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Role of RE in Energy Scenarios R&D needs

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Sustainable Development: a challenge for R&D?

28 May 2009 Bruxelles

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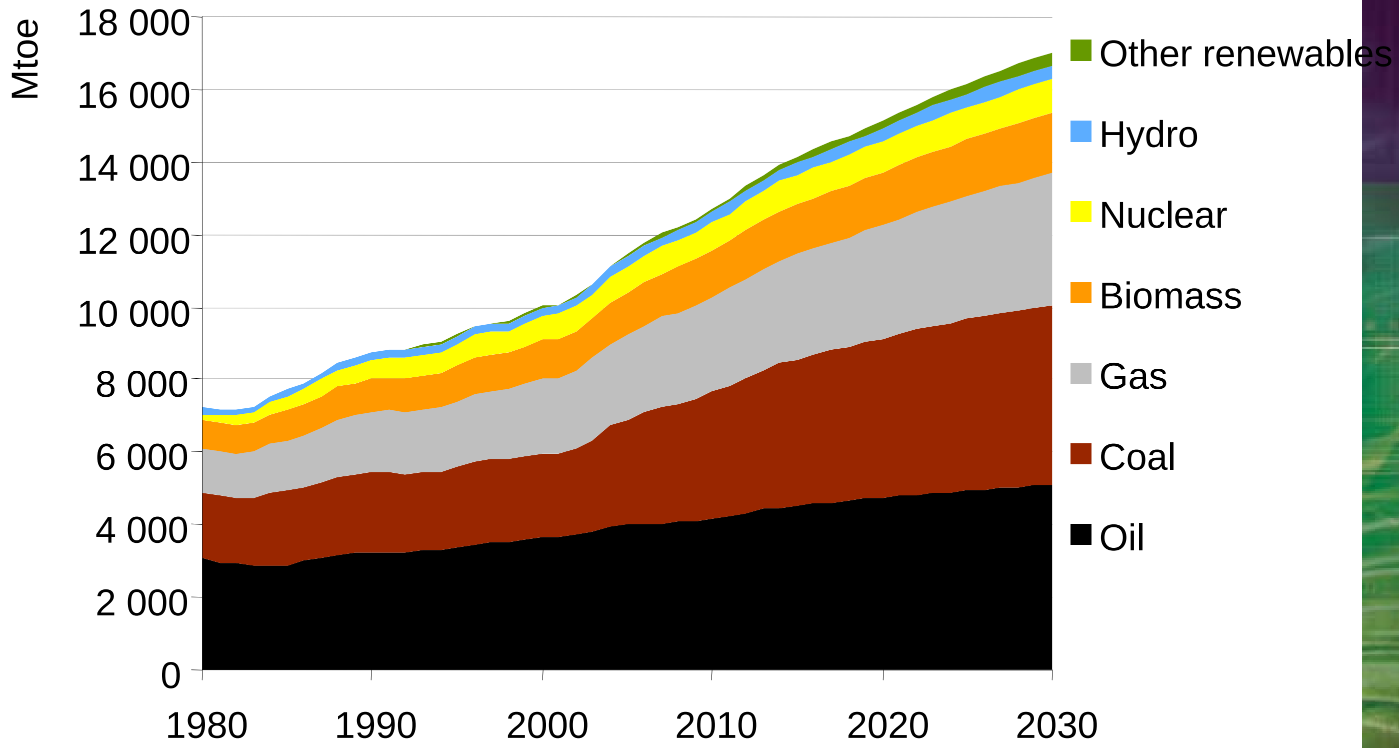
The Energy Challenges

Energy trends scenarios up to 2030

World Energy Outlook 2008

World primary energy demand
WEO 2008 Reference Scenario:
unsustainable x security supply



World energy demand expands by 45% between now and 2030 – an average rate of increase of 1.6% per year – with coal accounting for more than a third of the overall rise

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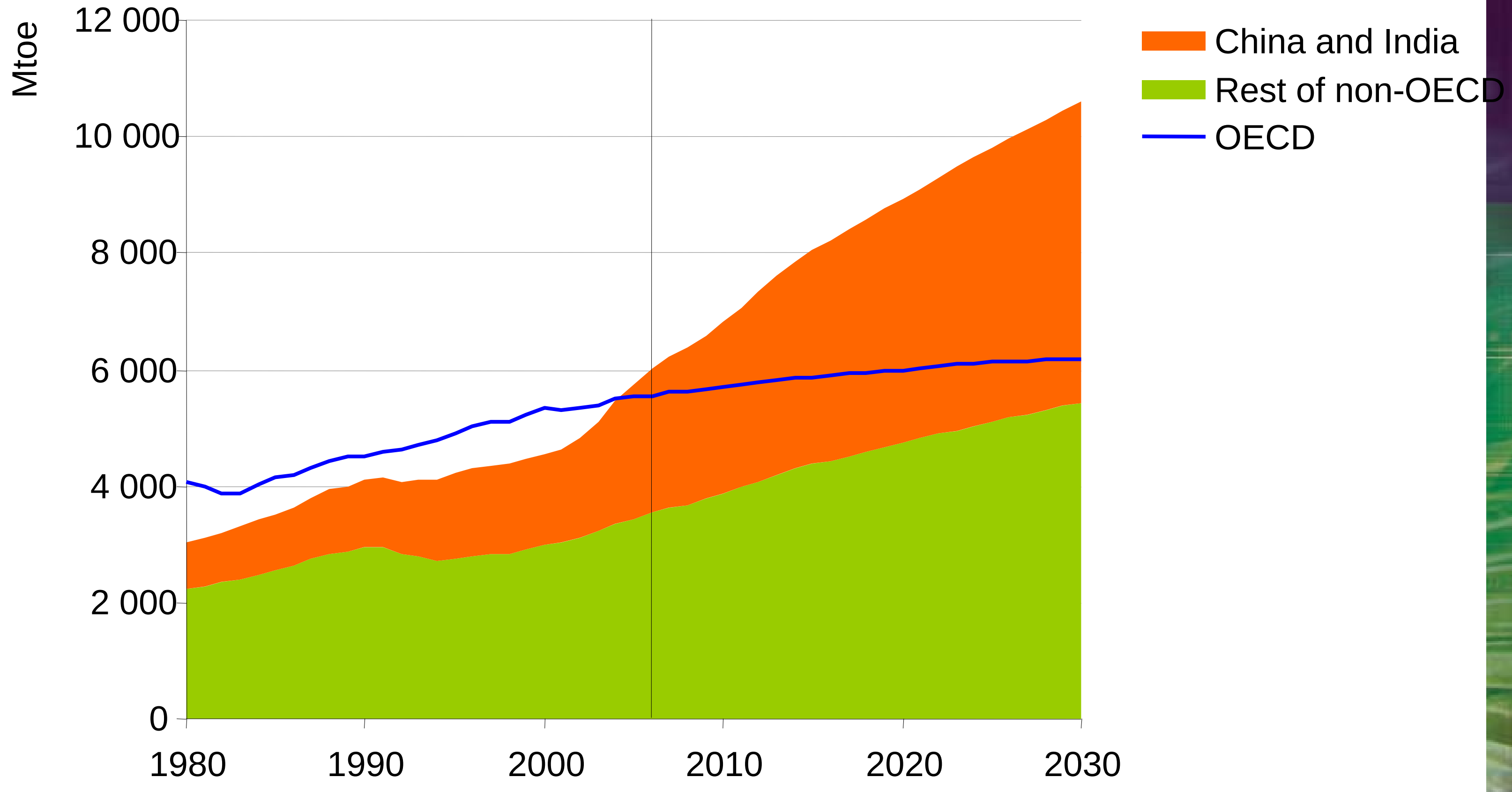
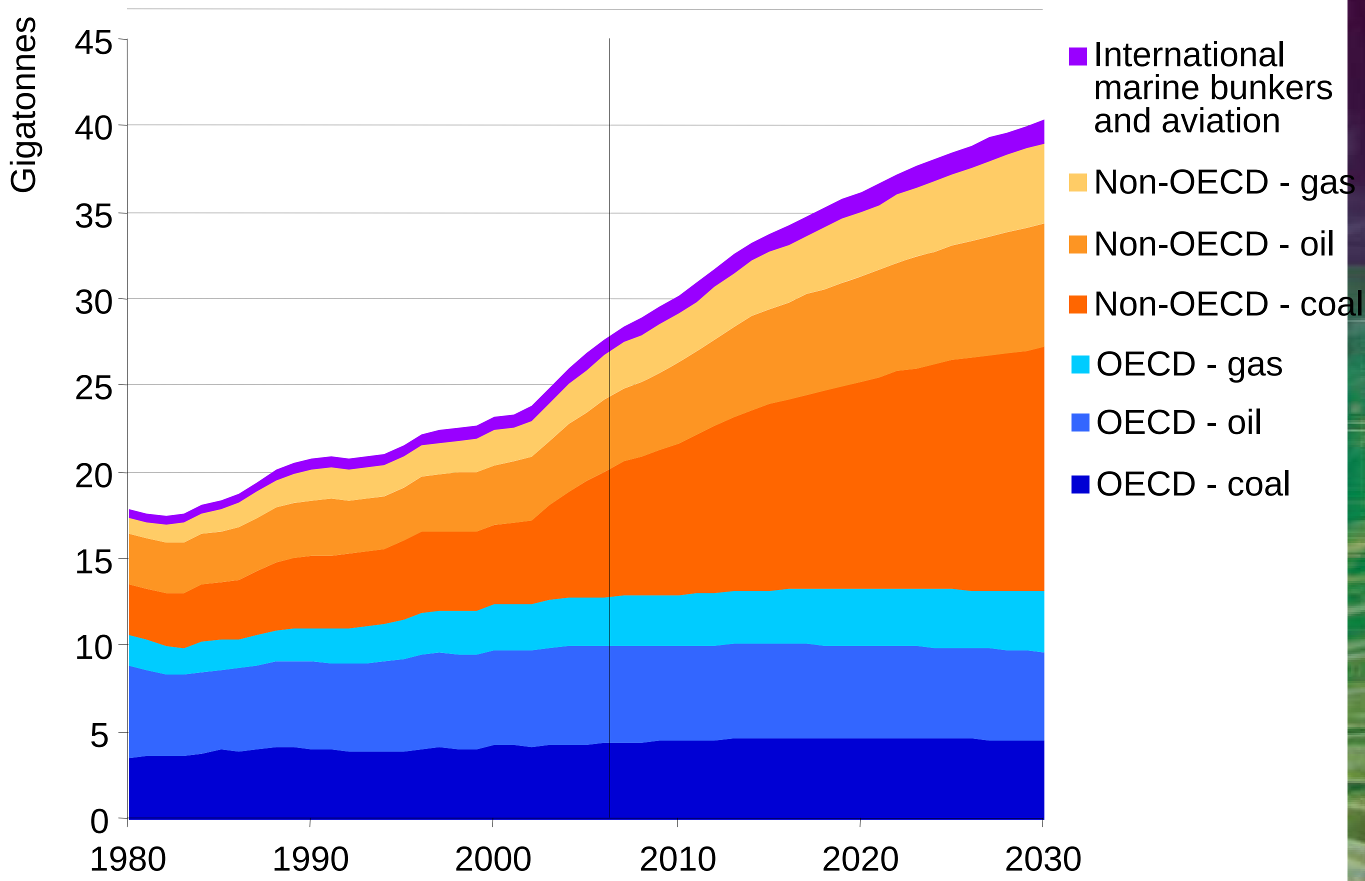
WEO 2008 Reference Scenario:
World primary energy demand



Non-OECD countries account for 87% of the increase in global demand between 2006 & 2030, driven largely by China & India

Energy-related CO_2 emissions in the Reference Scenario

absolutely unsustainable



97% of the projected increase in emissions comes from non-OECD countries. Such growth means a long-term concentration of GHG in the atmosphere of over 750 ppm of CO2. A global temperature increase of around 6 degrees.

Mapping a Better Energy Future

The Energy Future ***Absent New Policies***:

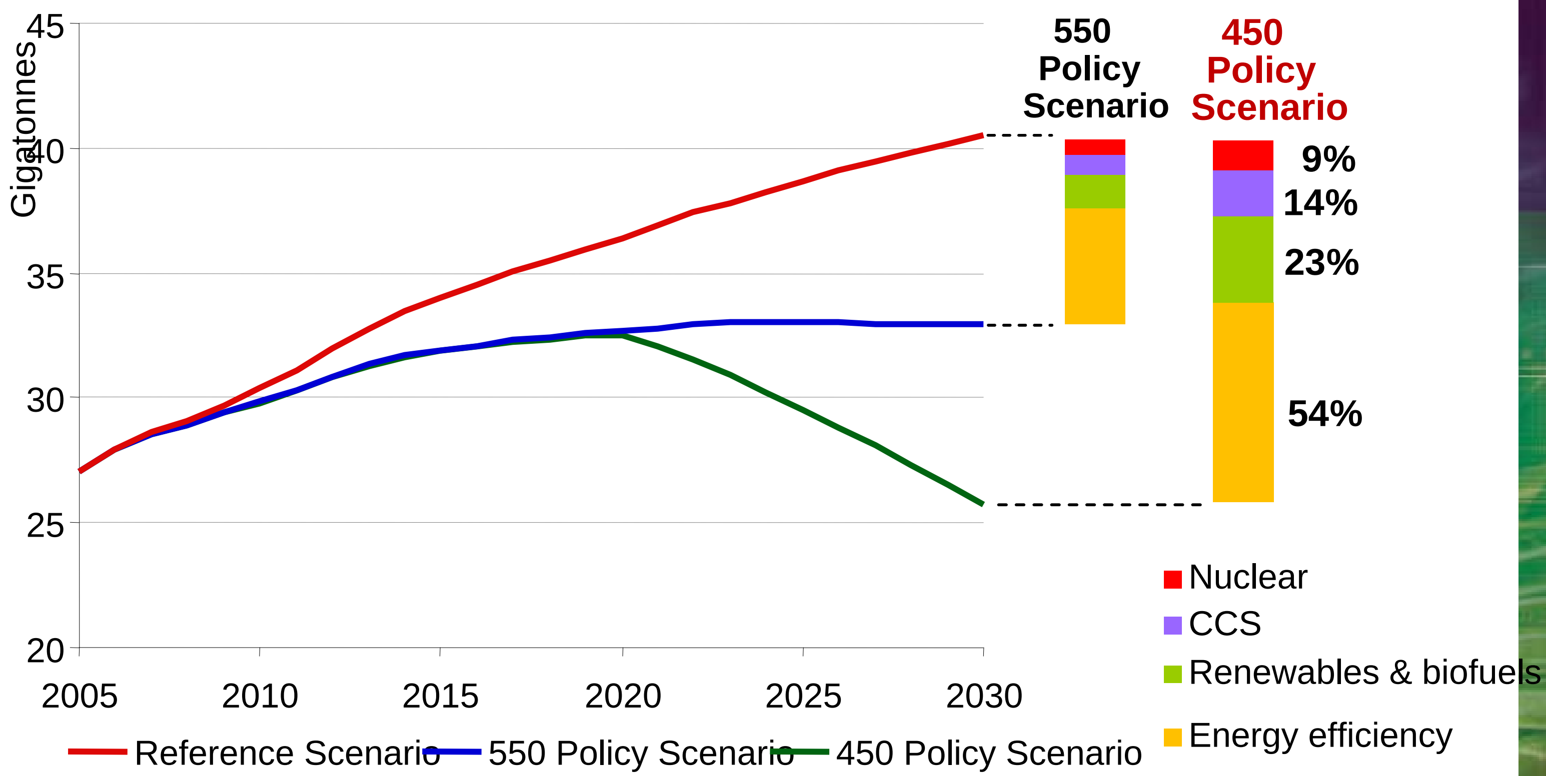
- **Security of oil supply is threatened**
- **Gas security** is also a growing concern
- **Investment** over the next decade will lock in technology that will remain in use for up to 60 years
- **CO2 emissions by 2050 will be almost 2.5 times** the current level!

On current trends, we are on course for **an "unstable,**

dirty & expensive energy future" as the carbon intensity

of the world economy will increase

Reductions in energy-related CO_2 emissions in the "policy" scenarios



While technological progress is needed to achieve some emissions reductions, efficiency gains and deployment of existing low-carbon energy accounts for most of the savings

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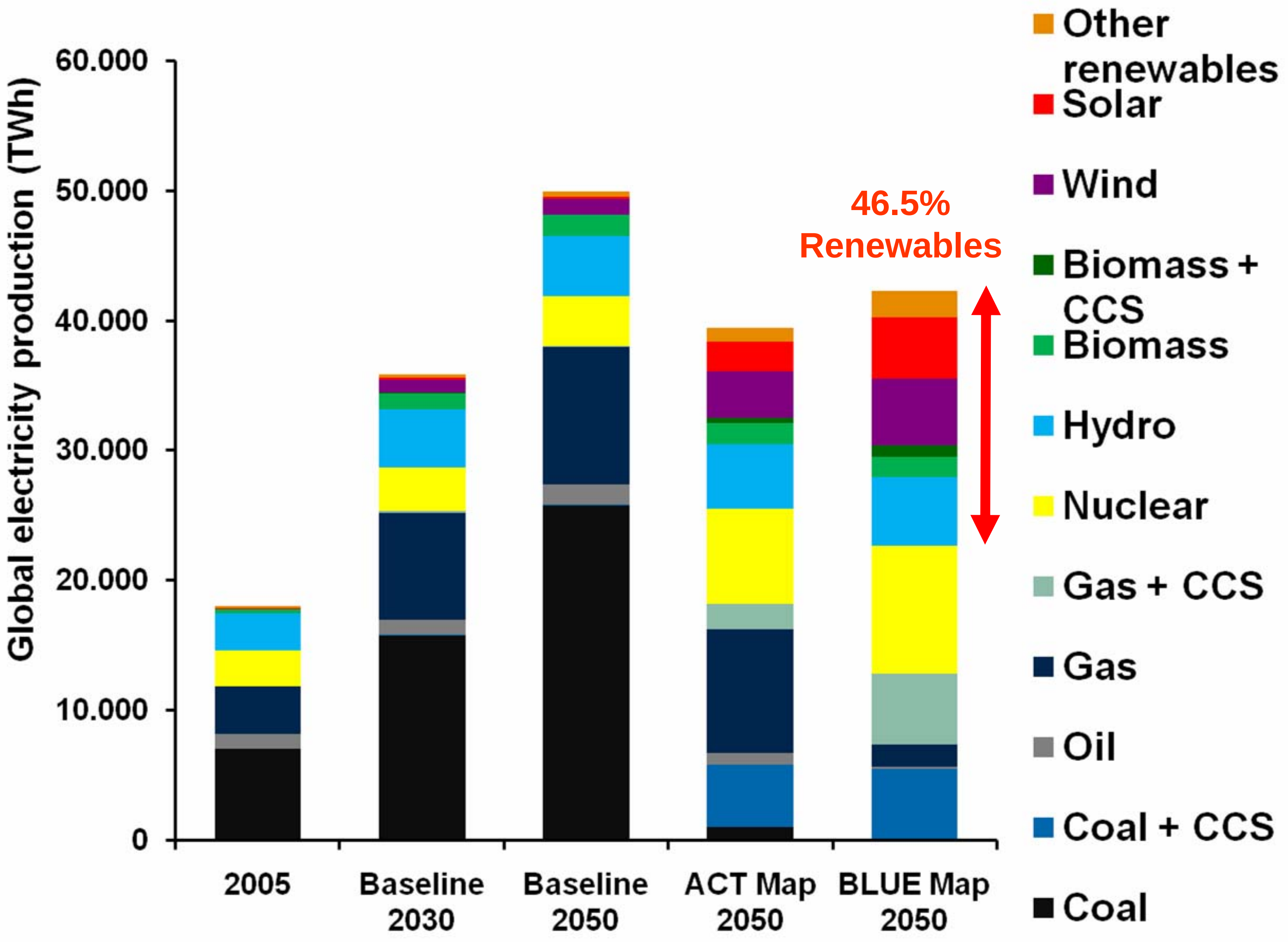
Energy Technology Perspectives 2008

scenarios up to 2050

The Challenge of a Technology Solution

Power Generation Mix
in various scenarios



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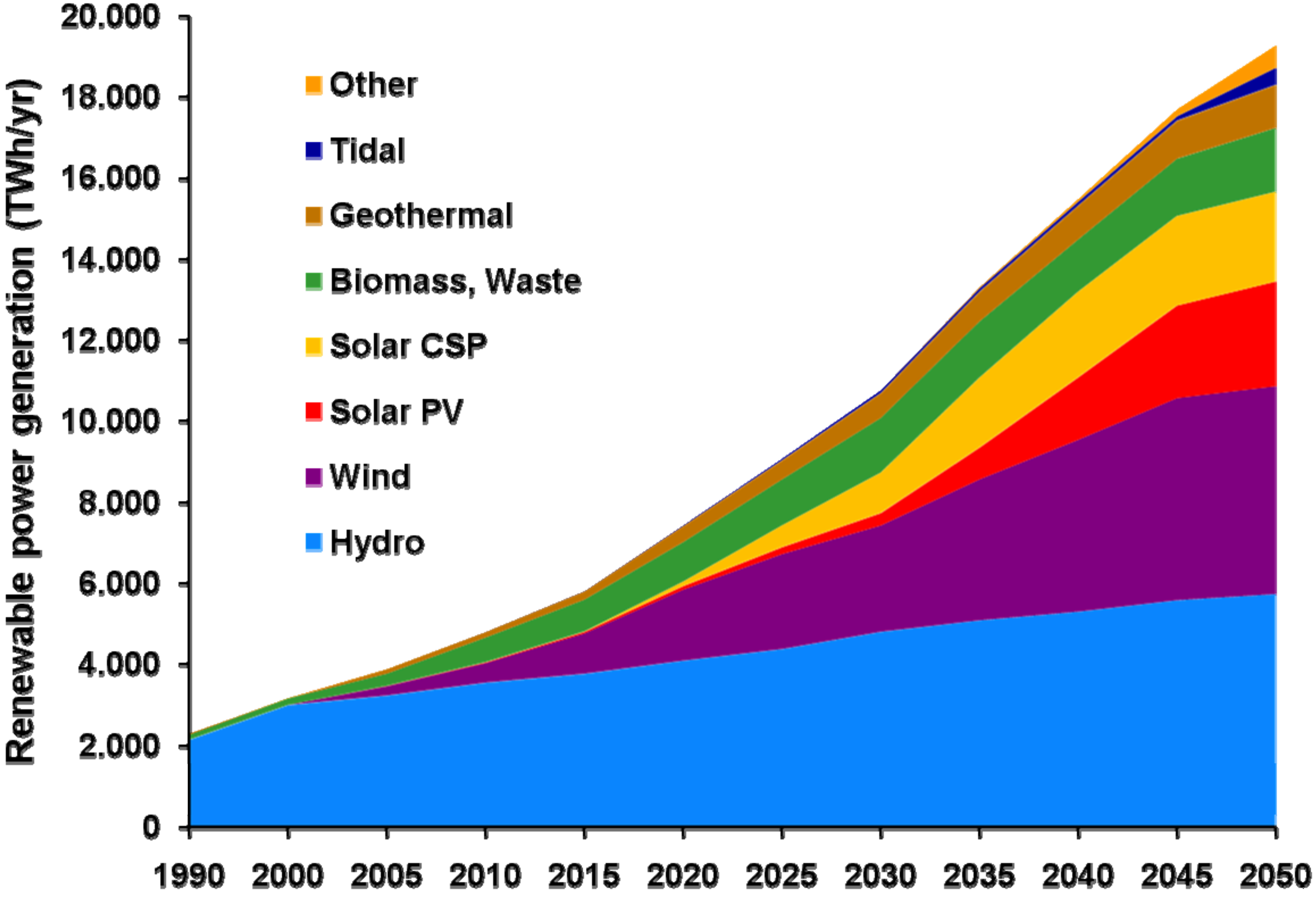
Power Renewables in BLUE Map



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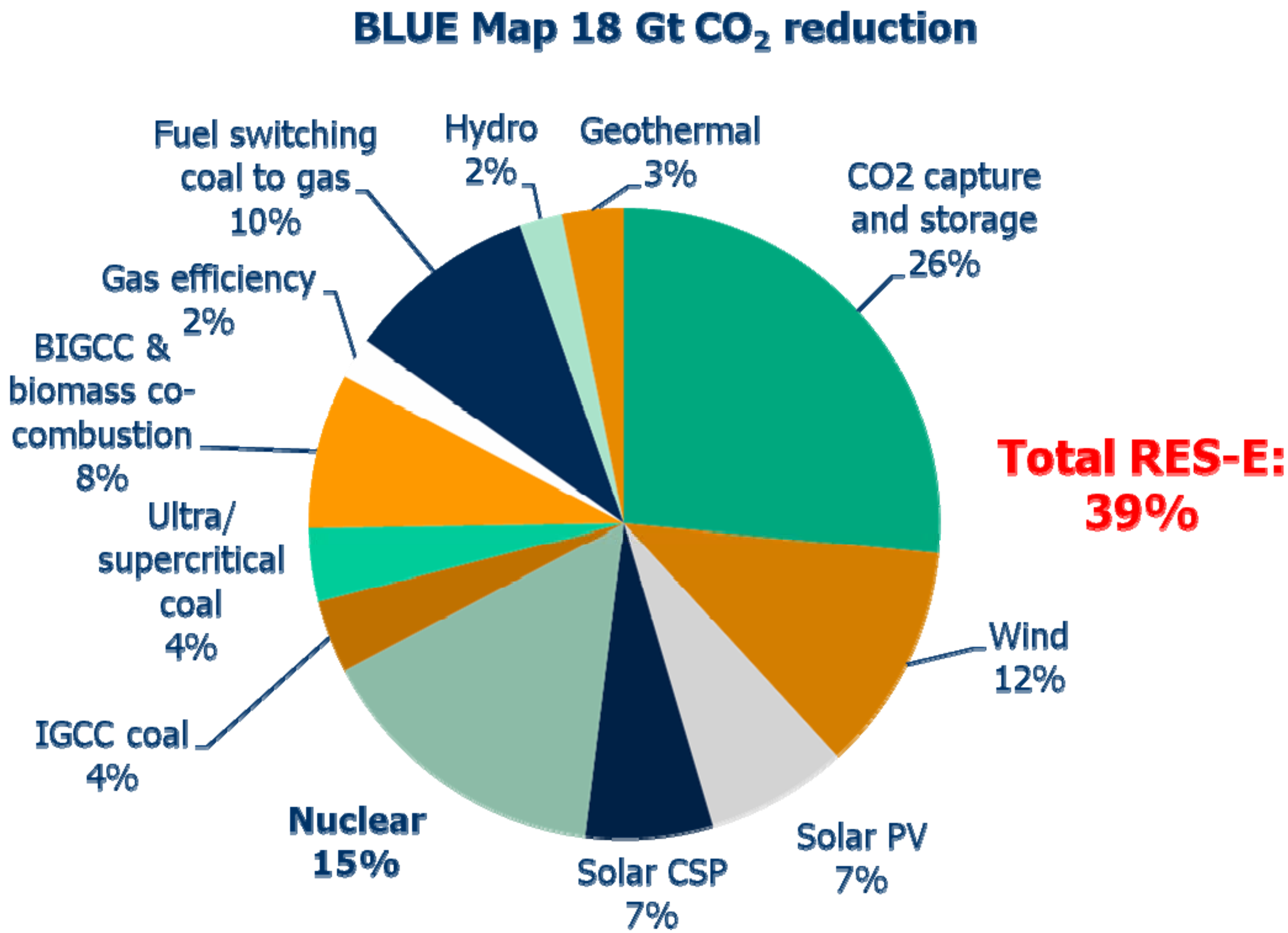
In support of the G8 Plan of Action

Power sector CO_2 reductions

BLUE Map vs. Base



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The Transition Challenge

- Technologies for ACT are available today
  - **BLUE requires new technology**
- **Anything not under development today will not play a significant role by 2030-2040**
- **High cost demonstration projects**
- Ramp-up production capacity
- Lack of skilled staff
- No strong champions
- Behavior incumbent players
- **Investment decisions are company decisions, not government decisions**
- **Public acceptance of a new energy paradigm**

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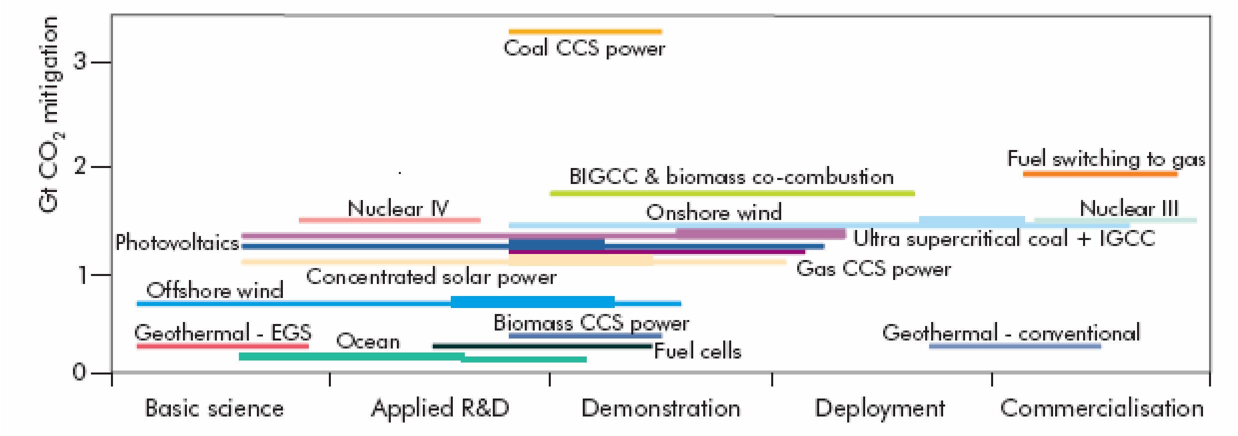
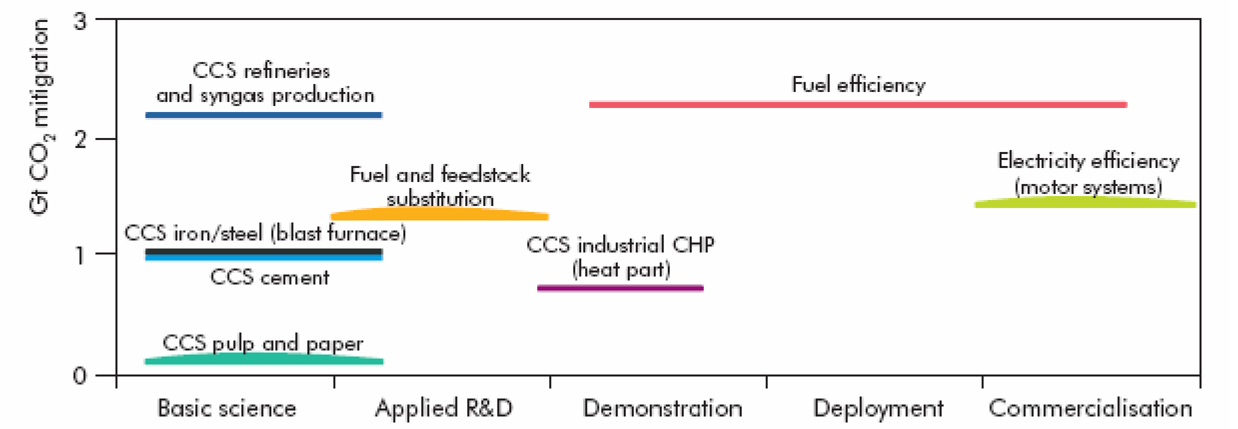
RD&D Needs

Technology RD&D Needs

- **Power generation**



- **Industry**



In support of the G8 Plan of Action

RD&D Policies

- Policy portfolio by governments
  - Supply-push and Demand-pull
- Increasing RD&D spending
  - No clear and established relationship between RD&D spending and outcomes
  - RD&D investments as inexpensive insurance policy against climate change
  - Current level of spending is not enough
  - Independent studies recommend 2 to 10 times increase of the current level
- Technology portfolio – Risk hedging
  - Unpredictable nature of innovation
  - Clear outcome focused-objectives
  - Continuous assessment

RD&D Policies

- **Basic science support**
  - ➢ **Many RD&D breakthroughs depend on Basic Science**
    - **Physics, materials science, including nano-technology, applied mathematics, computer sciences, bio-science and chemistry**
  - ➢ **Role of government and university labs**
  - ➢ **Strategic plan/technology roadmap for priority identification**
  - ➢ **International collaboration in pre-competitive stage**
- **Applied R&D and demonstration**
  - ➢ **Role of government to mobilize private sector**
  - ➢ **Gaps between basic science and applied R&D**
  - ➢ **High costs of demonstration**

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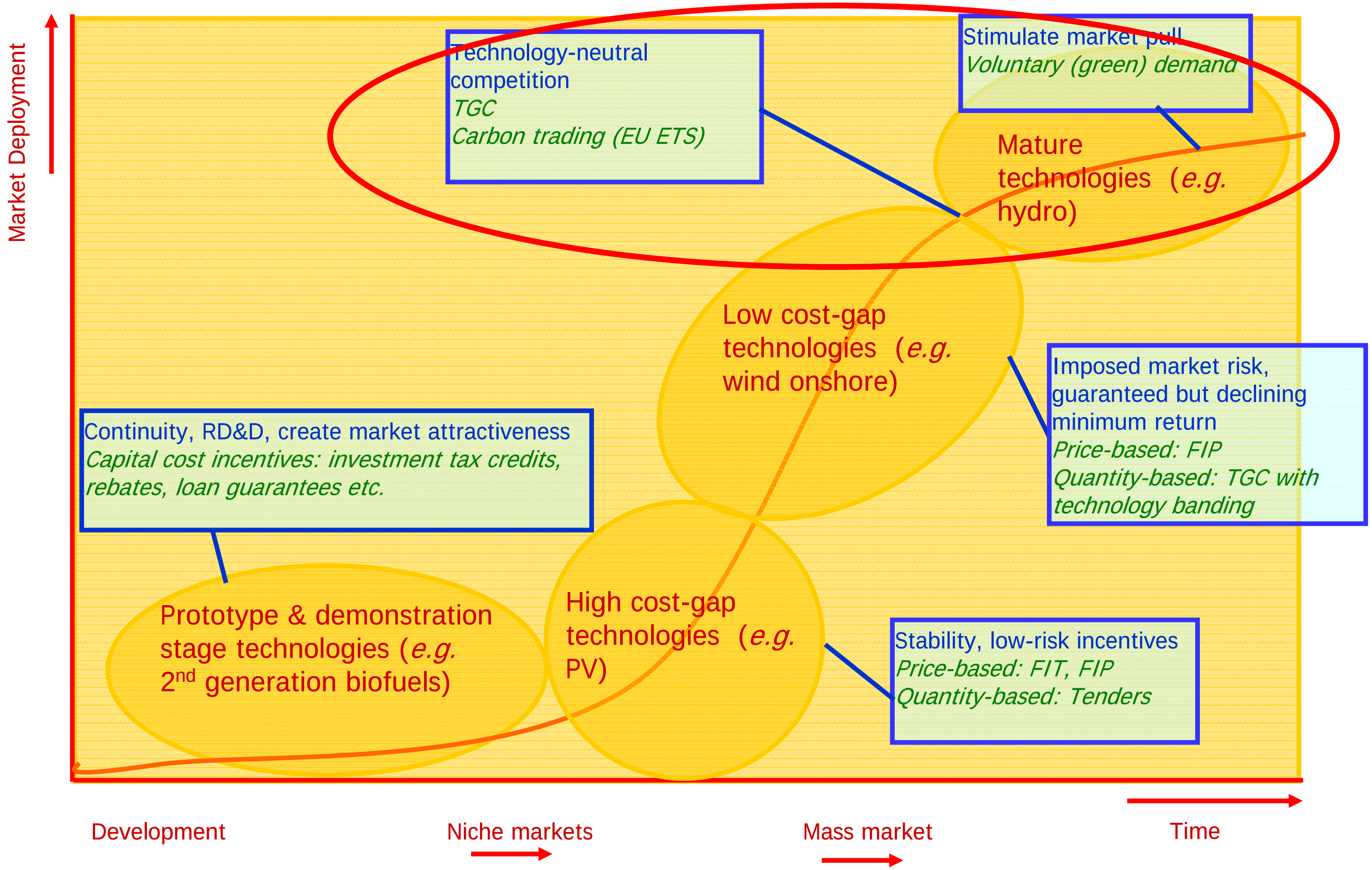
RD&D Policies

- Gap between RD&D and deployment, “Valley of death”
- Public-private partnerships for Applied R&D, demonstration
  - Funding and direct collaborations in applied R&D
  - Government leadership in demonstration
  - Both supply-push and demand-pull supports for the “Valley of the Death”
- International collaborations
  - Benefits
    - Cost sharing, economies of scale and reducing redundancy
    - Common pool of knowledge
    - Combining different comparative advantages among countries
  - IEA Implementing Agreements
  - Other international energy technology collaborations
  - Identification of gaps and opportunities

Fostering RETs' transition towards mass market integration



Note: The positions of the various technologies and incentive schemes along the S-curve are an indicative example at a given moment. The actual optimal mix and timing of policy incentives will depend on specific national circumstances. The level of competitiveness will also change in function of the evolving prices of competing technologies.

Energy RD&D – Key Messages

- Both public and private energy RD&D investments have declined since the early 1980s
- Current IEA Governments energy RD&D - USD 10 billion/yr
- Nuclear dominates government RD&D
- Companies energy RD&D - USD 40-60 billion/yr
- Information about industrial energy RD&D trends is scarce
- Unclear how much RD&D would be “sufficient” to meet the goals
  - Literature suggests USD 10-100 billion/yr additional investments
- Leave it to industry or role for government ?
- Cooperation or competition model ?

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Roadmaps

Roadmaps

17 technology roadmaps provide 87 % of CO_2 savings under the Blue scenario

- **Potentials**
- **Pathways to commercialization**
- **Technology targets**
- **How to get there**
- **Key actions needed**

- **Key areas for international cooperation**
- **Link short & medium term action needs with long-term potentials**
- **Broader than traditional roadmaps concept: "anything that progresses necessary technology development"**
- **Not prescriptive, but indicative and coherent**
- **Potential framework for enhanced technology cooperation**

Key Technology Options (Roadmaps)

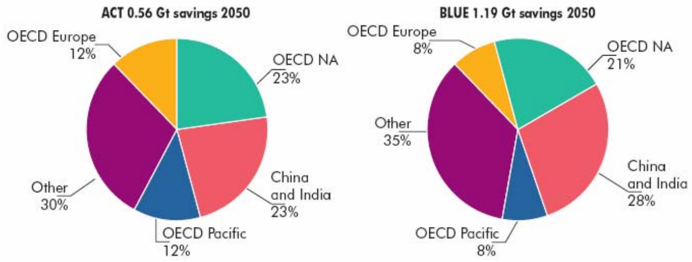
- **Supply side**
  - CCS power generation
  - Nuclear III + IV
  - Wind
  - Biomass – IGCC & co-combustion
  - Solar – PV
  - Solar – CSP
  - Coal – IGCC
  - Coal – USCSC
  - 2nd generation biofuels

- **Demand side**
  - Energy efficiency in buildings
  - Heat pumps
  - Solar space and water heating
  - Energy efficiency in transport
  - Electric and plug-in vehicles
  - Fuel cell vehicles
  - CCS in industry
  - Industrial motor systems

Roadmaps – Example CSP

3 % of CO_2 reduction potential in BLUE Map

Concentrating solar power



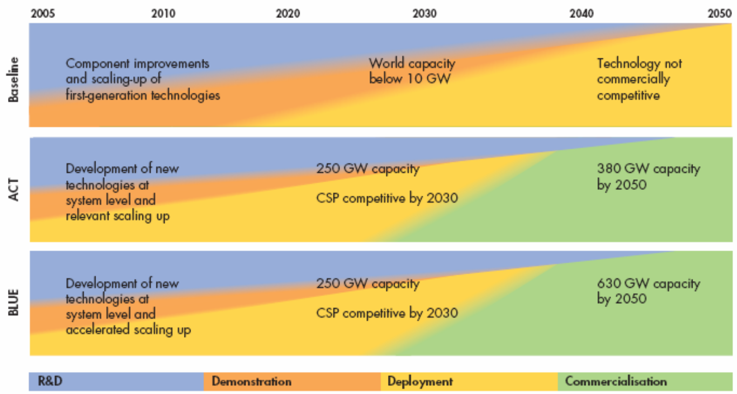
	Global Deployment Share 2030	RDD&D Inv. Cost USD bn 2005-2030	Commercial Inv. Cost USD bn 2030-2050
OECD NA	25%	65-75	45-50
OECD Europe	15%	40-50	25-30
OECD Pacific	15%	40-50	25-30
China & India	25%	65-75	45-50
Other	20%	55-65	50-55

	Global Deployment Share 2030	RDD&D Inv. Cost USD bn 2005-2030	Commercial Inv. Cost USD bn 2030-2050
OECD NA	23%	60-70	60-70
OECD Europe	14%	35-40	25-30
OECD Pacific	14%	35-40	25-30
China & India	24%	65-75	80-90
Other	25%	65-75	100-110

Technology targets

	ACT: Emissions Stabilisation	BLUE: 50% Emissions Reduction
RD&D		
System efficiency	Increase efficiency of systems to reduce costs	
Trough plants	Development of direct steam generation for trough plants	
Development of new technologies at system level for trough, dishes and towers	• Towers with air receivers to significantly increase working temperatures and conversion rates, demo by 2012 • Combined power and desalination plants, demo by 2012	Solar production of hydrogen and other energy carriers, demo by 2020
Low-cost, high efficiency thermal storage	Storage costs to fall to USD 0.05/kWh and efficiencies greater than 95%	
Deployment		
• Cogeneration power desalination • Troughs + direct steam generation • Troughs + molten salts	Commercial deployment by 2020	
Towers + air receiver + gas turbine	Commercial deployment by 2030	

Technology timeline



Key actions needed

- Economies of scale, mass production, learning by doing, and incremental improvements of all system components (mirrors, infrastructures, sun-tracking, heat receivers, pipes, balance of plants, etc.) will combine to improve performances and reduce costs.
- The emergence of heat storage, as an alternative to back-up with fossil fuels, significantly increases the value of the electricity produced in making power capacities guaranteed or even dispatchable.
- The development of incremental improvements such as direct steam generation, use of molten salts in troughs, cogeneration of heat for desalination and power, and cheaper dishes will further help increase performance and reduce costs.
- Development of towers with air receivers will significantly increase working temperatures and conversion rates and reduce costs even further, but still requires important R&D efforts.
- Low-cost long-range DC transmission systems.

Key areas for international collaboration

- Continuing co-ordination of R&D efforts, outreach efforts sharing and information exchanges through IEA's SolarPACES Implementing Agreement.
- Effective financing of CSP plants in developing countries beyond the global environment facility-supported plants.
- Developing efficient interconnection via high-voltage, direct-current lines to feed important consuming areas from neighbouring sunny regions.

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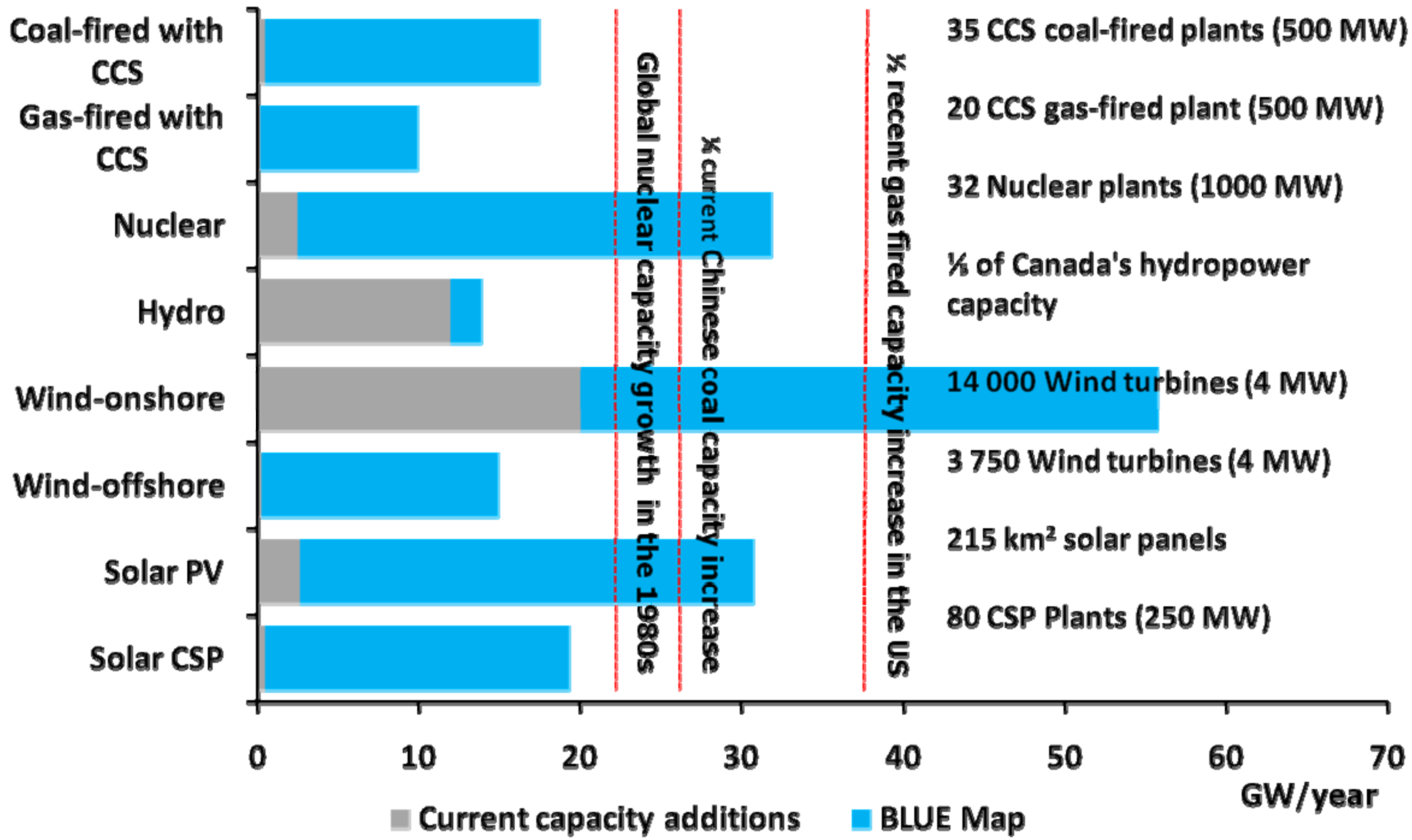
Investment needs

Annual Investment in New Generating Capacity BLUE Map



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Financing Needs *on top of Baseline*

- BLUE = +USD 45 trillion (is only 1.1% of cumulative GDP: it is affordable.);
- Demand side investments dominate (80%) and poses huge challenges for ensuring timely investment, problems include:
  - Millions of individual purchasing decisions
  - Difficulty in standardizing finance
  - Higher transaction costs for many small projects
- Undiscounted fuel savings BLUE -USD 51 trillion (2010-2050) exceed additional investment
  - However valuation at market prices is debatable
- Financing needs
  - +10 to +100 bln USD/yr RD&D (short/mid-term)
  - +100 to +200 bln USD /yr learning investments (short/mid-term)
  - +1000 to +2000 bln USD /yr commercial investments (mid/long term)

Key Messages

- **A sustainable energy future is possible with a portfolio of clean and efficient technologies, RE definitely among them.**
- **The task will take decades and it will require significant investments costs. But Business As Usual would cost more!!**
- **The task is urgent: *it must be carried out before a new generation of inefficient and high-carbon energy infrastructure is locked into place.***
- **Implementing sustainable scenarios will require a transformation in:**
  - ✓ ***the way power is generated,***
  - ✓ ***the way homes, offices and factories are built and use energy,***
  - ✓ ***the technologies used for transport.***
- **It will also take unprecedented co-operation between the developed and emerging economies to achieve the results implied**

Thank You !

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