

INTERNATIONAL

ENERGY



AGENCY



Energy Technology Perspectives 2008

Dolf Gielen

Brussel, 12 December 2008

Afbakening

- Deze studie beschrijft de rol van technologie
- Transitiepaden worden geschetst voor de belangrijkste technologieën
- Dit kan een basis vormen voor internationale samenwerking op het gebied van energietechnologie
- De studie gaat niet over de post-Kyoto doelstellingen voor landen
- Het is geen studie over klimaatbeleids instrumenten



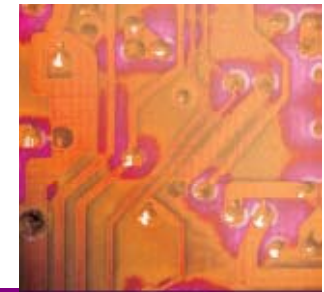
Energy Technology Perspectives 2008: Inhoud

- **Hoe verder?**
 - **Korte en middellange termijn beleid**
 - **Speciale aandacht voor transitiepaden**
- **Scenario analyse**
 - **Baseline consistent met het WEO2007 Referentie Scenario**
 - **Wereldwijde emissies stabilisatie in 2050 (ACT)**
 - **50% reductie van emissies in 2050 (BLUE)**
- **Technologie vooruitzichten:**
 - **Electriciteitsopwekking**
 - **Eindgebruiks sectoren**



ACT Scenarios

- Energie CO₂ emissies in 2050 terug naar het niveau van 2005
- Update van ACT gepubliceerd in ETP2006
 - Opties met marginale kosten tot USD 50/t CO₂ – wereldwijd (+20 USD/vat olie)
 - Kosten schatting is verdubbeld sinds ETP2006
- Dit scenario impliceert een sterk gewijzigd energie systeem



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL

ENERGY



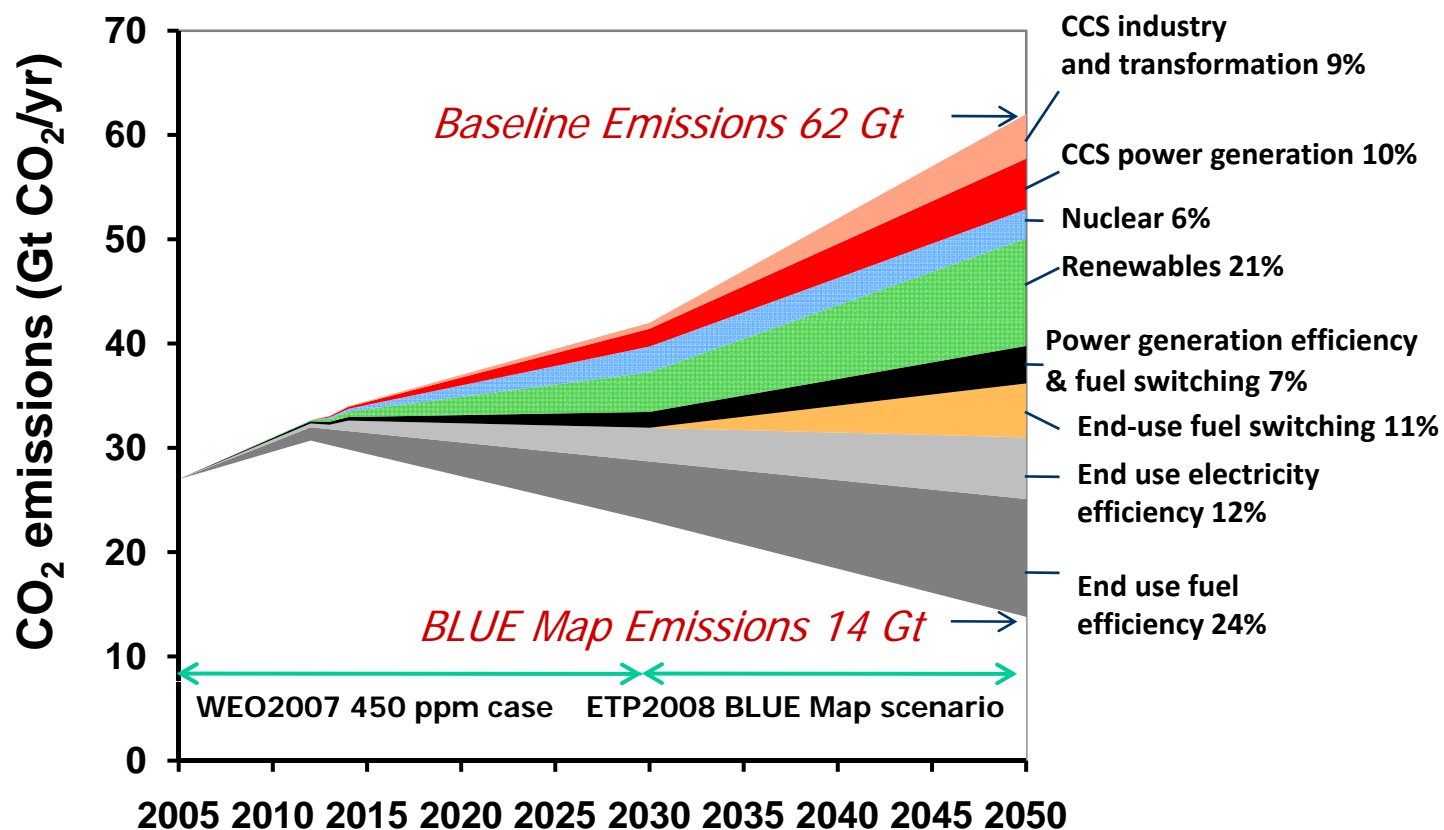
AGENCY

Blue Scenarios

- Energie CO₂ emissies gehalveerd in 2050, in vergelijking tot 2005
- Dit kan leiden tot stabilisatie van de CO₂ concentratie op het niveau van 450 ppm (afhankelijk van de emissies na 2050)
- Opties met kosten tot USD 200/t CO₂ (+80 USD/bbl oil)
 - Aanzienlijk hogere kosten met minder optimistische aannames
- Blue is onzeker, daarom zijn meerdere varianten geanalyseerd
- Blue vereist wereldwijde deelname
- Het resultaat is een compleet gewijzigd energiesysteem



Een Energie Revolutie: Hoe kunnen de emissies gereduceerd worden

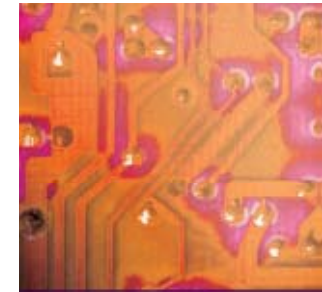


ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY

Gemiddelde Jaarlijkse Capaciteitsuitbreiding , 2010 – 2050 *Een Energie Revolutie*



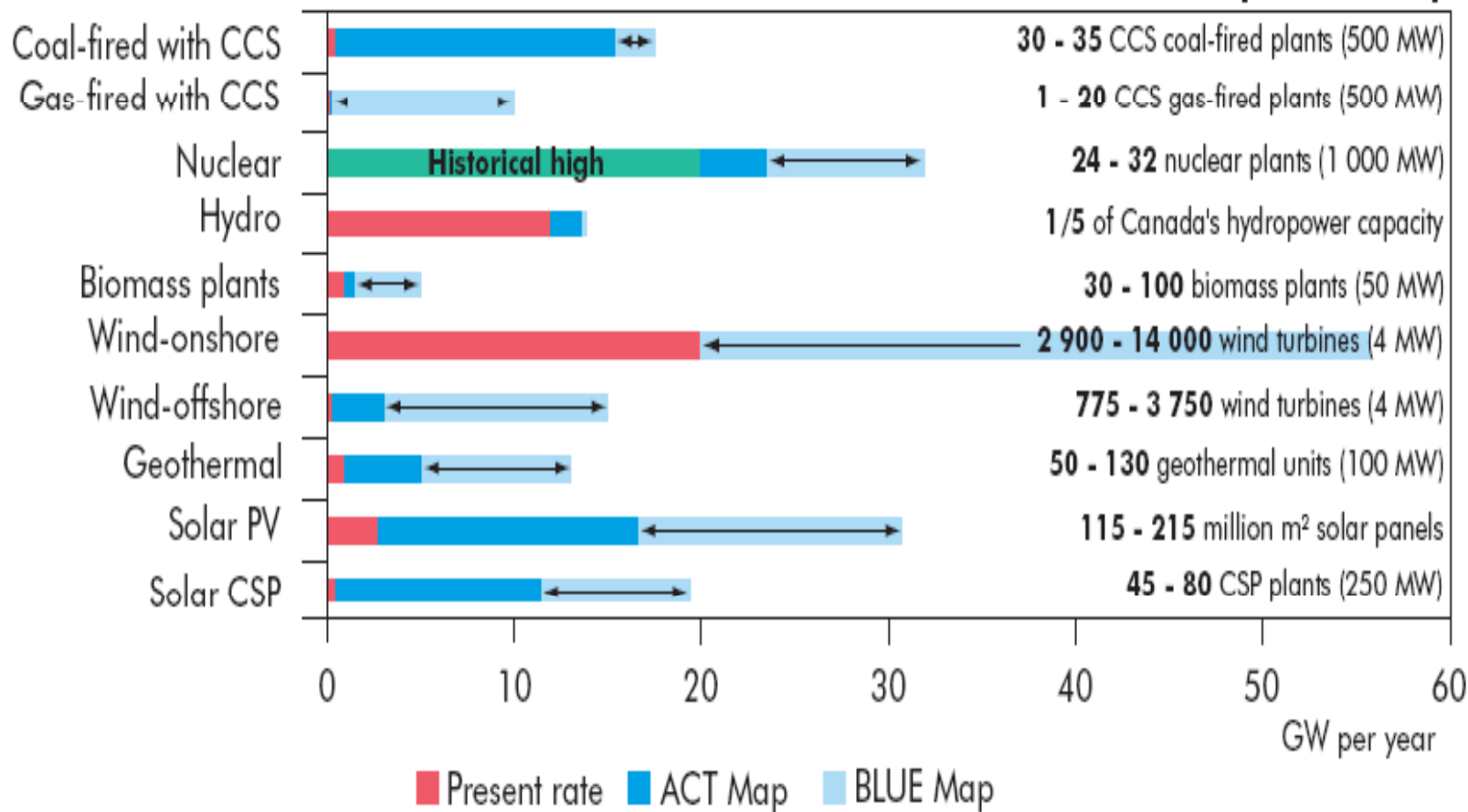
ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

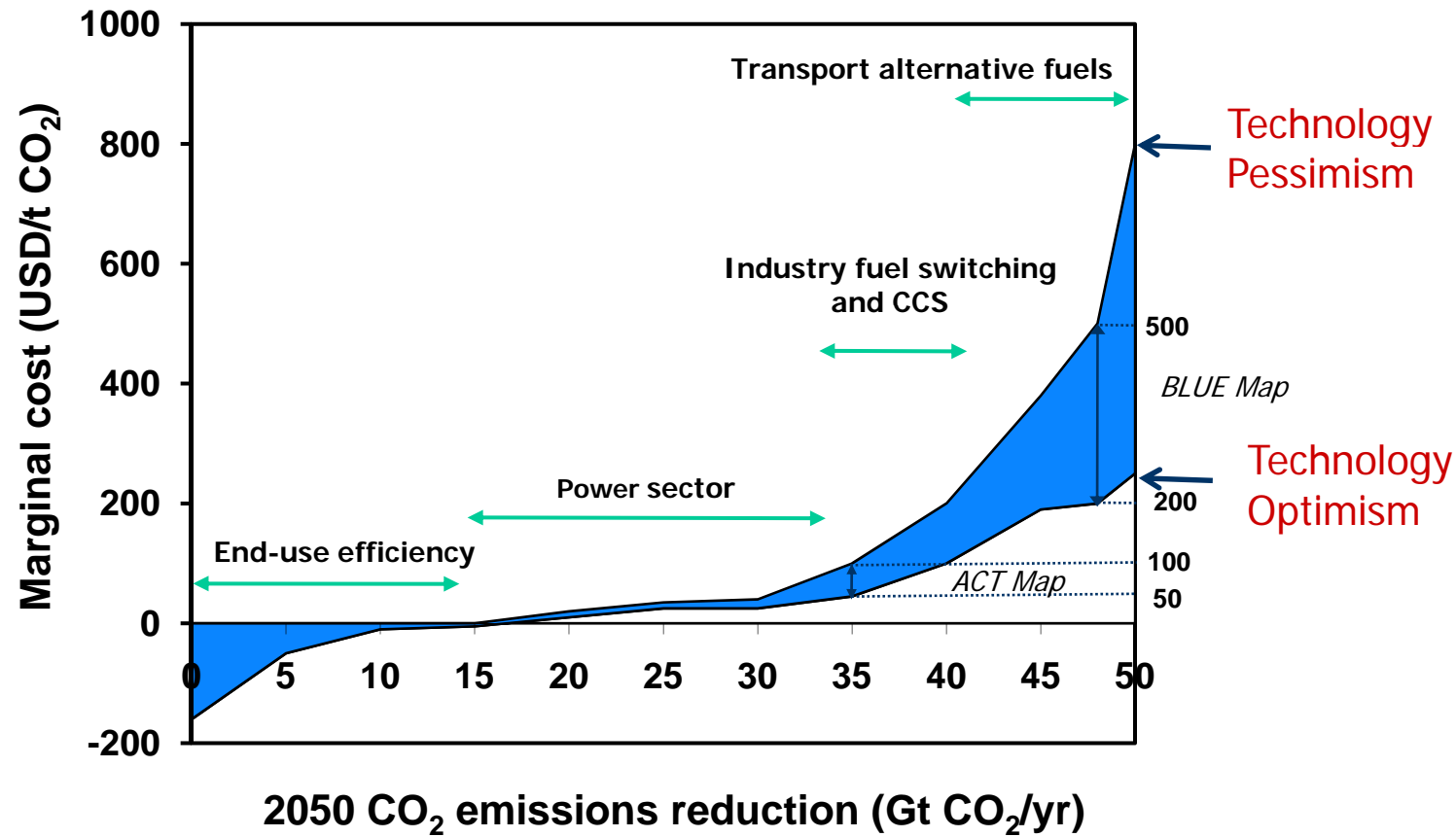


INTERNATIONAL
ENERGY
AGENCY

ACT Map - BLUE Map



De kosten van emissie reductie

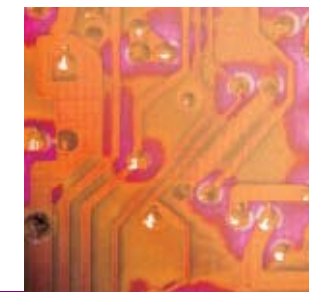


To bring emissions back to current levels by 2050 options with a cost up to USD 50/t are needed. Reducing emissions by 50% would require options with a cost up to USD 200/t, possibly even up to USD 500/t CO₂



Emissie Reducties

	ACT Map [%]	BLUE Map [%]	ACT Map [%]	BLUE Map [%]
Referentie	2005	2005	Baseline 2050	Baseline 2050
Electriciteitssector	-43	-71	-81	-90
Overige transformatie	16	-62	-51	-84
Transport	31	-30	-42	-69
Industrie	65	-21	-18	-60
Gebouwde omgeving	-2	-41	-36	-61
Totaal	2	-48	-57	-78



ENERGY
TECHNOLOGY
PERSPECTIVES

2008

Scenarios &
Strategies
to 2050

INTERNATIONAL

ENERGY



AGENCY

De Belangrijkste Opties (Roadmaps/transitiepaden)

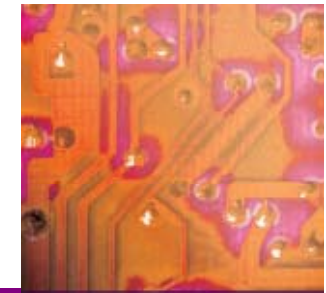
87% van de emissie reductie in BLUE Map

● Aanbodkant

- **CCS centrales**
- Kolen – IGCC
- Kolen – USCSC
- Kernenergie III + IV
- **Zon – PV**
- Zon – CSP
- Wind
- Biomassa – IGCC & bijstook
- 2^e generatie biobrandstoffen
- **Electriciteits netwerken**

● Vraagkant

- Energie efficiëntie in gebouwen
- Energy efficiëntie in motor systemen
- Efficiënte verbrandingsmotoren
- Warmtepompen
- **Plug-ins and elektrische voertuigen**
- Brandstofcellen
- Industrieel CCS
- Zon – verwarming
- **Cement**



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL

ENERGY

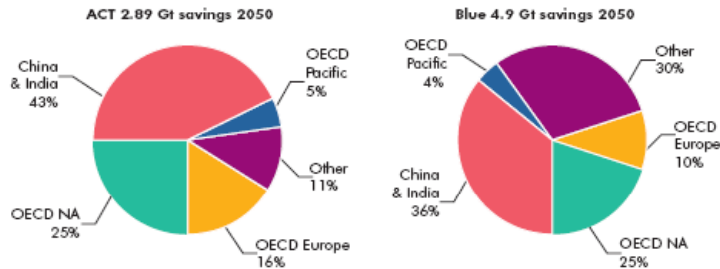


AGENCY

Roadmap – CCS

10% van het CO₂ reductie potentieel in BLUE Map

CO₂ Capture and Storage - Fossil-Fuel Power Generation

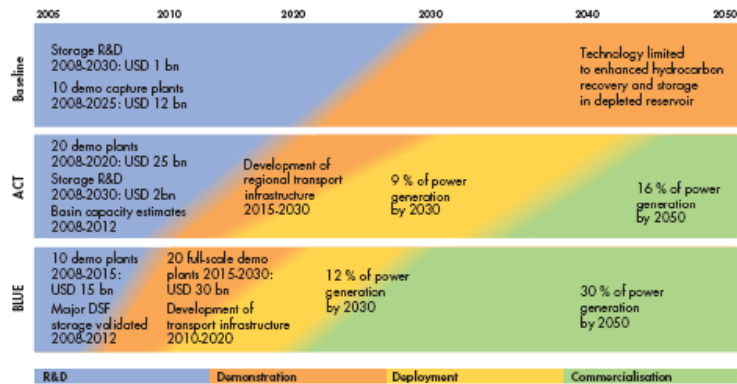


	Global Deployment Share 2030	RDD&D Inv. Cost USD bn 2005-2030	Commercial Inv. Cost* USD bn 2030-2050		Global Deployment Share 2030	RDD&D Inv. Cost USD bn 2005-2030	Commercial Inv. Cost* USD bn 2030-2050
OECD NA	35%	25-30	160-180	OECD NA	35%	30-35	350-400
OECD Europe	35%	25-30	100-120	OECD Europe	35%	30-35	150-200
OECD Pacific	10%	7-8	30-40	OECD Pacific	10%	10-12	70-80
China & India	15%	10-12	280-300	China & India	15%	12-14	450-500
Other	5%	3-4	60-70	Other	5%	4-5	300-350

Technology Targets

	ACT: Emissions Stabilisation	BLUE: 50% Emissions reduction
RD&D	Technologies tested in small- and large-scale plants. Cost of CO ₂ avoided around 50 USD/t by 2020. Chemical looping tested	
Capture technologies for three main options (post-combustion, pre-combustion, and oxy-fuelling)		
Demonstration targets	20 large-scale demo plants with a range of CCS options, including fuel type (coal/gas/biomass) by 2020	30 large-scale demo plants with a range of CCS options, including fuel type (coal/gas/biomass) by 2020
New gas-separation technologies: membranes & solid adsorption	New capture concepts: next-generation processes, such as membranes, solid absorbers and new thermal processes	
Technology transfer	Technology transfer to China and India	Technology transfer to all transition and developing countries
Deployment	Major transportation pipeline networks developed and CO ₂ maritime shipping	
Regional pipeline infrastructure for CO ₂ transport		
Deployment targets	Early commercial large-scale plants by 2015 (ZEP, ZeroGen, GreenGen)	30% of electricity generated from CCS power plant

Technology Timeline

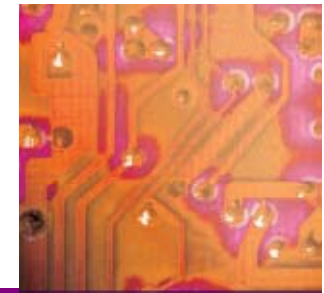


Key Actions Needed

- Develop and enable legal and regulatory frameworks for CCS at the national and international levels, including long-term liability regimes and classification of CO₂.
- Incorporate CCS into emission trading schemes and clean development mechanisms.
- RD&D to reduce capture cost and improve overall system efficiencies.
- RD&D for storage integrity and monitoring. Validation of major storage sites. Monitor and valuation methods for site review, injection & closure periods.
- Raise public awareness and education on CCS.
- Assessment of storage capacity using Carbon Sequestration Leadership Forum methodology at the national, basin and field levels.
- New power plants built after 2020 to have CCS.
- New power plants to be "capture-ready" after 2015.

Key Areas for International Collaboration

- Development and sharing of legal and regulatory frameworks.
- Develop international, regional and national instruments for CO₂ pricing, including CDM and ETS.
- Raise public awareness and education.
- Sharing best practices and lessons learnt from demonstration projects (pilot and large-scale).
- Joint funding of large-scale plants in developing countries by multi-lateral lending institutions, industry and governments.
- Development of standards for national and basin storage estimates and their application.
- Organizations: CSLF, IEA GHG, IEA CCC, IPCC.

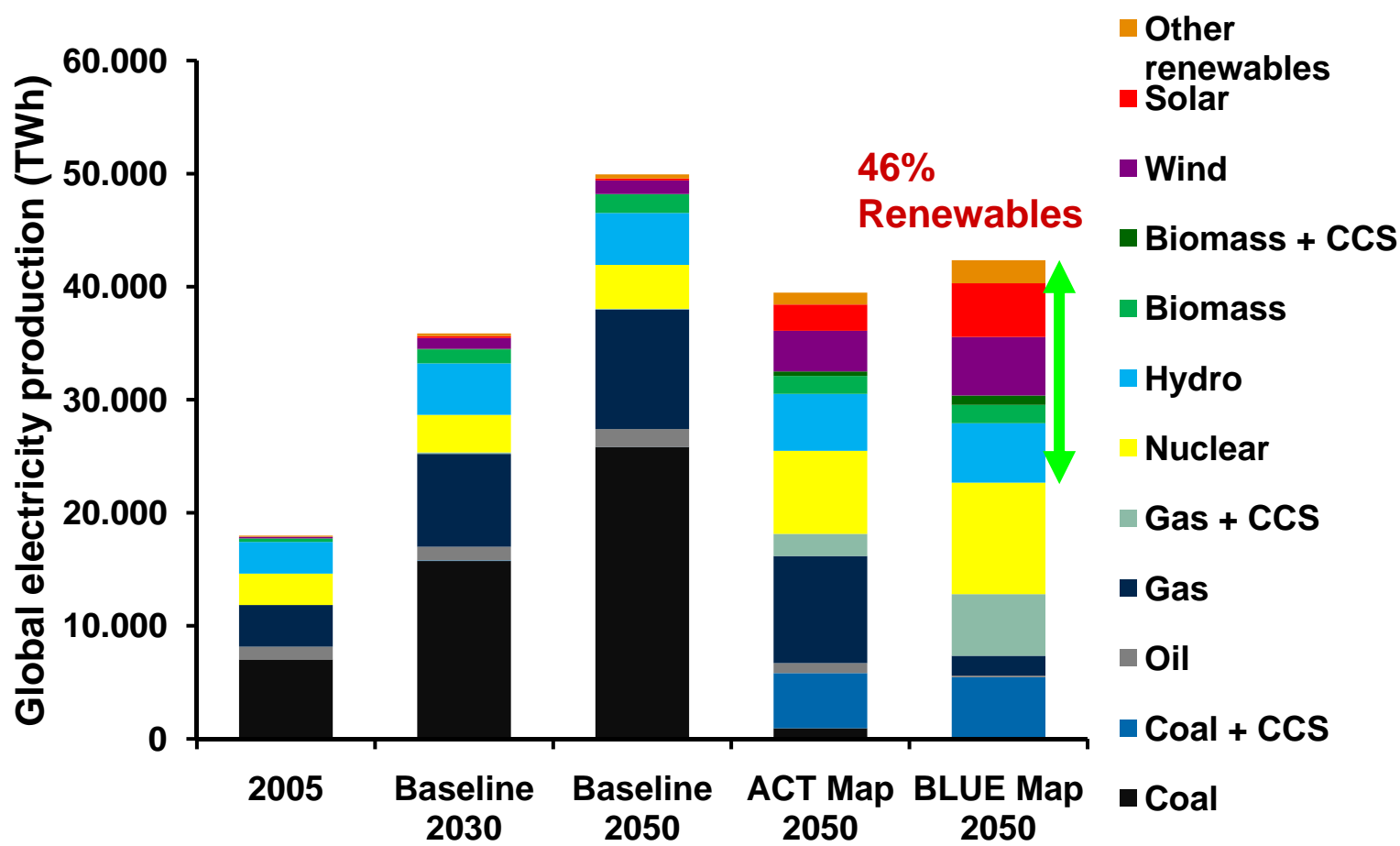


Additionele Investeringsen

- BLUE USD 45 000 miljard (1.1% of GDP);
ACT USD 17 000 miljard
- Met name investeringen aan de vraagkant (80%)
- Ongedisconteerde brandstofbesparingen
BLUE USD 51 000 miljard (2010-2050)
 - Marktprijzen of productiekosten ?
- Het probleem voor BLUE is de verdeling van kosten en baten
- Groei van additionele investeringen
 - USD +10 to +100 bln/jr OOD
 - USD +100 to +200 bln/jr learning investments
 - USD +1000 to +2000 bln/yr commerciële investeringen (lange termijn)



Electriciteitsopwekking



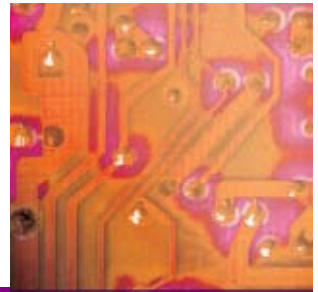
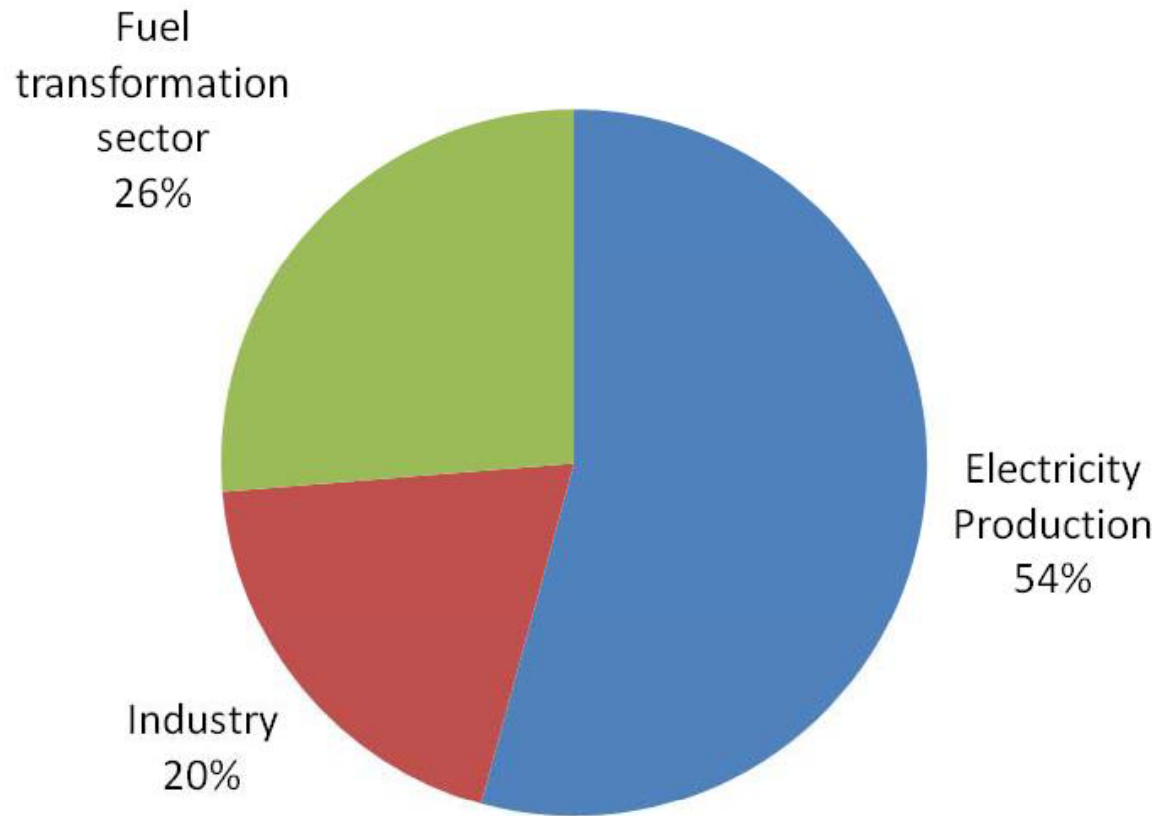
ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY

CO₂ afvang en opslag in BLUE Map

BLUE Map 10.4 Gt CO₂ captured



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

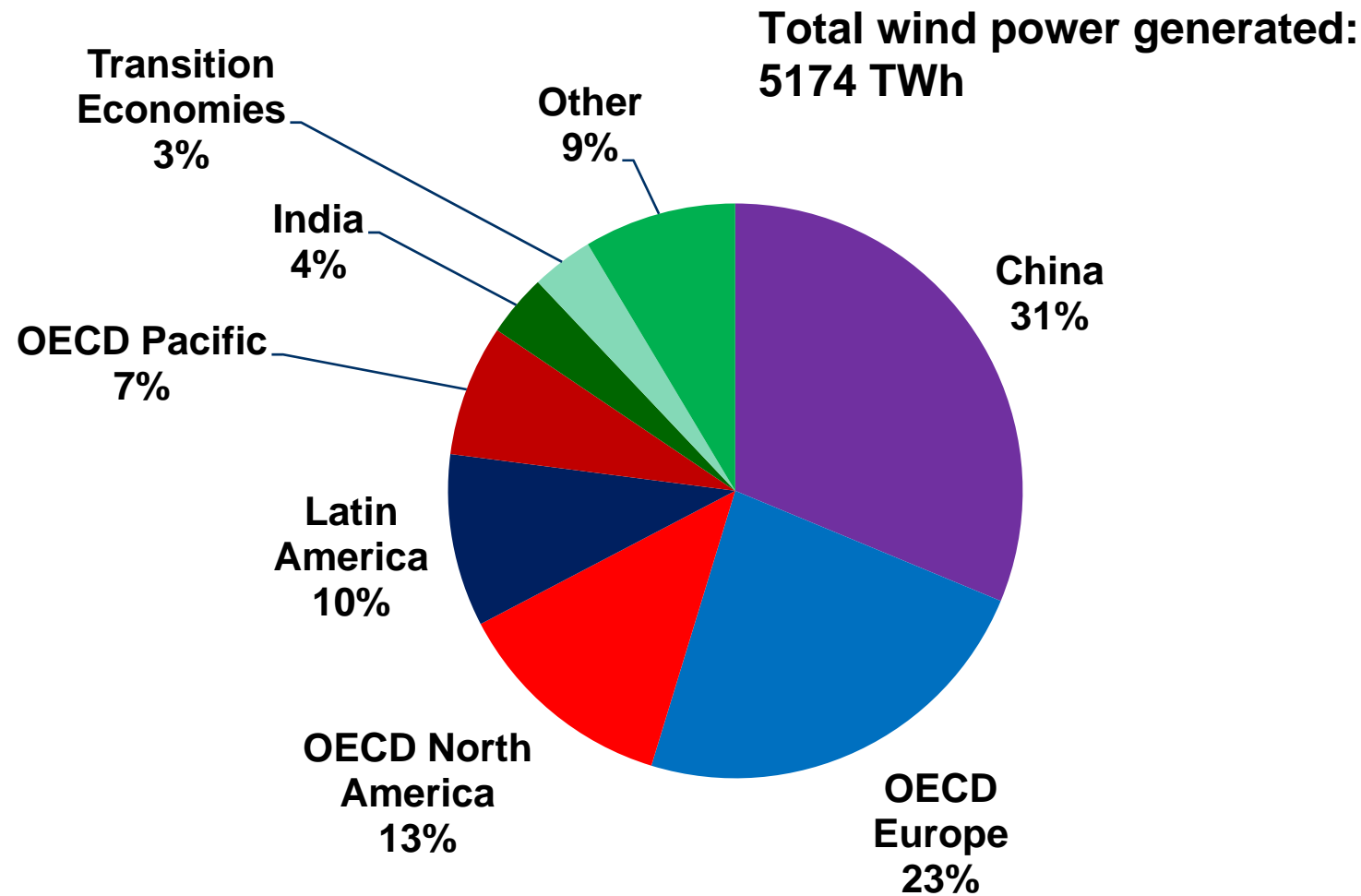
INTERNATIONAL

ENERGY



AGENCY

Wind: Electriciteitsopwekking per Regio, BLUE Map Scenario, 2050

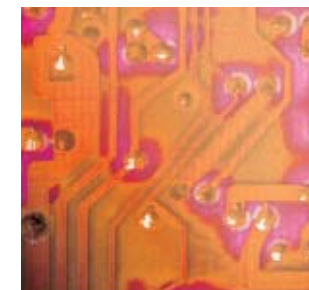
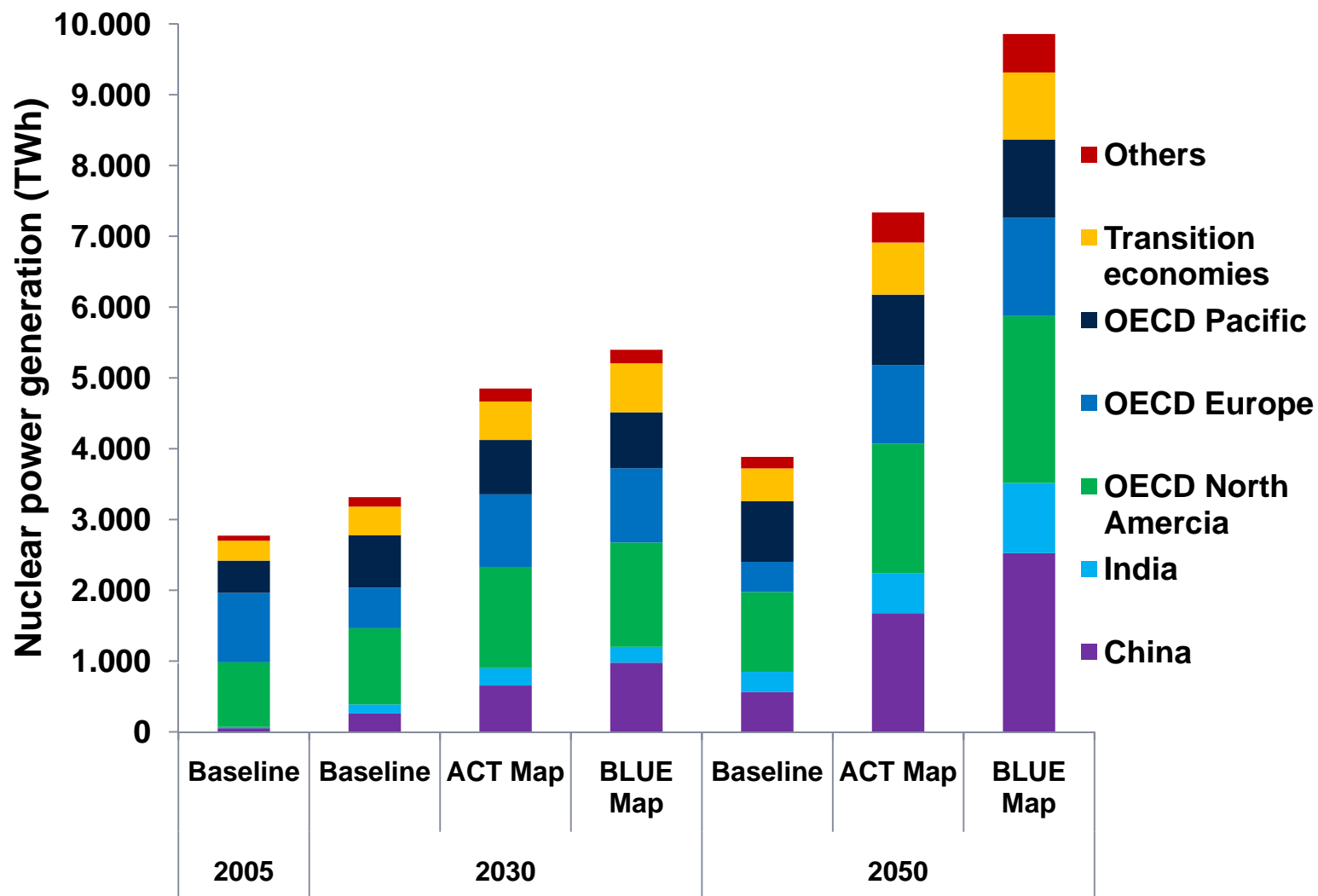


ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios & Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY

Projecties voor Kernenergie



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

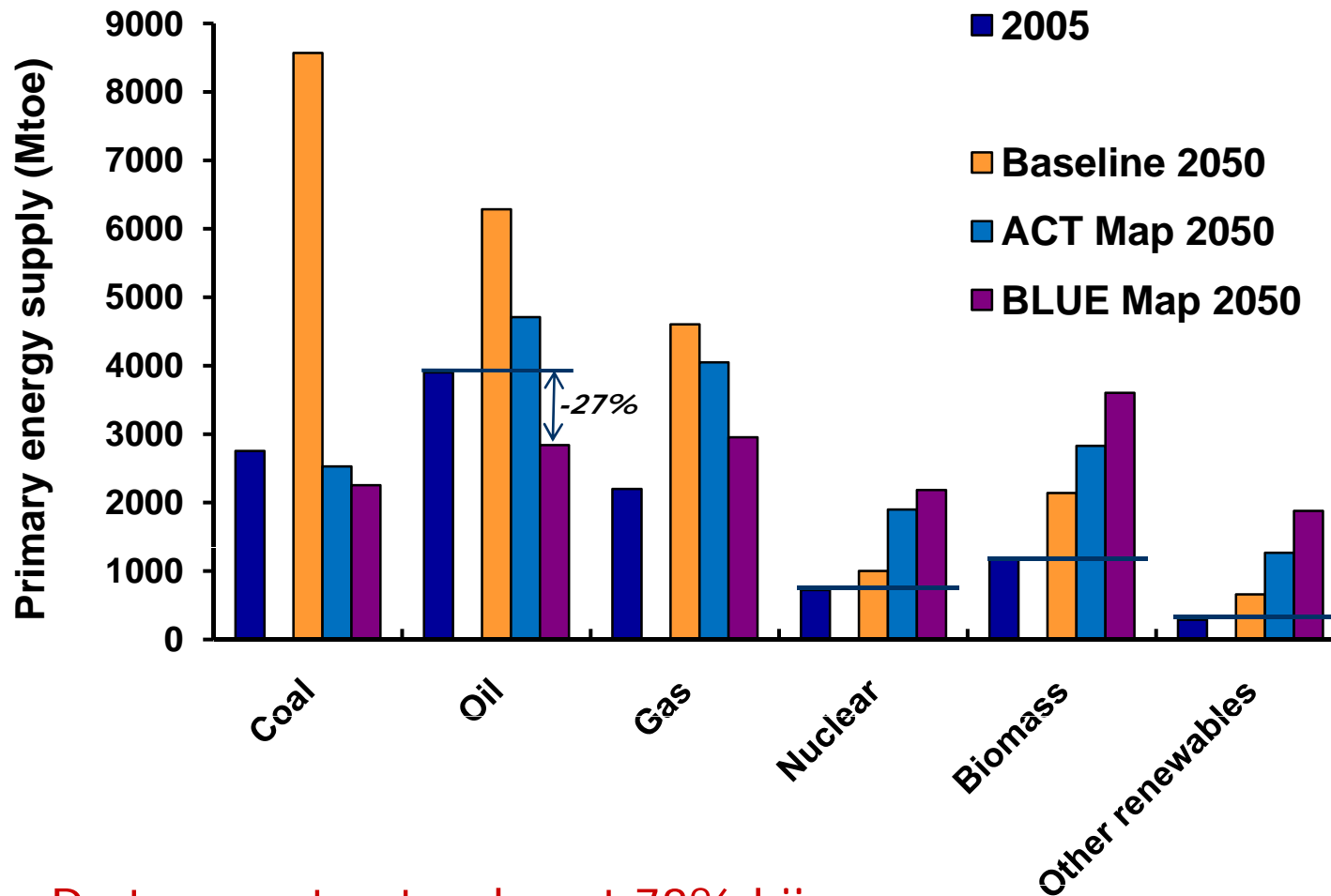
Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY

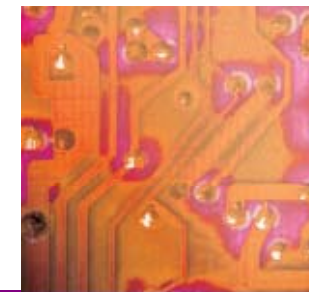


Primaire Energievraag

Belangrijke voordelen voor de voorzieningsveiligheid



De transportsector draagt 78% bij aan de besparing op het oliegebruik



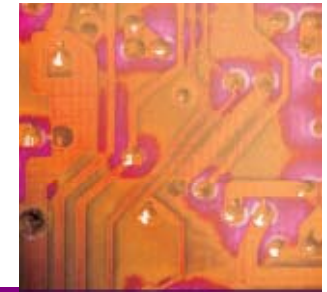
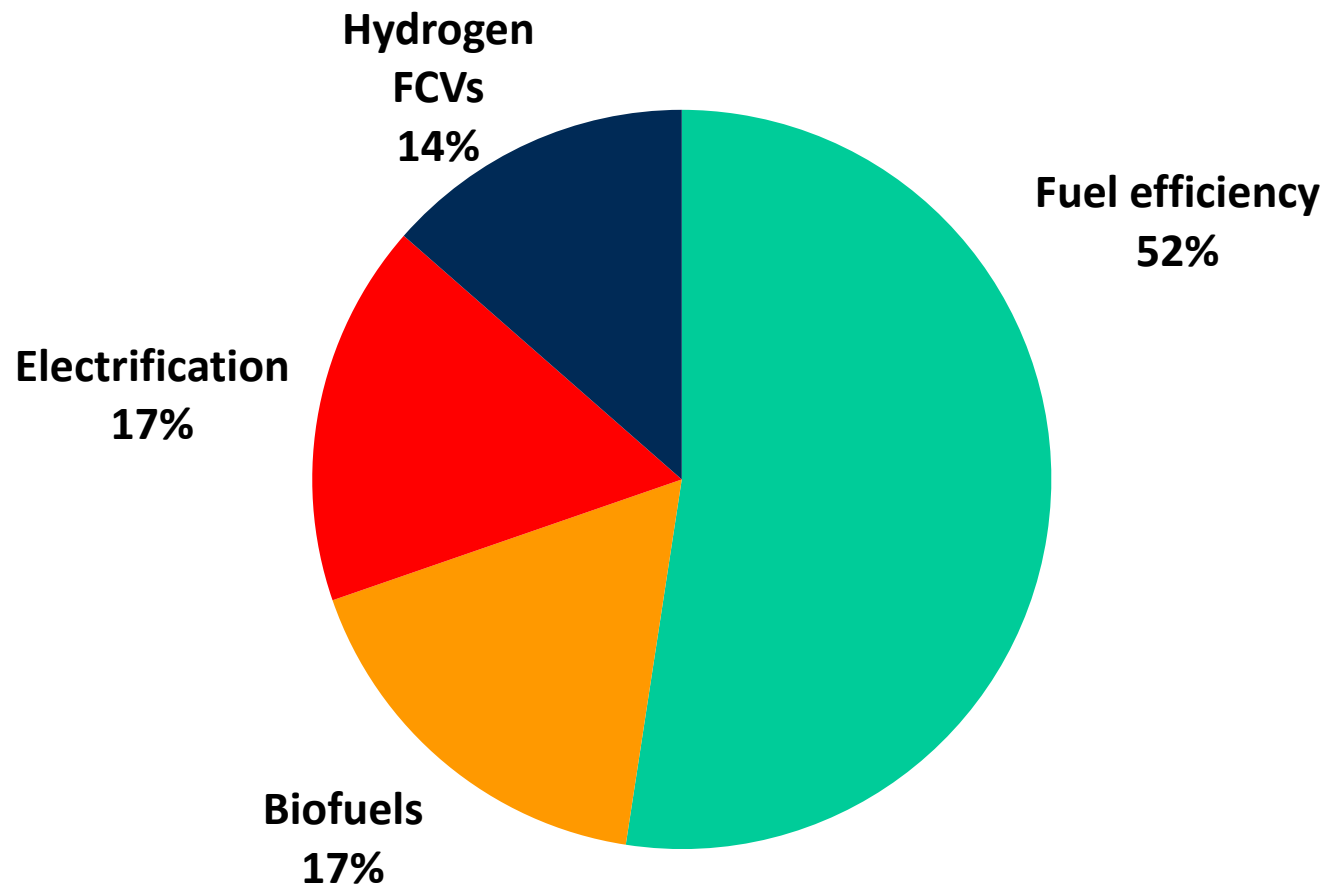
ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios & Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY 

Transport Sector Emission Reducties

BLUE Map 12.5 GtCO₂ reduction



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

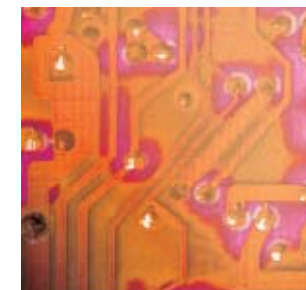
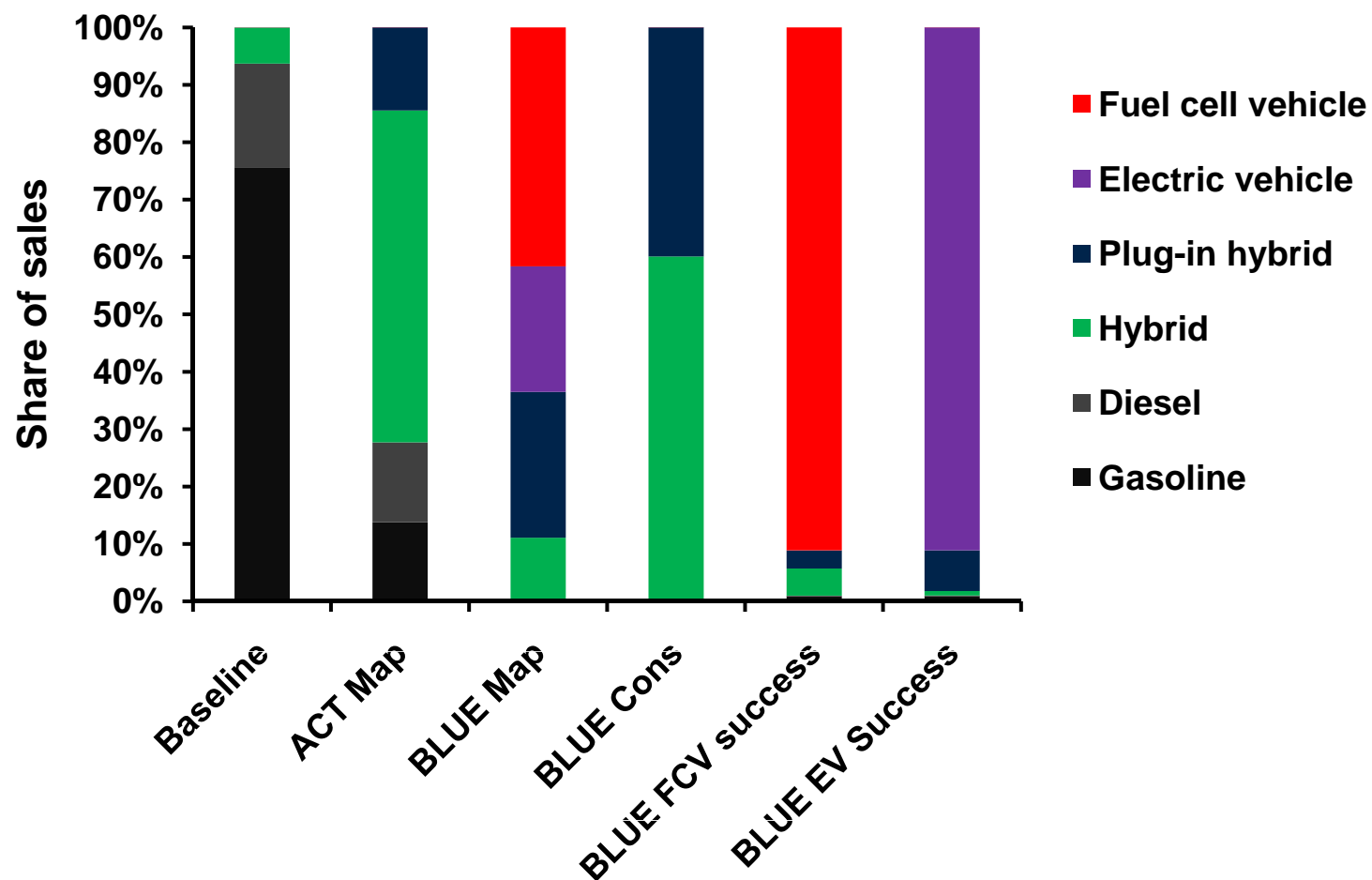
INTERNATIONAL

ENERGY



AGENCY

Auto's: Marktaandeelen in 2050



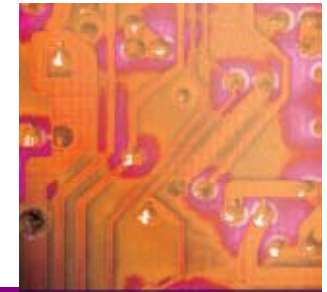
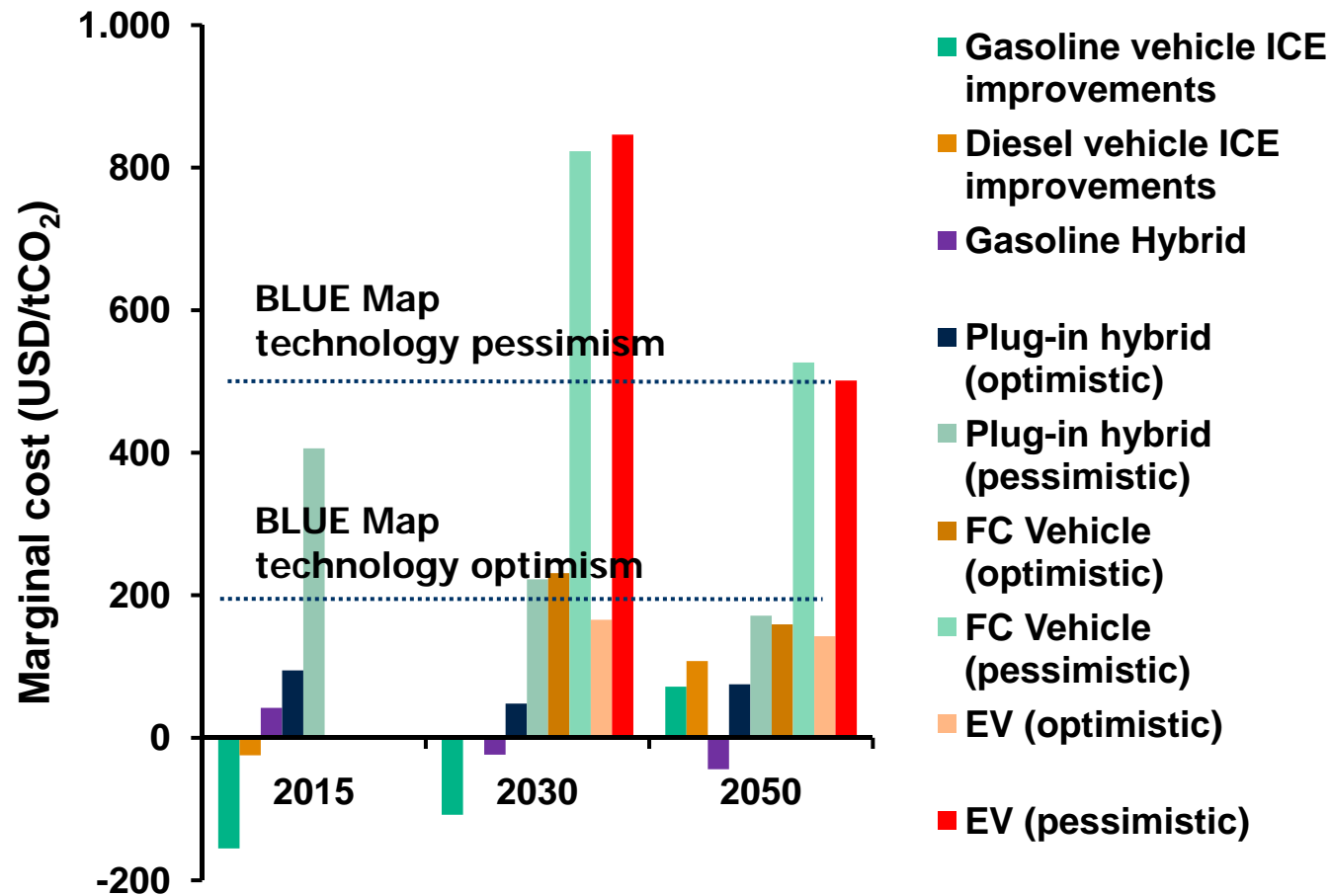
ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY



Personenauto's Kosten per ton CO₂



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

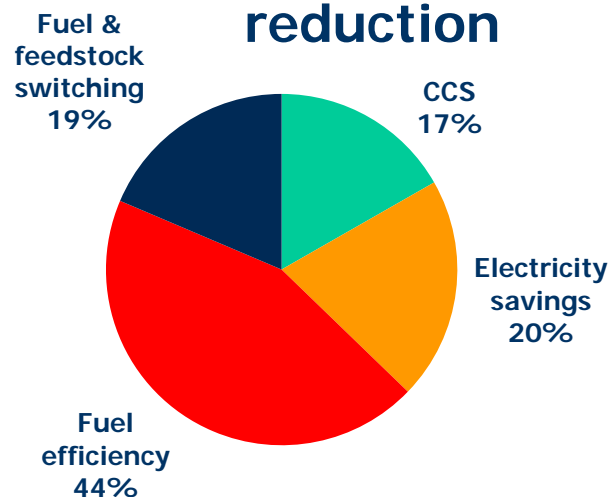
Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY

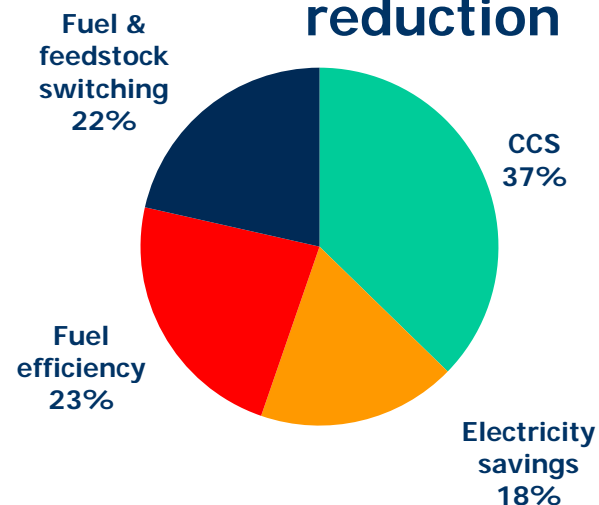


Industriële Emissie Reducties

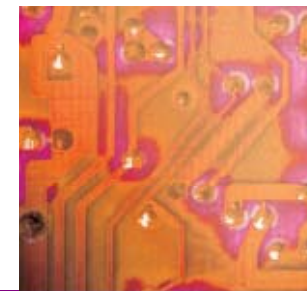
ACT Map 4.3 GtCO₂ reduction



BLUE Map 9.8 GtCO₂ reduction



CCS speelt een sleutelrol



ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

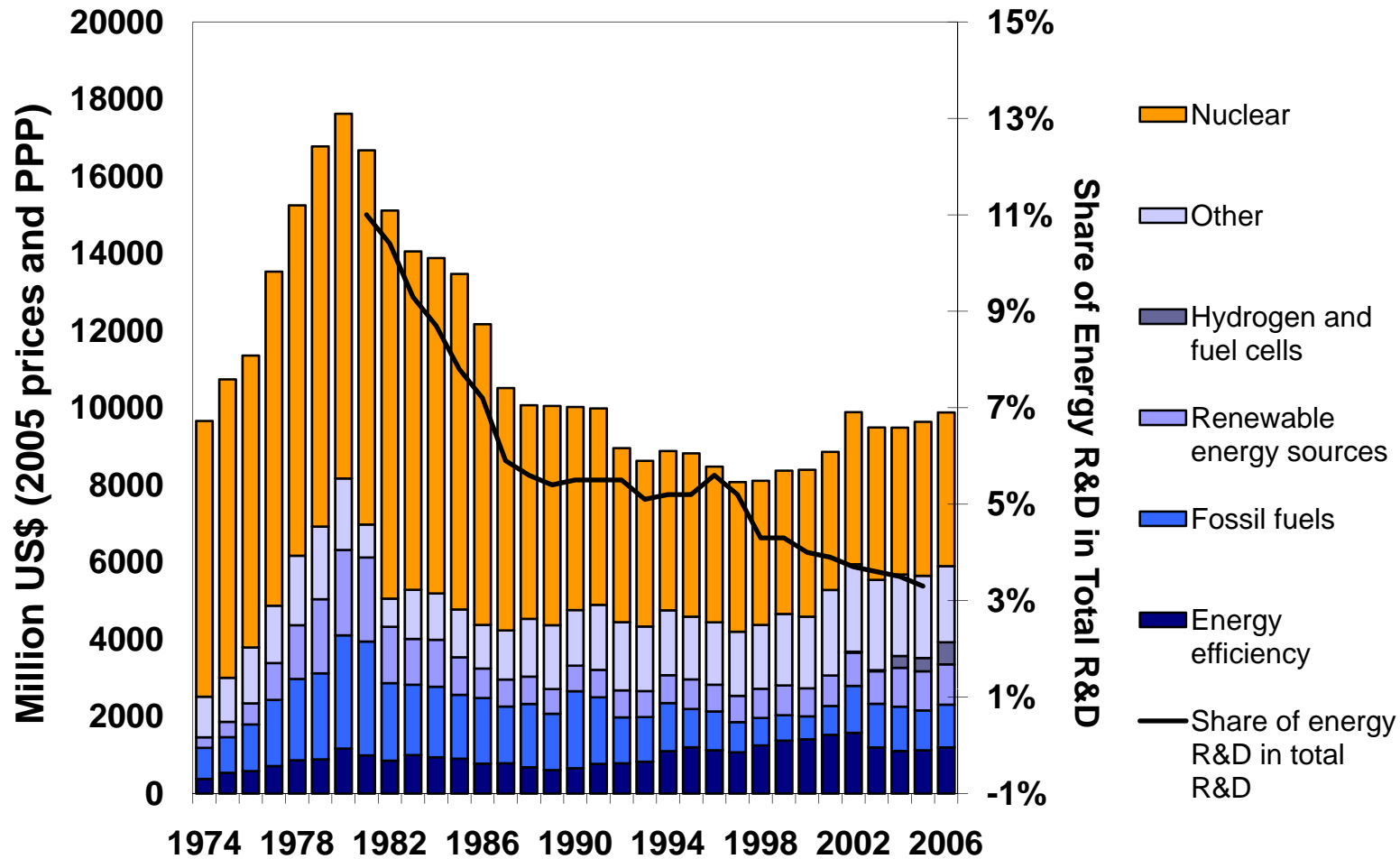
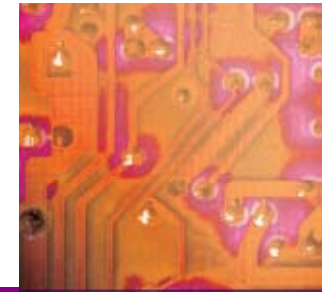
INTERNATIONAL

ENERGY



AGENCY

Overheidsuitgaven voor Energie OO&D in IEA Landen – USD 10 mld per jaar



ENERGY
TECHNOLOGY
PERSPECTIVES
2008
Scenarios &
Strategies
to 2050

INTERNATIONAL
ENERGY
AGENCY



Conclusies

- Sterke reducties van emissies zijn technisch mogelijk
- Dit vereist een wereldwijde energierevolutie
 - Ontwikkelingslanden maken deel uit van de oplossing
- Deze transitie is urgent
 - Barrieres: financiering; levensduur kapitaalgoederen; tijdsfad van technologische ontwikkeling
 - Het IEA technologie netwerk kan een basis vormen voor internationale samenwerking tav transitiepaden



Suggesties for Europa en Vlaanderen

- Participeer in de IEA roadmap/transitie analyse
- Meer nadruk op internationale samenwerking in energietechnologie
 - Toegang en RD&D capacity building
- Geloofwaardige lange-termijn doelstellingen voor industrie and de electriciteitssector
- Publieke acceptatie
- Technologieontwikkeling
 - CCS: demo's & industriële toepassingen, CO₂-EOR Noordzee, oxyfuelling
 - Electriciteitssector: netwerken, opslag
 - Transport: 2e generatie biobrandstoffen, meer aandacht voor batterijen
 - Energiebesparing: implementatie, motor systemen
 - Gebouwen: warmtepompen, zonneboilers
 - Industrie: materiaal efficiency, biomassa grondstoffen



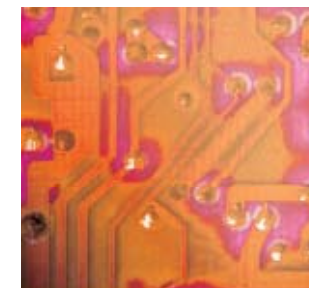
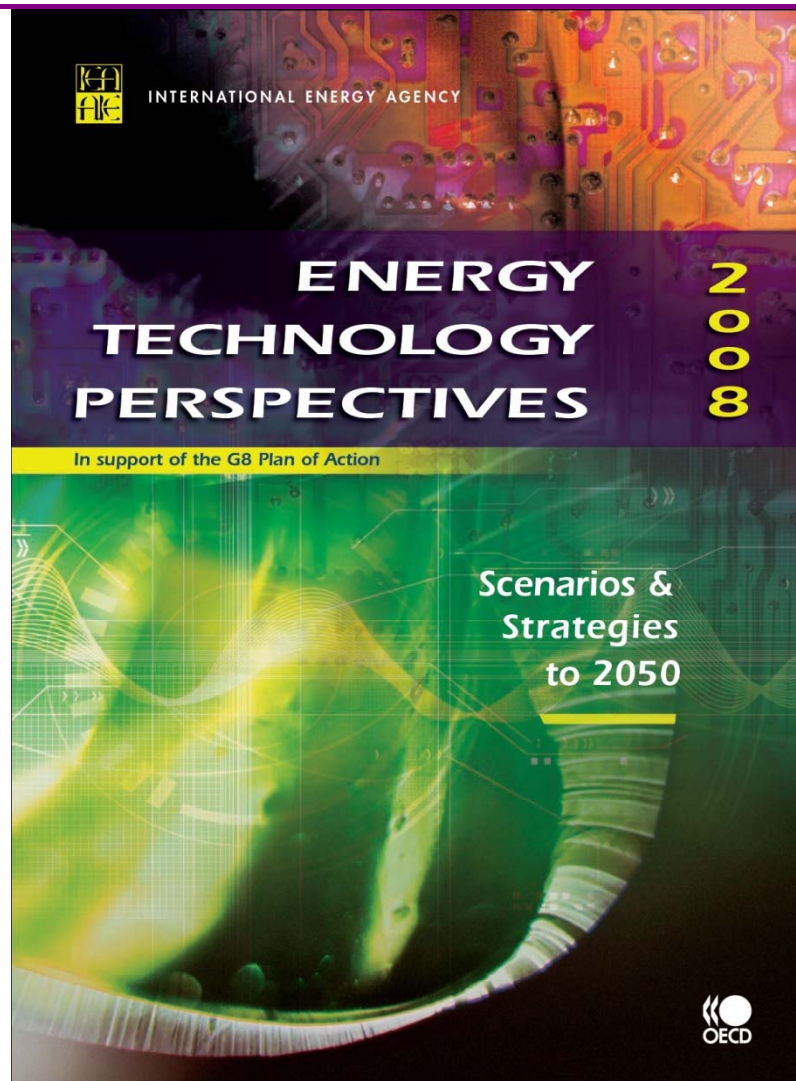
Hoe verder?

- **Uitwerking transities/roadmaps**
- **Drie sector publicaties**
 - Gebouwen, Industrie, Transport
- **Analyse van OOD**
 - Hoeveel moet geïnvesteerd worden ?
 - Wat zijn de hiaten ?
- **Vorbereiding ETP2010**
 - Meer gedetailleerde landen/regio analyse ?



www.iea.org

In support of the G8 Plan of Action



*ENERGY
TECHNOLOGY
PERSPECTIVES*
2008

*Scenarios &
Strategies
to 2050*

INTERNATIONAL
ENERGY AGENCY 

© OECD/IEA - 2008