensation mechanisms** for correcting these market failures and
- **a *learning investments* to reduce cost and improve performance**

Toward a Consistent Technology Policy

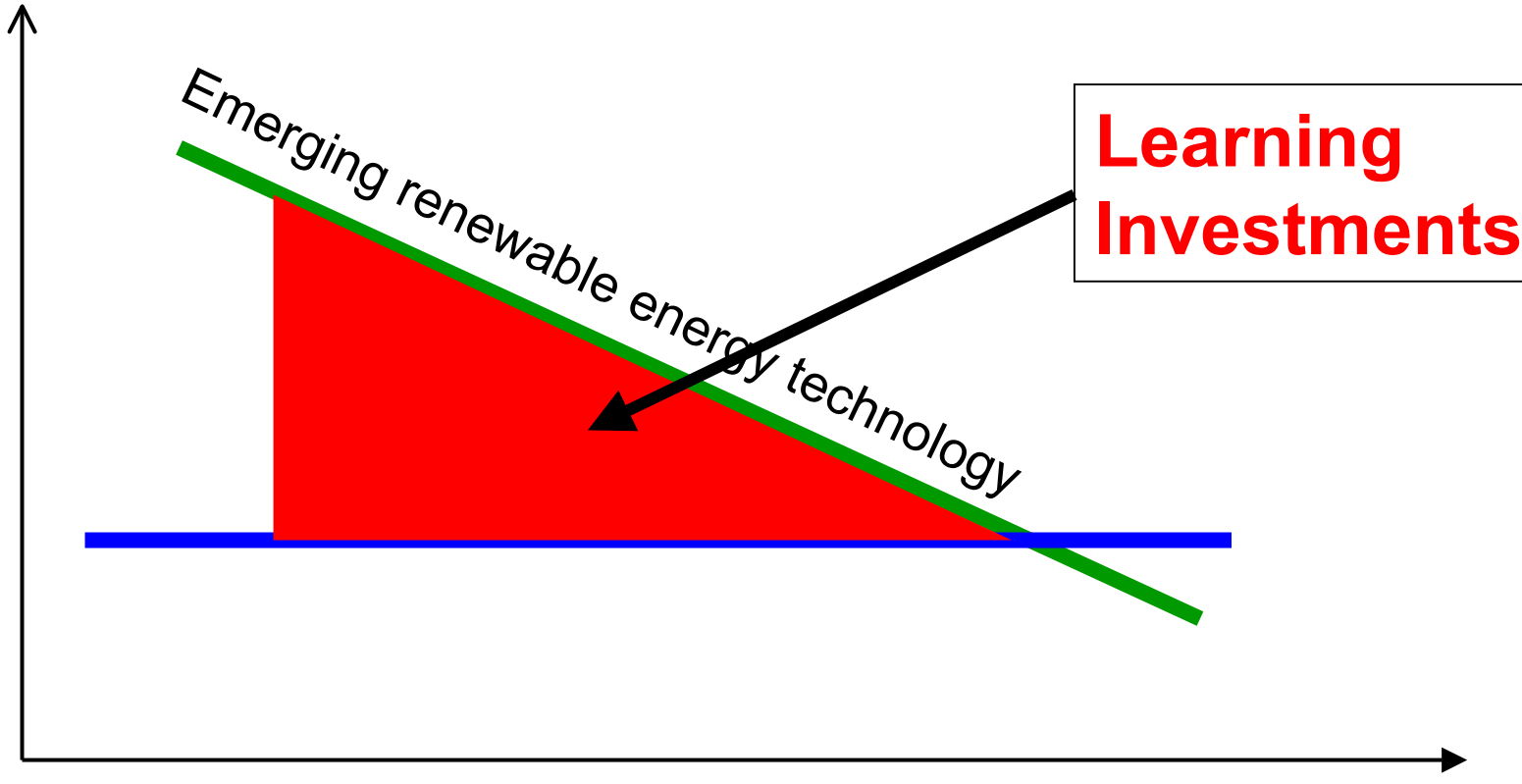
Complementary Strategies

- **R&D, Feed-In-Tariffs and Tradable RE Certificates** should be considered as **technology development policies:**
  - ✓ **R&D** encourages **new applications**
  - ✓ **Feed InTariffs** support **industry development**
  - ✓ **Tradable RE Certificates support markets** for lowest cost/most mature technologies



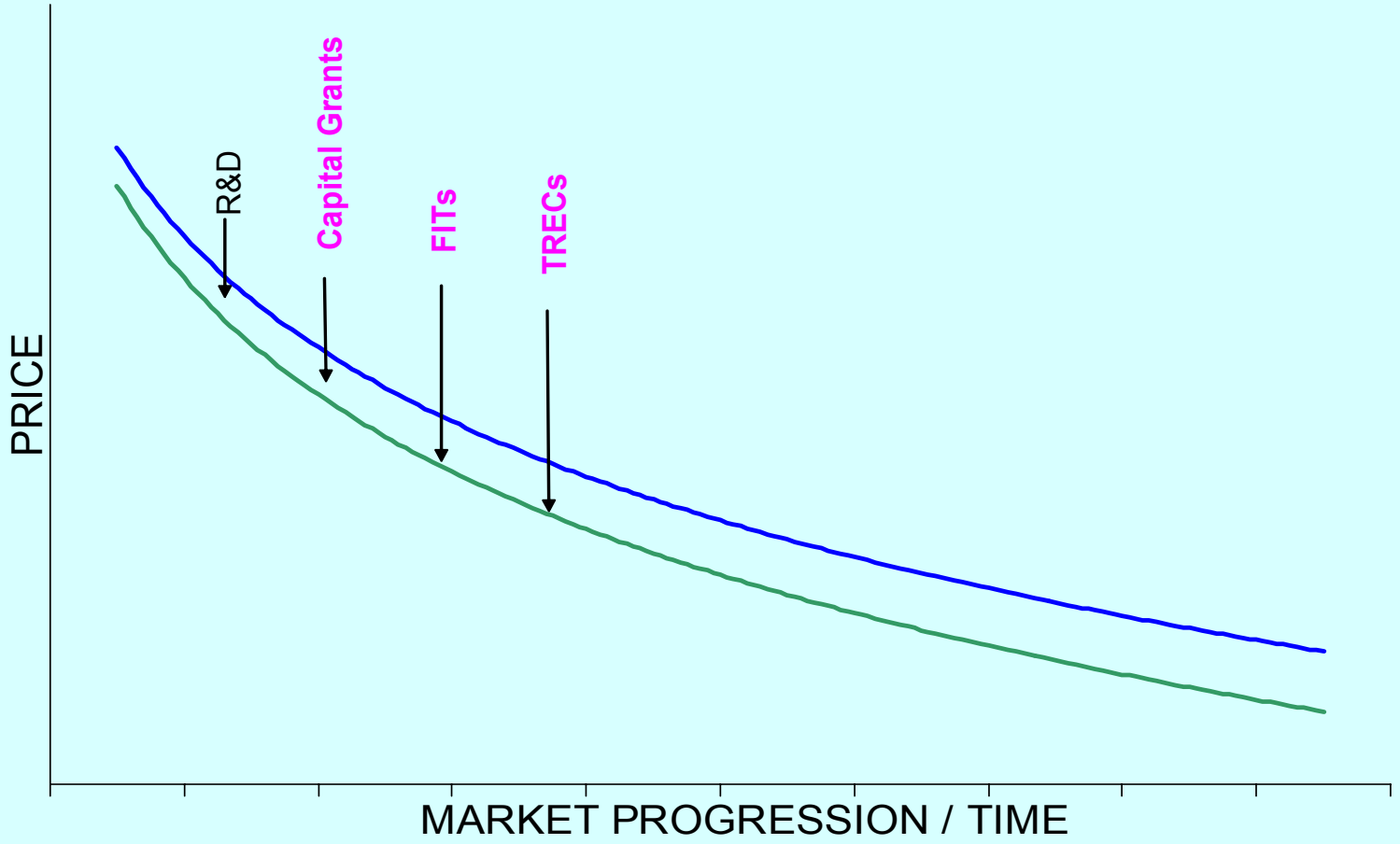
- **Certified Emission Reductions monetise environmental externalities**

The technology learning curve

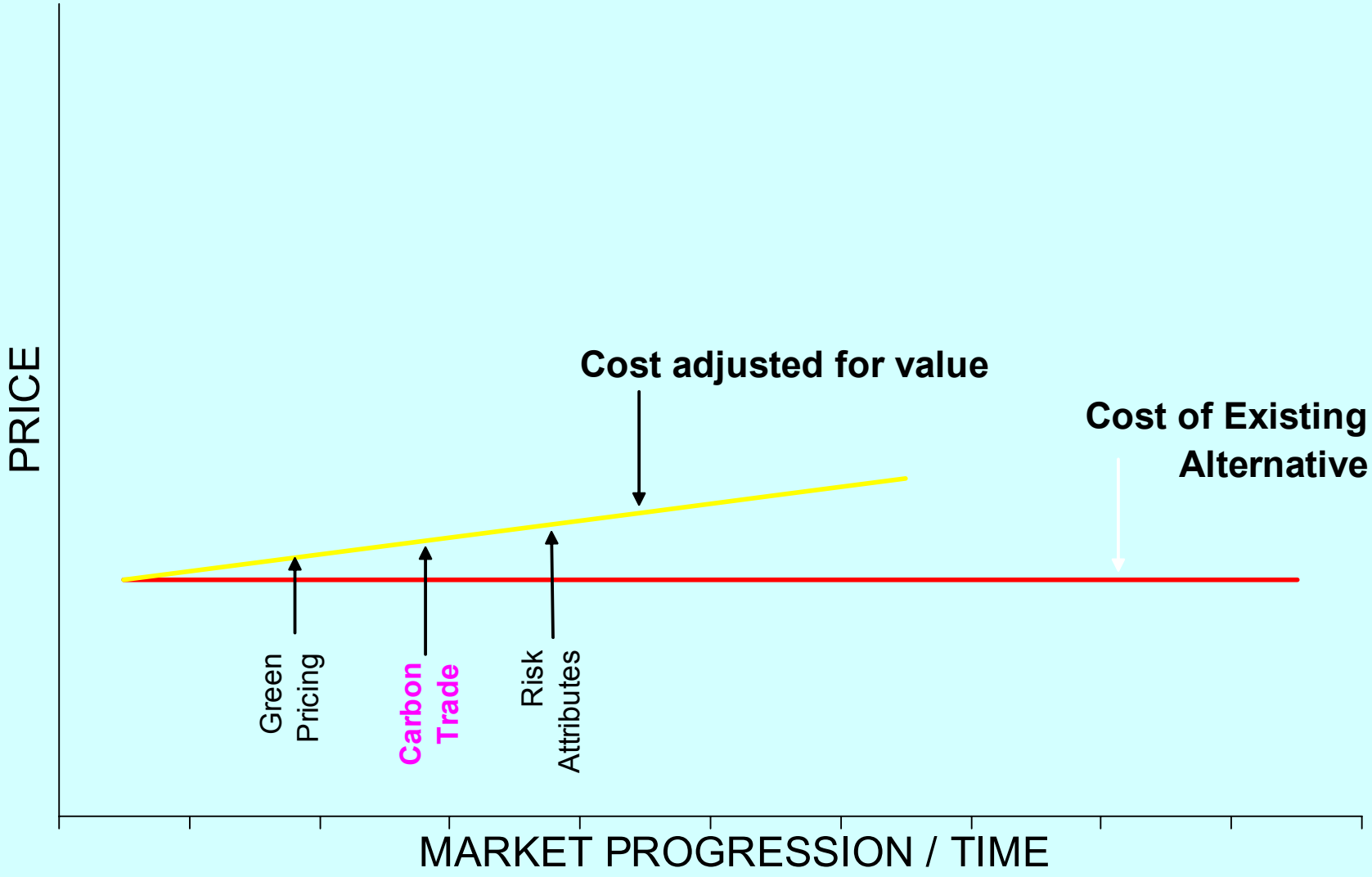


Source: C.O. Wene, IEA

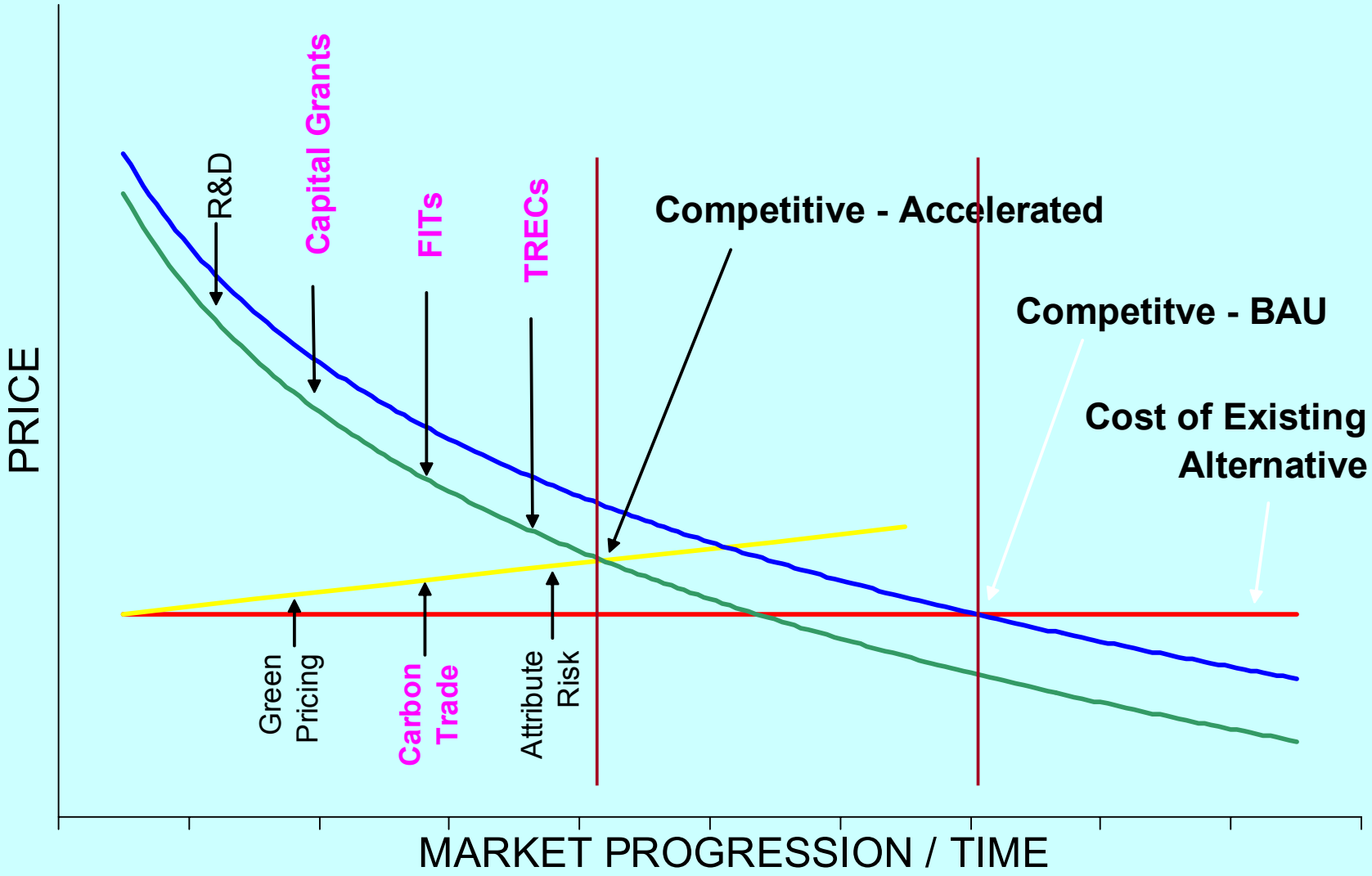
Developing Technology



Adjusting the Cost Framework



Complementary Strategies



National Policy Measures

- **Establish legally binding targets** for renewable energy
  *Essential for maintaining and further **stimulate investor confidence***

- **Establish incentive mechanisms** which provide **defined and stable returns for investors**

  - ✓ *The price for renewable power must **allow for risk return profiles** that are competitive with other investment options.*
  - ✓ *The **duration** of a project must **allow investors to recover** their investment.*

Available options:

Capital Grants
Price-based Mechanisms
feed-in price
fixed premium

Quantity-based Mechanisms
quotas with tendering
quotas with trading- green certificates

National Policy Measures

A successful framework requires political effort in four vital fields :

- **Well designed support scheme ensuring investor confidence**
- **Appropriate administrative procedures**
- **Fair grid access and strategic grid planning**
- **Public acceptance and support**

If one or more of these key components are missing, little progress will happen.

Policy Options to Optimise RE Markets

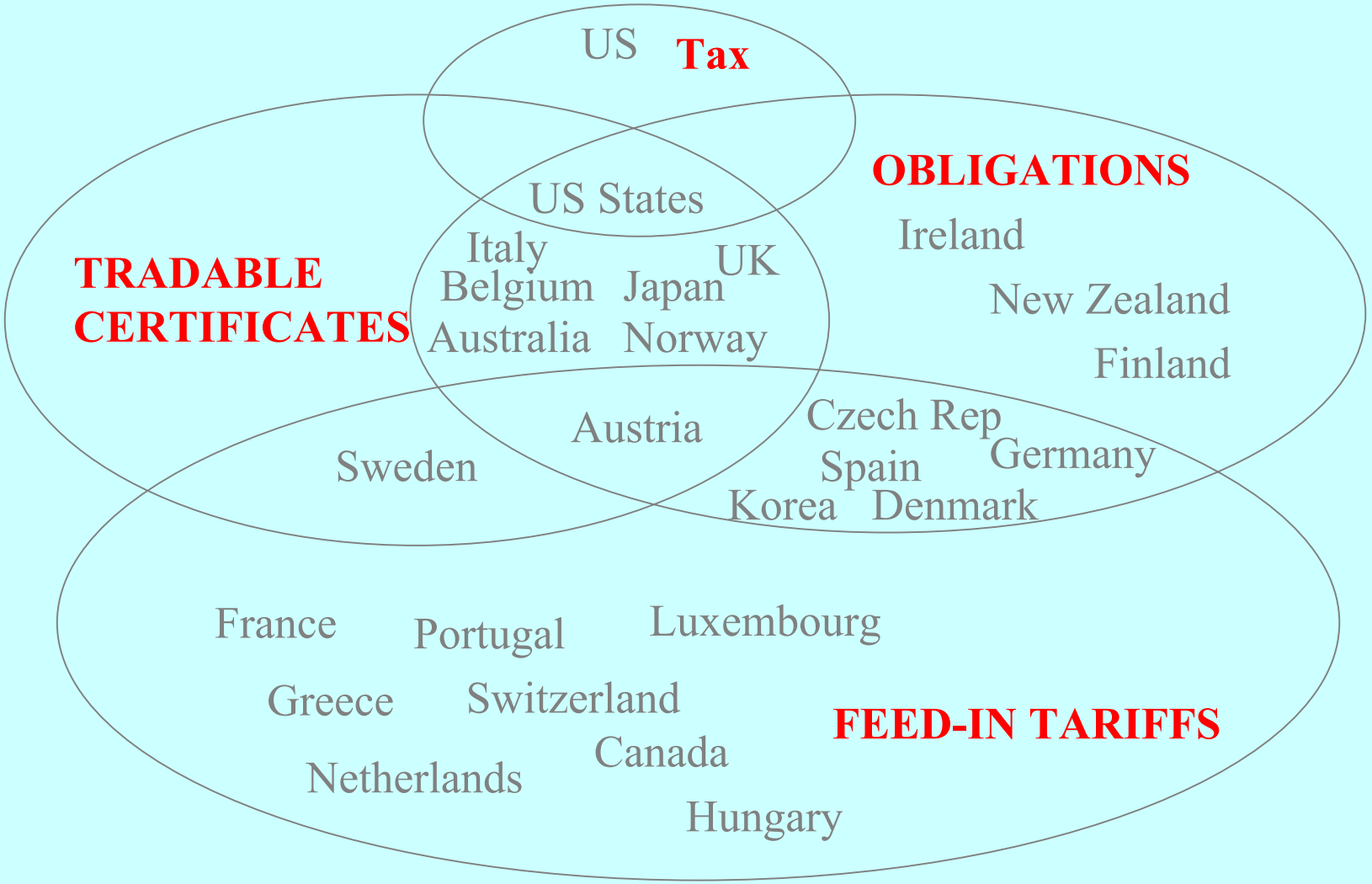
Short-term investments to reduce costs

- ✓ demand stimulation by tariffs, portfolio quotas, national targets
- ✓ elimination of burdensome policies (siting, permits, licensing, etc.)
- ✓ continued R&D
- ✓ International Financial Institution support of non OECD market development

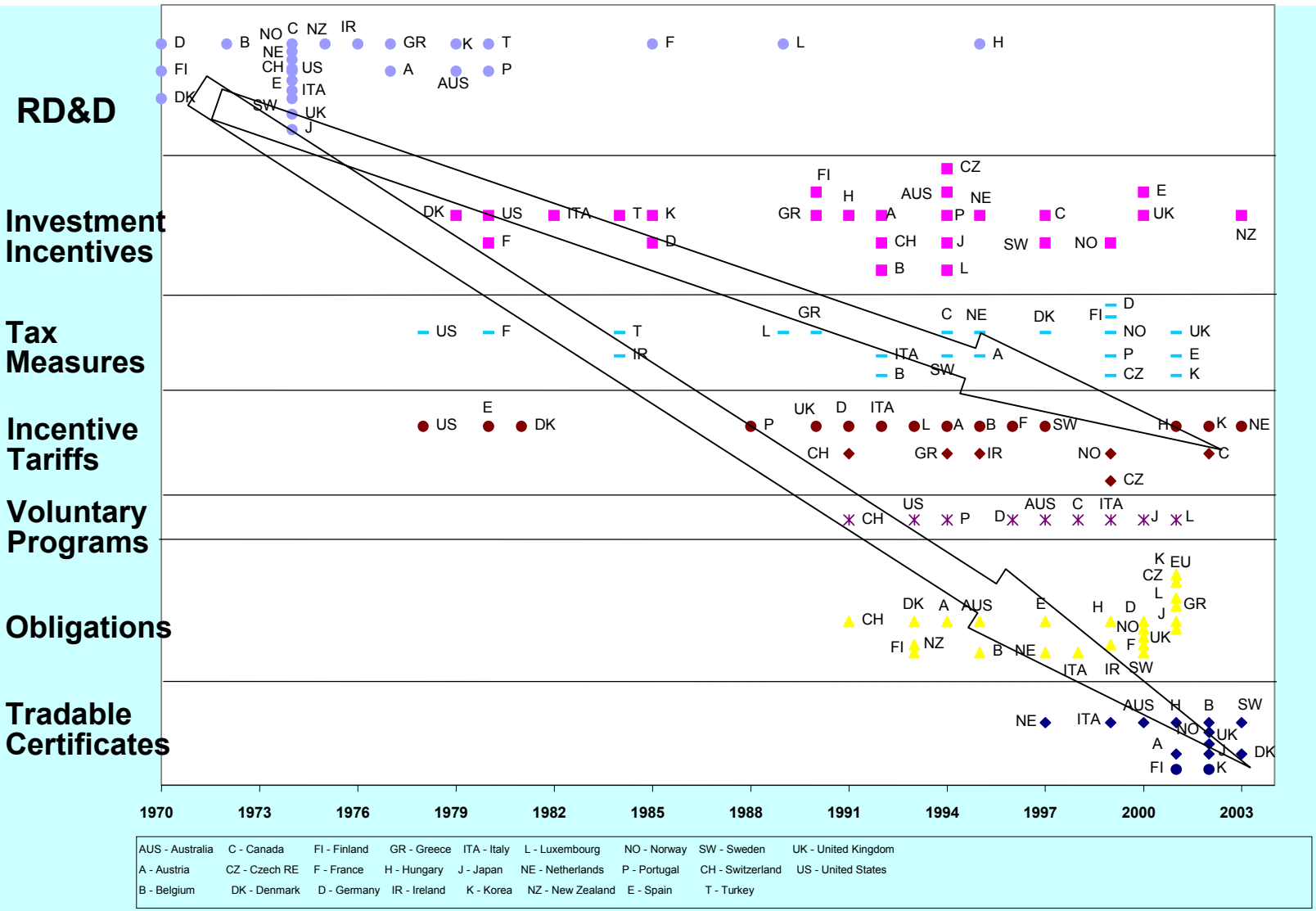
Long-term market competitiveness rules

- ✓ **valuation** of security, diversity and environmental **benefits**
- ✓ green pricing with **tradable renewable energy certificates**
- ✓ **certified emission reductions** with targets and penalties
- ✓ integration of **distributed generation** in energy market liberalisation rules

RE Market Deployment Policies



Evolution of RE Policies in IEA Countries



IEA Renewable Energy Publications

Conclusions: RE a “no regret”

- **RE is an integral part of the energy supply in many countries today.**
- **RE has tangible economic, ecological and social benefits.**
- **RE has the technological potential to complement fossil fuels and nuclear as mainstream energy source**
- **Debate needs to shift from ‘one policy is best’ to ‘multiple and complementary policies’ are best**
- BUT: **RE market development depends on a coherent, predictable, supportive political & legal framework.**

Contact

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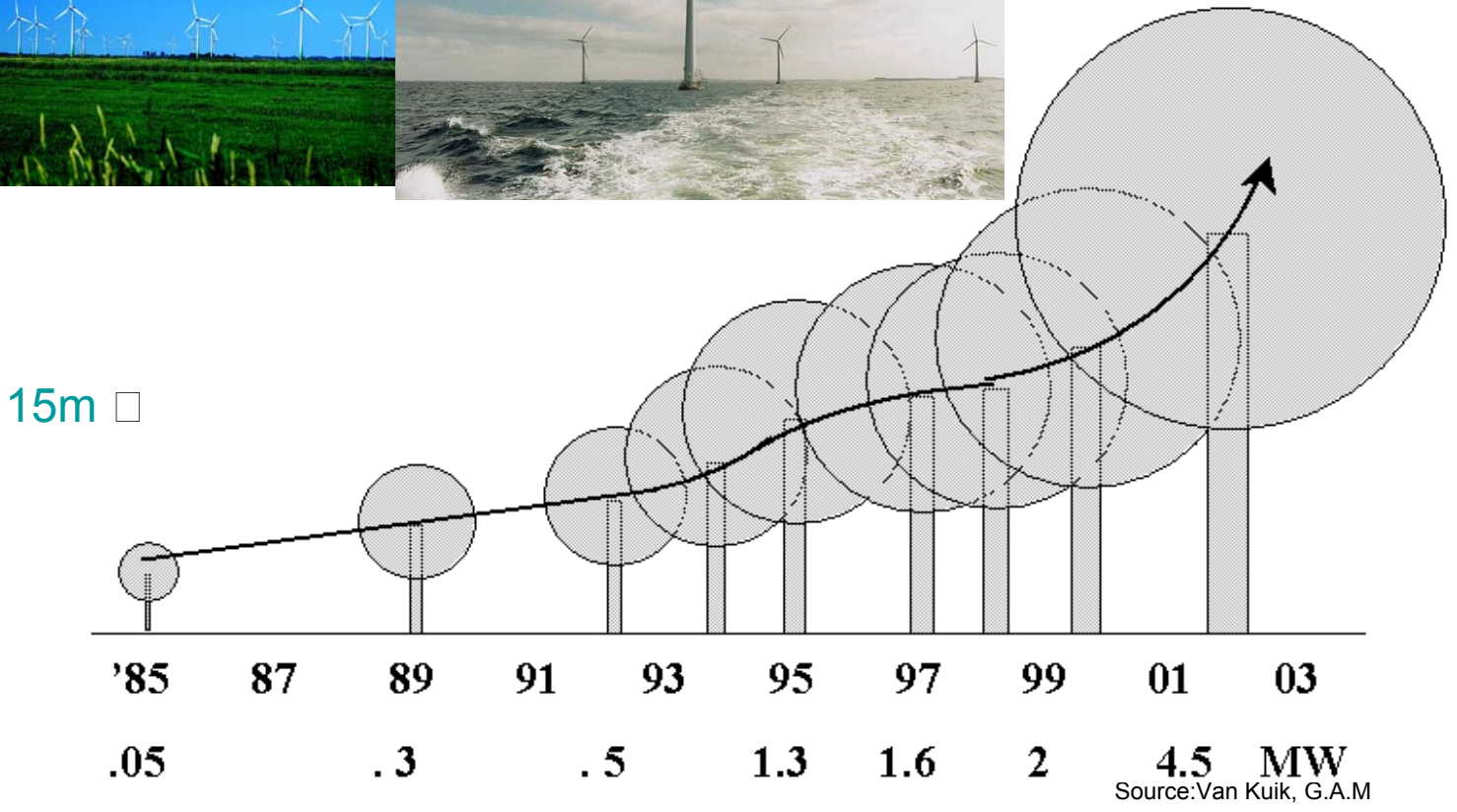
The Reality Today
Market Development in Wind and PV

But emerging Markets Are Concentrated

- **Rapid growth in emerging technologies, like wind and solar, but limited to just a few markets:**
  - ✓ 86% of wind capacity in Denmark, Spain, US and Germany
  - ✓ 85% of PV capacity in Japan, Germany and US
- **Prompts concerns about market stability, although many new policies since 2000 suggest broadening of market "front".**

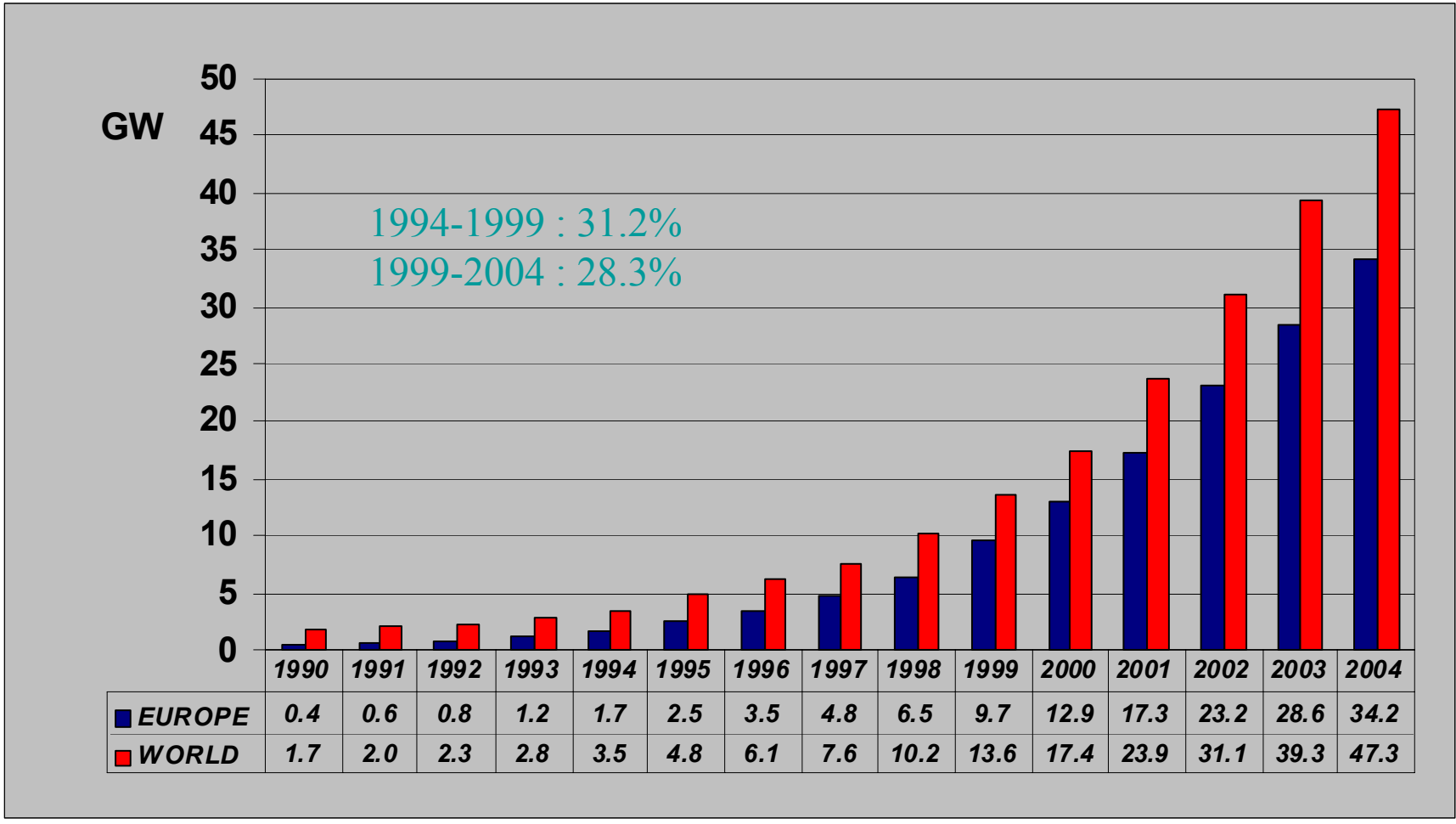
Energy from wind

Wind:tecno-economic development



Source:Van Kuik, G.A.M

Cumulative Wind Energy Installed Capacity

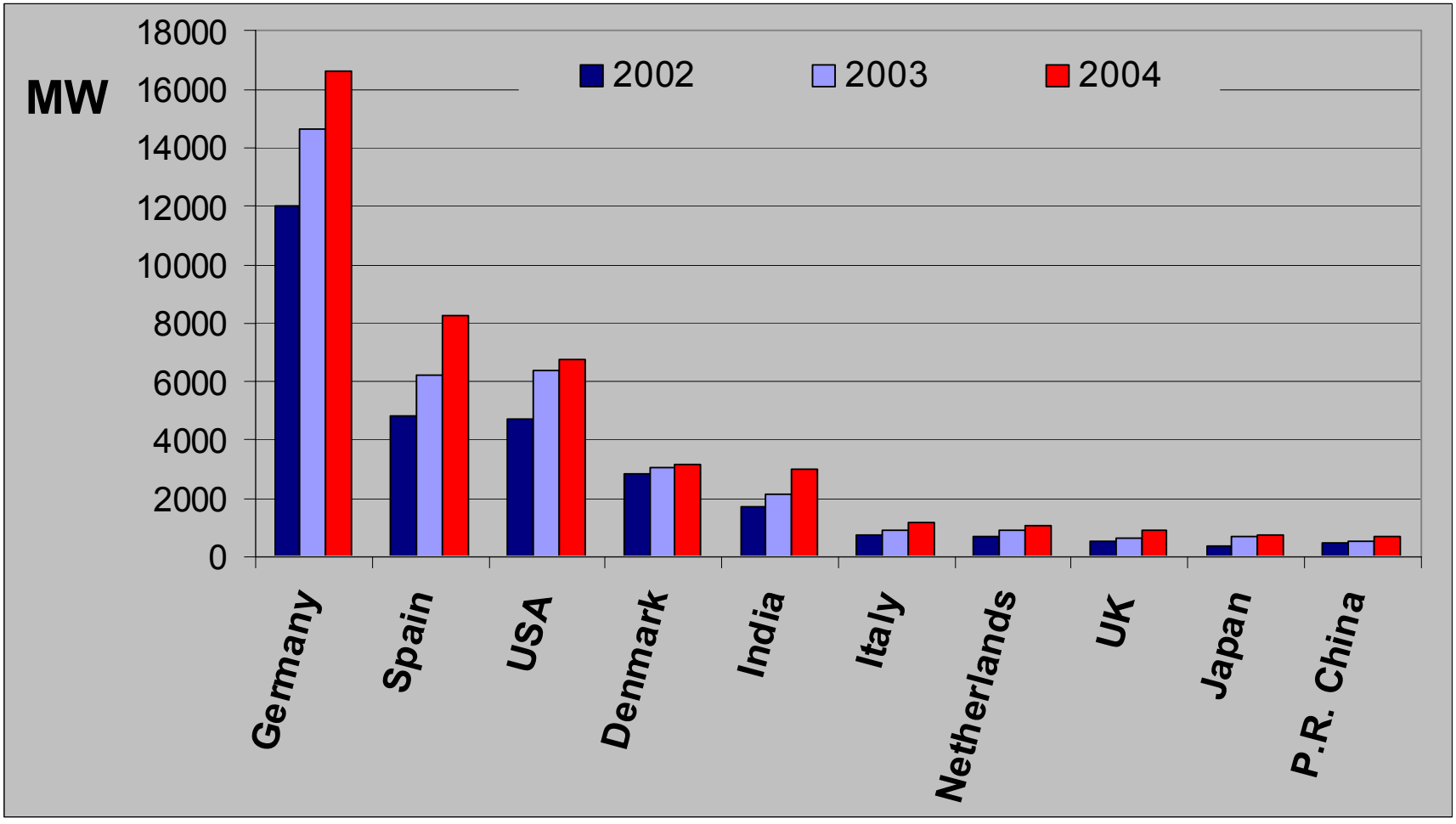


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EUROPE	0.4	0.6	0.8	1.2	1.7	2.5	3.5	4.8	6.5	9.7	12.9	17.3	23.2	28.6	34.2
WORLD	1.7	2.0	2.3	2.8	3.5	4.8	6.1	7.6	10.2	13.6	17.4	23.9	31.1	39.3	47.3

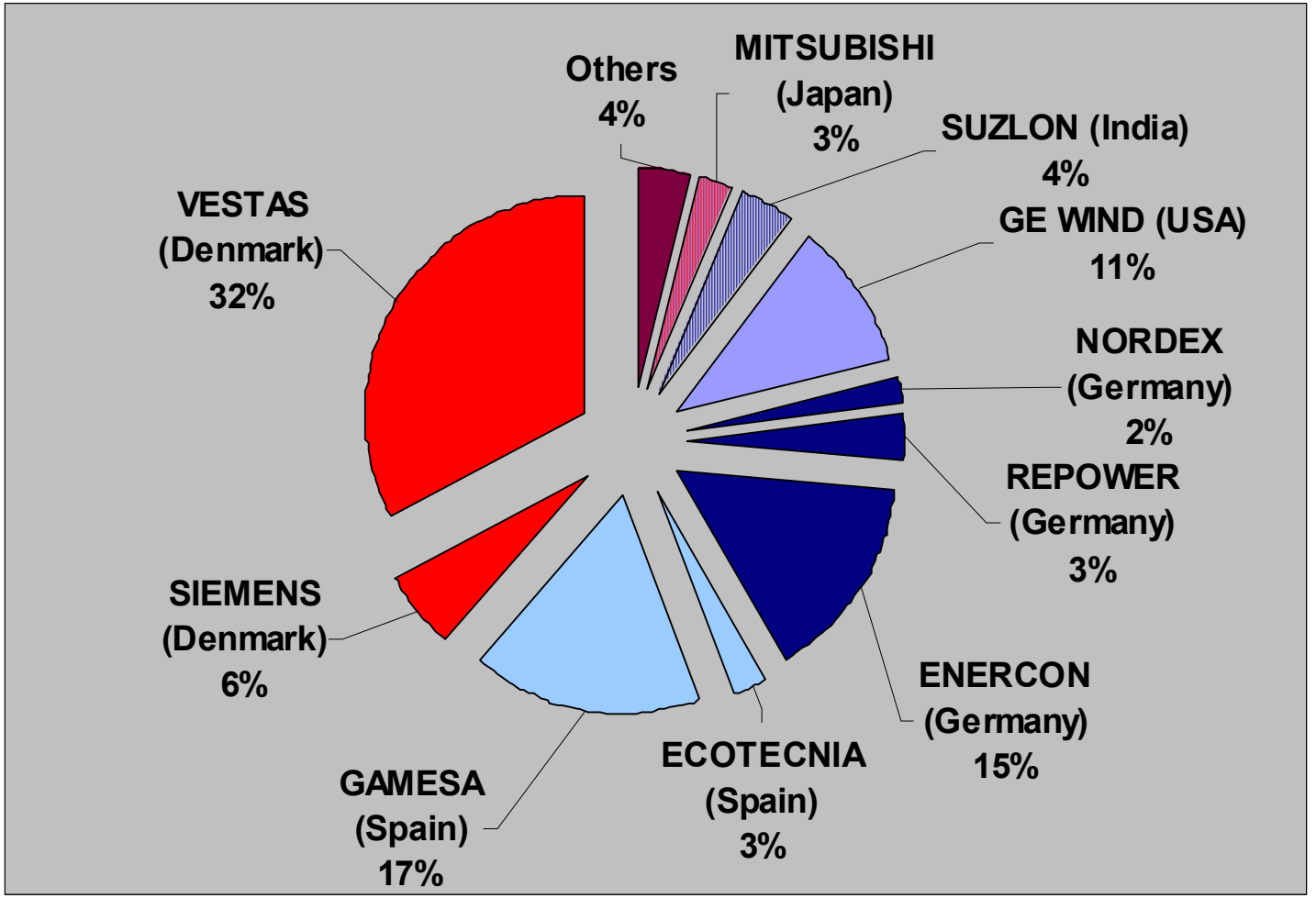
Growth rates

Source: EWEA

The Top-10 Markets in the World



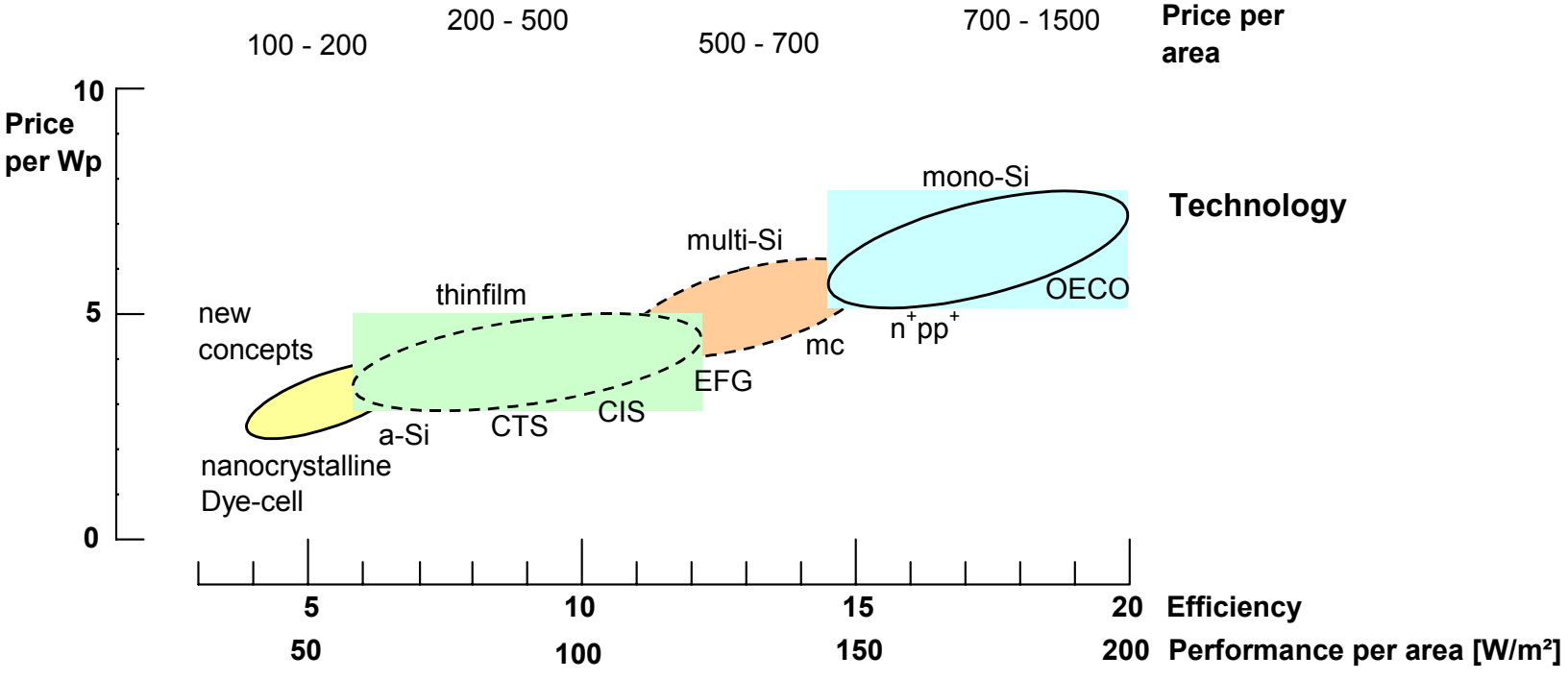
Top 10 wind suppliers



Applications of photovoltaic systems

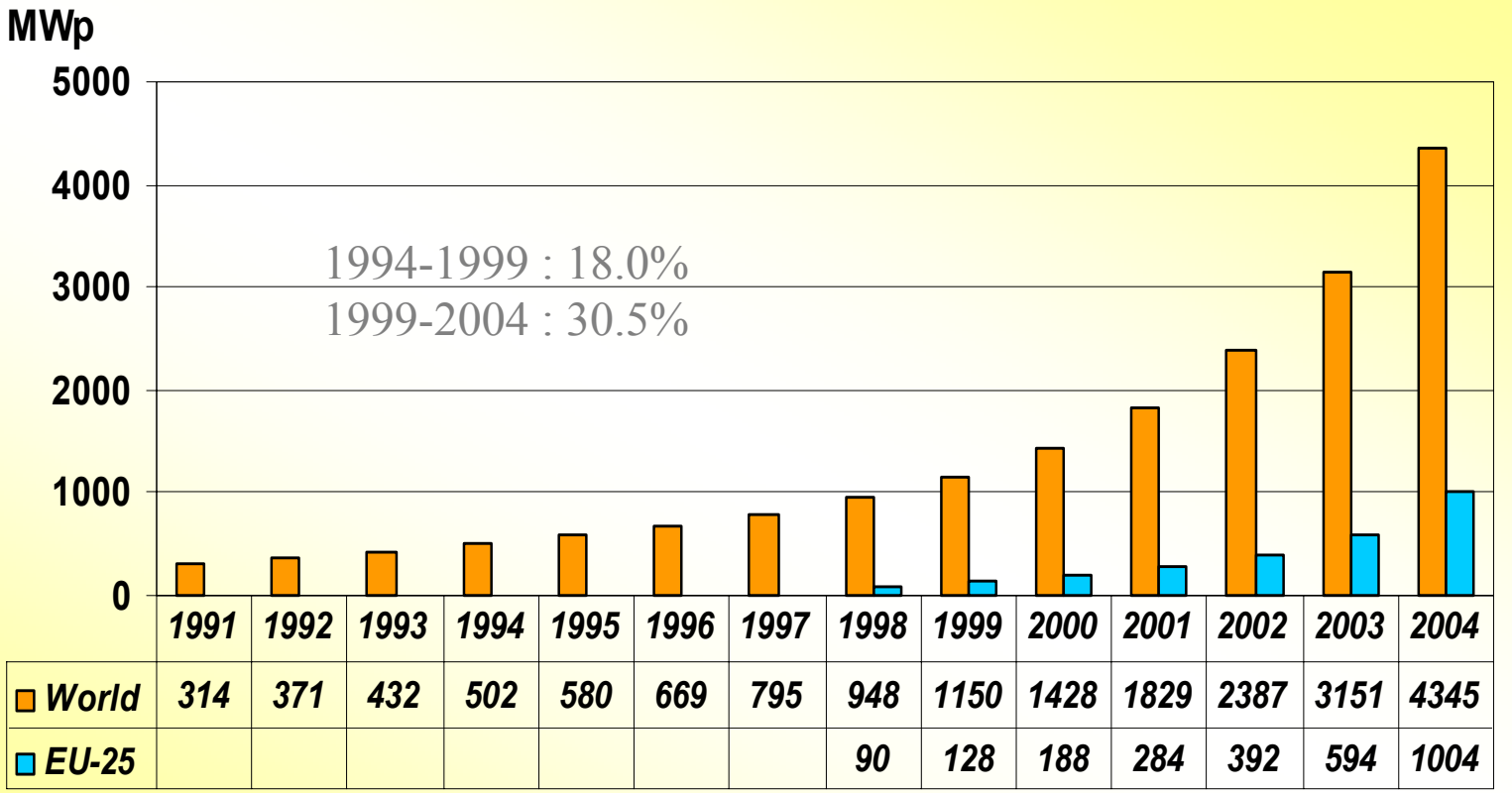
PV:techno-economic development

example: cell technologies



Source:RWE Solar GmbH

Cumulative Photovoltaic Installed Capacity (MWp)

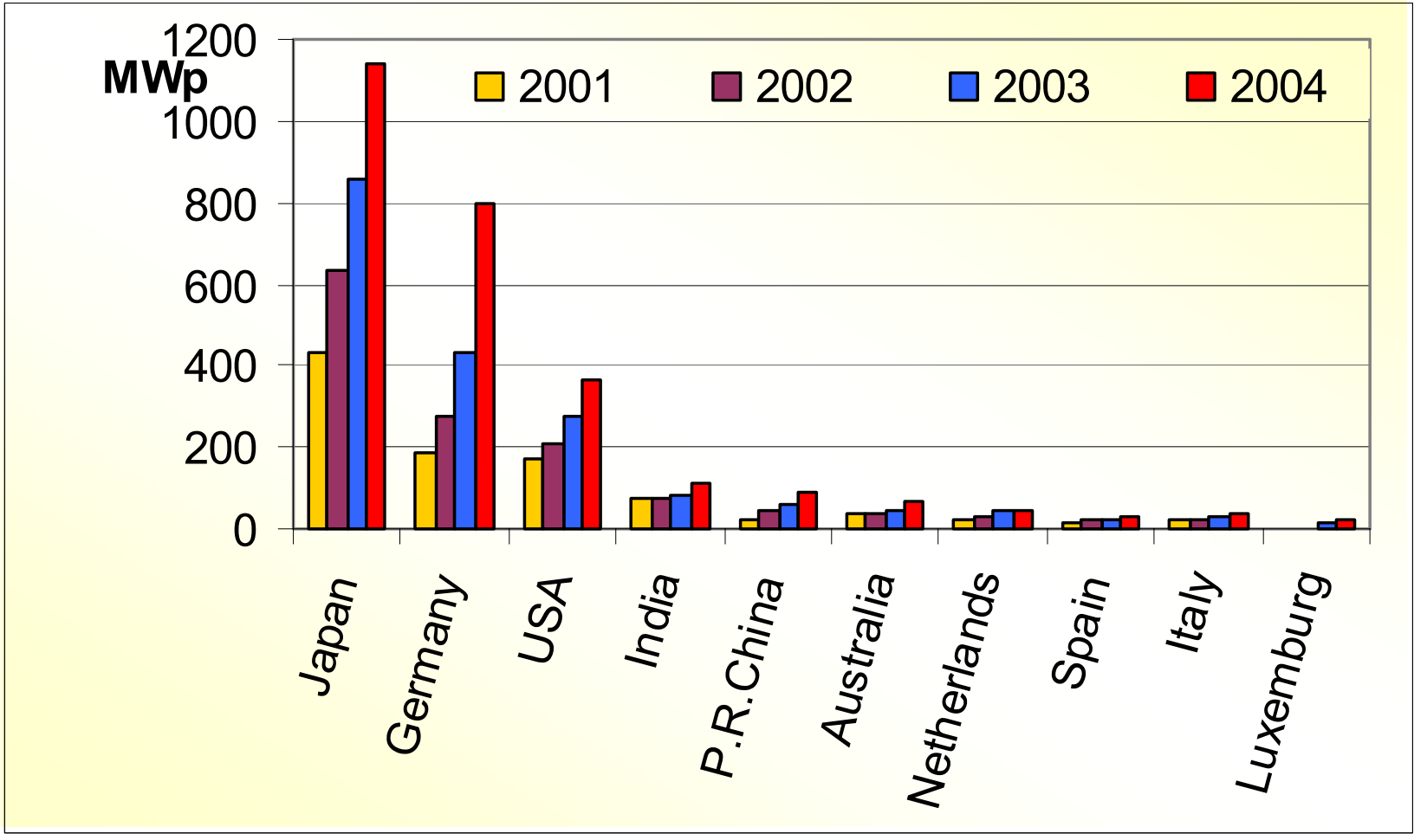


	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
World	314	371	432	502	580	669	795	948	1150	1428	1829	2387	3151	4345
EU-25								90	128	188	284	392	594	1004

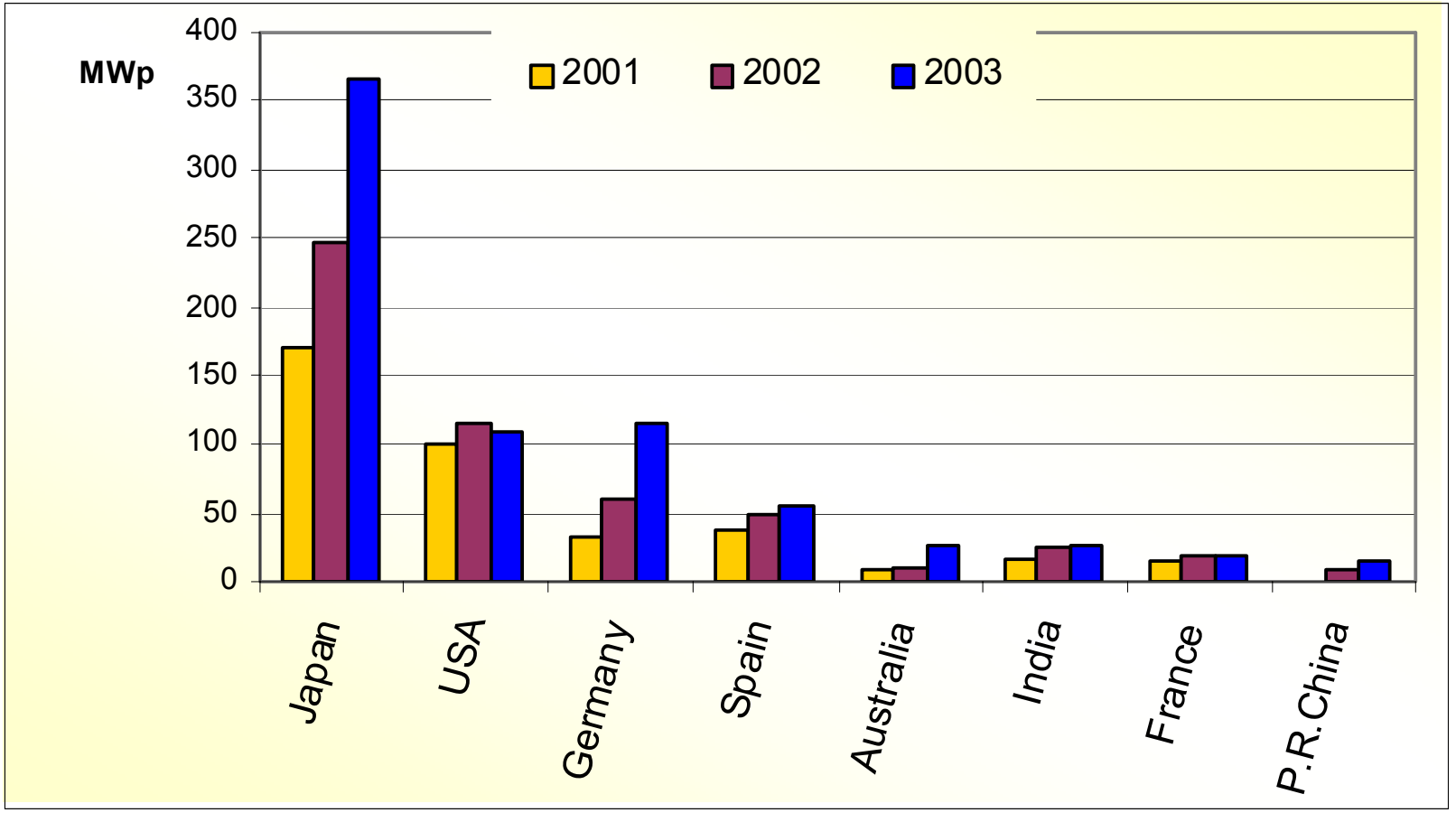
Growth rates

Source: Eurec Agency, EPIA, Observ'ER

The Top PV Markets



Top PV producing countries



Source: EPIA, Observ'ER, IEA-PVPS

The Top PV Manufactures