CHULALONGKORN UNIVERSITY
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Systemic Approach to Sustainability Transition From Top-down and Bottom-up:
System & Technology Innovation & Societal Transformation

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Springer Briefs in Environment, Security, Development & Peace
SpringerBriefs on Pioneers in Science & Practice

UNITED NATIONS UNIVERSITY
UNU-EHS
Institute for Environment and Human Security

Freie Universität Berlin

Contents

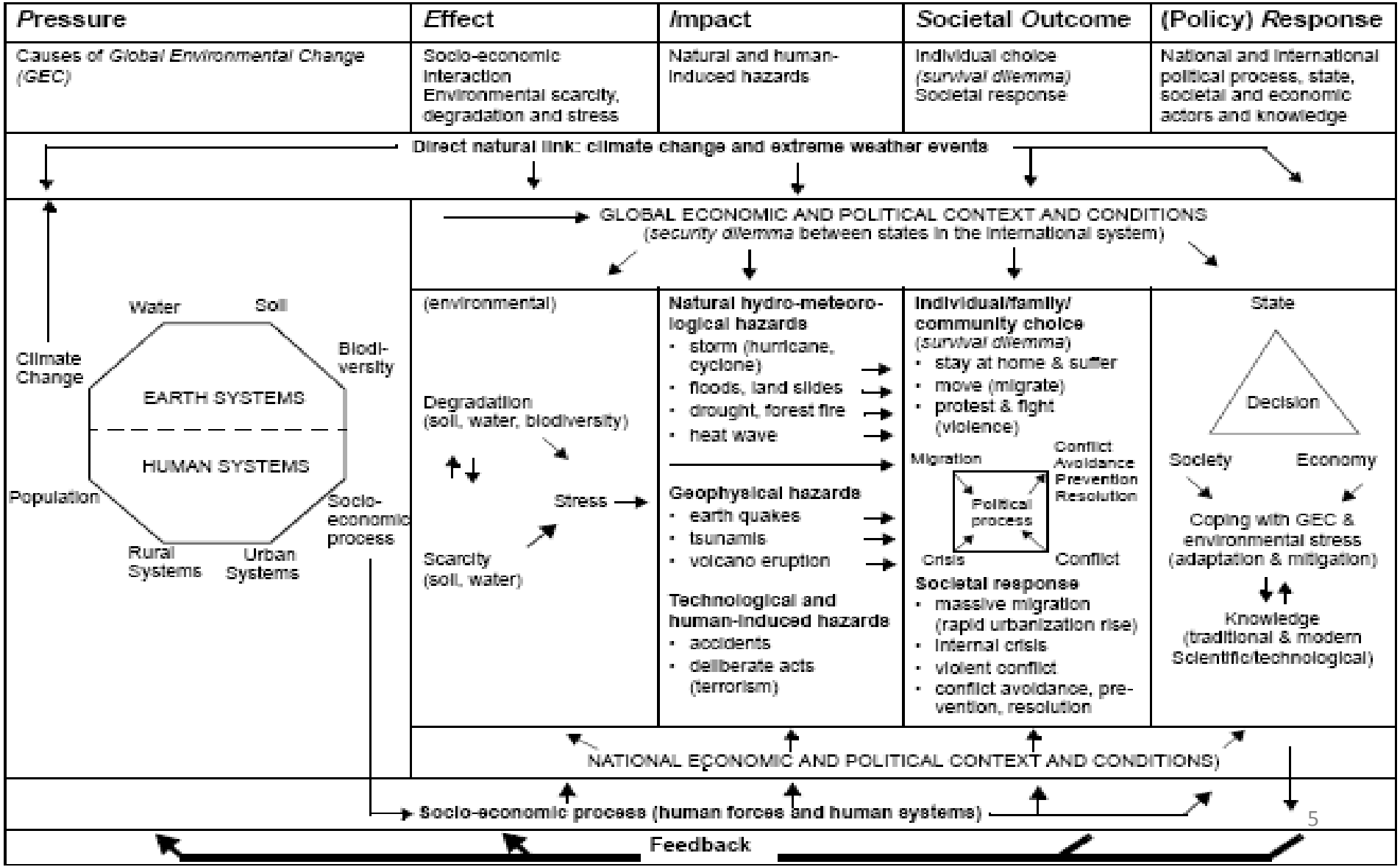
1. Introduction

- **Sustainability Transition** is a **Research Programme** which emerged in the Netherlands (DKI, 2005-2010) and spread in Europe and globally through annual conferences of the Sustainability Transition Research Network (**STRN):** Amsterdam(2009), Lund(2011); Copenhagen(2012), Zuerich(2013) and Utrecht(2014 with ca.750 global members
- It addresses both **systemic approaches** to Sustainability Transition: from **Top-down and Bottom-up** (this talk) and on the **demand side** (human preferences) & **supply side** (sectoral transition): next talk.
- **My interest is educational** to foster global education, research and policy debates and to prepare a handbook with Ursula Oswald Spring, John Grin (co-chair, Dutch Knowledge network DKI), Juergen Scheffran
  - **Handbook on Sustainability Transition and Sustainable Peace** (2015)
  - publish books on **Sustainable Development** & **Sustainability Transition (SDST)**
  - **foster academic education & research globally (to give more voice & visibility to scholars in the global South), increase global recognition of Thai scholars**

1.1 Challenge and Policy Response: Energy Sector & Global Environmental Change

- **Cause of Greenhouse Effect:** Anthropogenic burning of hydro carbon energy sources: coal, oil (petrol) & natural gas
- **Effect:** Increase on Greenhouse Gases
- **Impacts:** Increase in Number & Intensity of Hydrometeorological Hazards (Cyclones, floods, droughts)
- **Policy Response:** Reduce emissions by a) increasing energy efficiency and b) decreasing of fossile energy sources
- **Sustainability Transition is possible & taking place: a Case Study of „Energiewende“ in Germany**

1.2 Global Environmental Change & Impacts: PEISOR Model



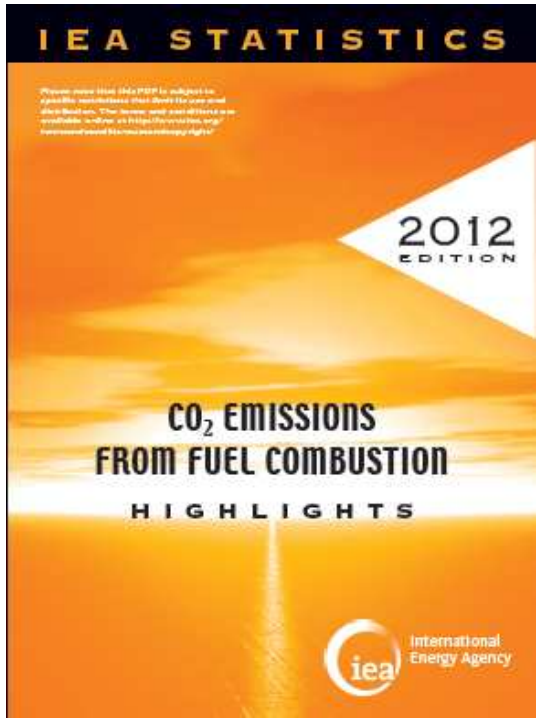
1.3 Responding to GHG Emissions: Sustainability Transition in the Energy Sector

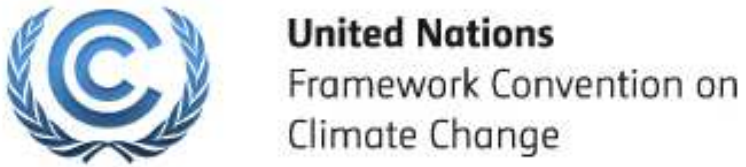
- **Policy Response of the Peisor Model: to Address the cause: Anthropogenic Climate Change**
- **Energy Sector: Major Contributor of GHG, CO2 is the most important GHG**
- **3 Key Policy Goals:**
  - **Reduce GHG Emissions**
  - **Use less energy: efficiency improvement in production process and in goods used**
  - **Use non-fossil energy sources: renewables: wind, solar, biomass, geothermal, wave energy**
  - **Produce the energy where the output is highest: concentrated soalr energy from deserts, offshore wind**

1.4. Case Study of Germany: Sustainable Energy Transition since 1990

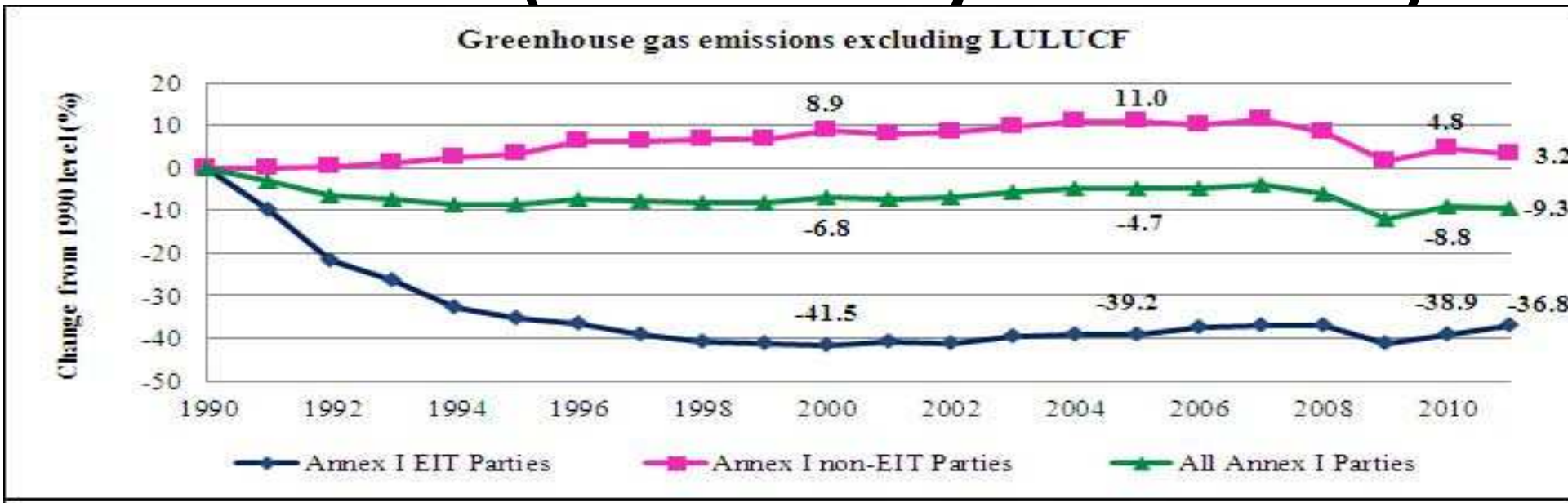
- Response to Arab & OPEC Oil shocks (1973, 1979)
- USA: President Carter: Project Independence (1977)
- USA: leader to laggards
  - Reagan, Bush Administrations cut subsidies: collapsed
  - Clinton & Obama Adminsitrations: pushed renewables
- Early 1990: Japan MITI ambititious goals: Moonshine programme (1991-2020), nuclear lobby (interest, mindset)
- Germany: strong nuclear programme, public opposition since late 1970s in south (Whyl), north Germany (Brokdorf)--> Greens
  - Research program: AEG et al. (big companies, failure)
  - Small family-owned companies: e.g. Enercon where innovators
  - Public awarness & support, instruments, incentives
  - Interaction of top-down and buttom-up initiatives

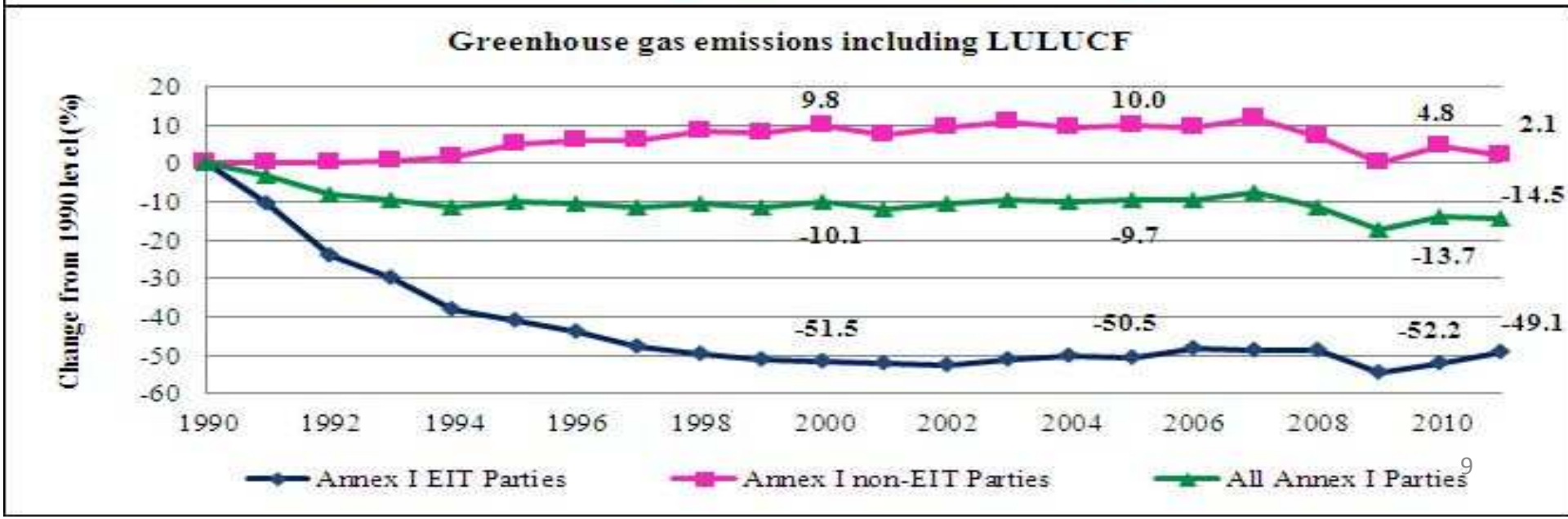
2. Global Greenhouse Gas Emissions & Energy Sector (2013)



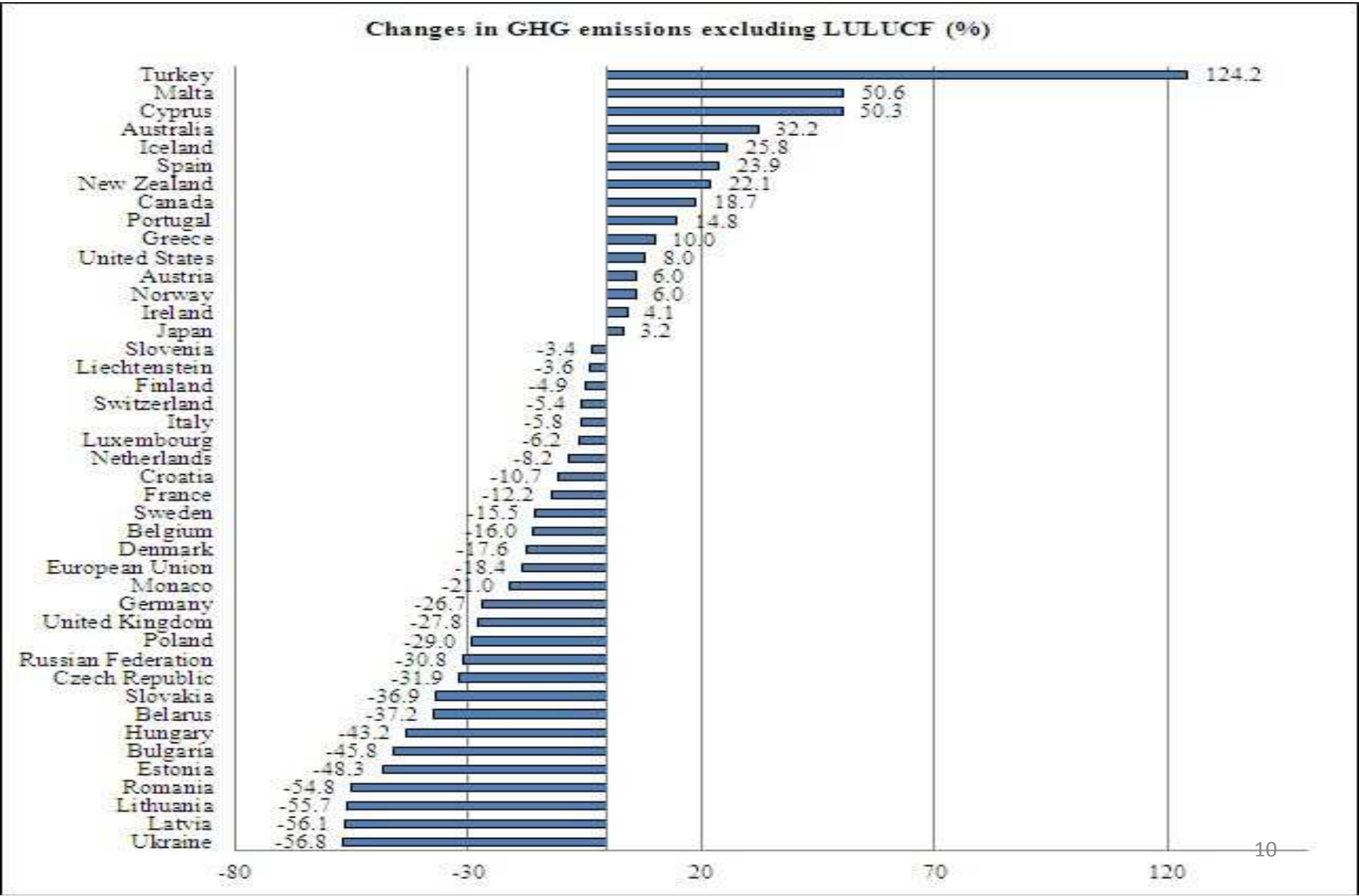


2.1. UNFCC Data on Annex-I Countries (2013): 1990-2010 (EIT: Economy in Transition)

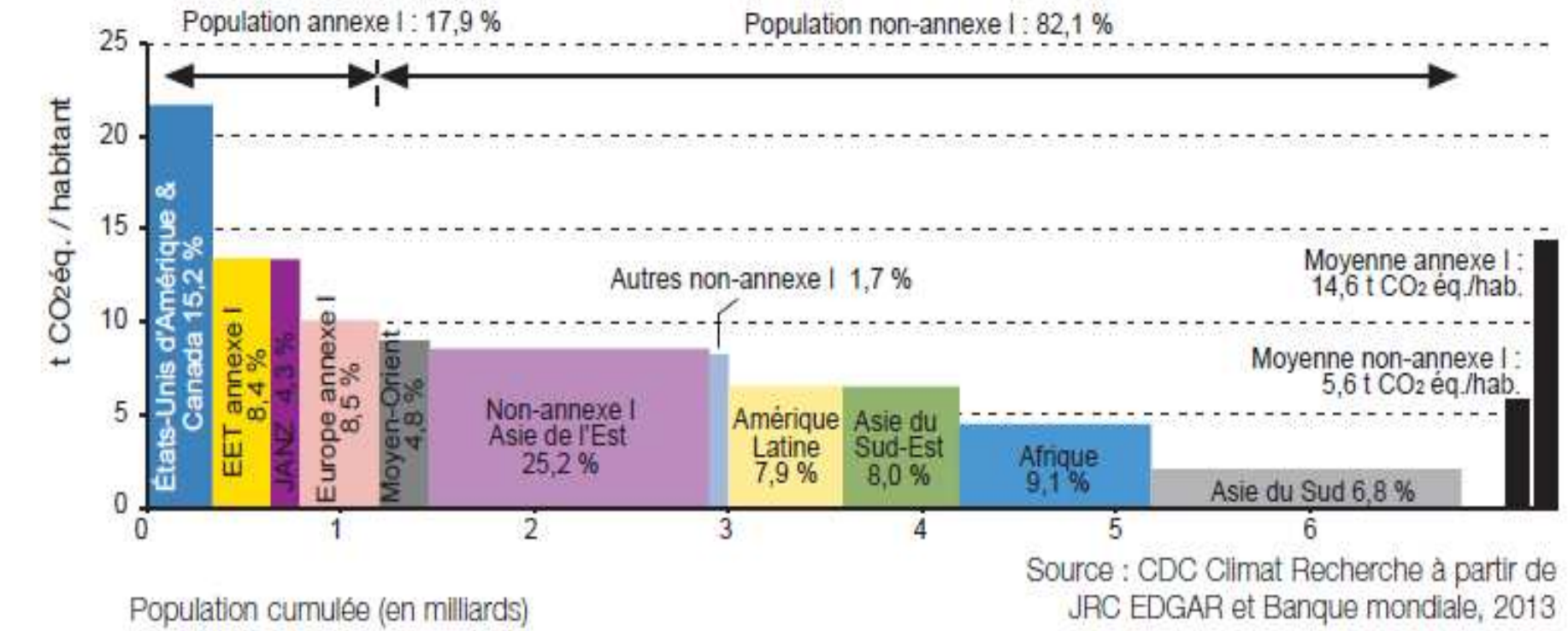




2.2. UNFCC Data on Annex-I Countries (28.10.2013) GHG Emissions excluding LULUCF (%)



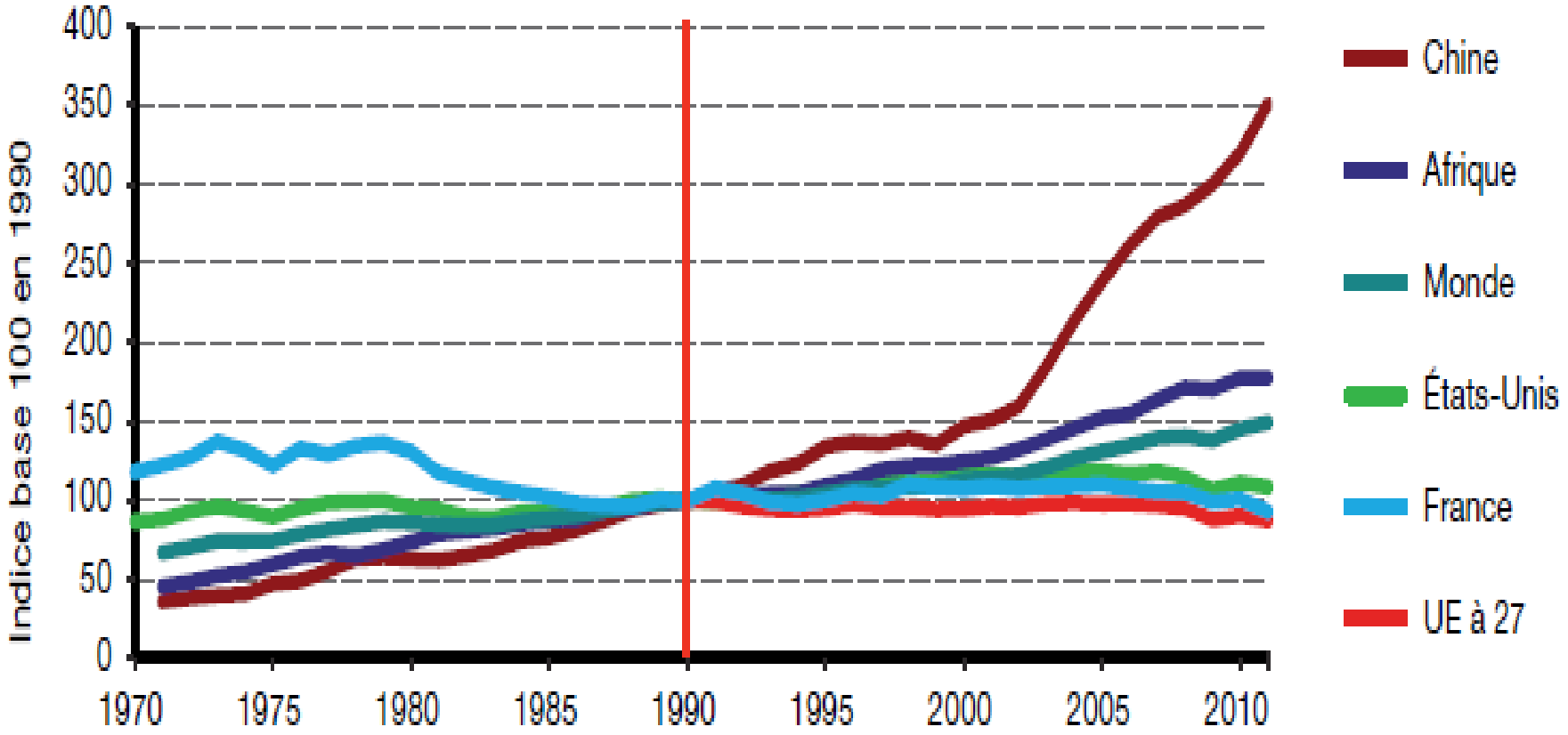
2.3. Global GHG Emissions by Region/cap (2010)



Le pourcentage indiqué correspond à la part des régions dans les émissions mondiales de GES.
EET : Économies en transition, JANZ : Japon, Australie, Nouvelle-Zélande.

2.4 Global CO2 Emissions (1970-2010)

Émissions de CO_2 dues à la combustion d'énergie[1] dans le monde



Source : Agence internationale de l'énergie, septembre 2013

2.5. CO2 Emissions by region/country (1990-2011)

En Mt CO_2

	1990	2010	2011	Part 2011 (%)	Évolution (%) 2011/2010	Évolution (%) 2011/1990
Amérique du Nord	**5 562**	**6 375**	**6 249**	**19,9**	**– 2,0**	**+ 12,4**
dont : Canada	428	528	530	1,7	+ 0,4	+ 23,7
États-Unis	4 869	5 429	5 287	16,9	– 2,6	+ 8,6
Amérique latine	**608**	**1 144**	**1 163**	**3,7**	**+ 1,7**	**+ 91,3**
dont : Brésil	192	389	408	1,3	+ 5,0	+ 112,1
Europe et ex-URSS	**7 937**	**6 482**	**6 490**	**20,7**	**+ 0,1**	**– 18,2**
dont : UE à 27	4 052	3 667	3 543	11,3	– 3,4	– 12,6
ex-UE à 15	3 082	2 978	2 853	9,1	– 4,2	– 7,4
dont : Allemagne	950	769	748	2,4	– 2,8	– 21,3
Espagne	205	268	270	0,9	+ 0,9	+ 31,7
France	**353**	**357**	**328**	**1,0**	**– 8,0**	**– 6,9**
Italie	397	398	393	1,3	– 1,4	– 1,1
Royaume-Uni	549	482	443	1,4	– 8,1	– 19,3
12 nouveaux États membres	970	689	690	2,2	+ 0,1	– 28,9
dont : Russie	2 179	1 577	1 653	5,3	+ 4,9	– 24,1
Afrique	**544**	**967**	**968**	**3,1**	**+ 0,1**	**+ 77,7**
Moyen-Orient	**589**	**1 617**	**1 674**	**5,3**	**+ 3,5**	**+ 184,1**
Extrême-Orient	**4 847**	**12 401**	**13 257**	**42,3**	**+ 6,9**	**+ 173,5**
dont : Chine	2 278	7 294	8 000	25,5	+ 9,7	+ 251,2
Corée du Sud	229	564	588	1,9	+ 4,1	+ 156,3
Inde	582	1 710	1 745	5,6	+ 2,0	+ 199,7
Japon	1 062	1 138	1 186	3,8	+ 4,2	+ 11,7
Océanie	**282**	**427**	**427**	**1,4**	**+ 0,0**	**+ 51,3**
Pays de l'annexe I	**13 901**	**13 466**	**13 355**	**42,6**	**– 0,8**	**– 3,9**
Pays hors annexe I	**6 469**	**15 947**	**16 874**	**53,8**	**+ 5,8**	**+ 160,8**
Soutes internationales maritimes et aériennes[2]	**619**	**1 096**	**1 114**	**3,6**	**+ 1,6**	**+ 80,0**
Monde	**20 989**	**30 509**	**31 342**	**100,0**	**+ 2,7**	**+ 49,3**

Source : Agence internationale de l'énergie, septembre 2013

1. Émissions de la combustion d'énergie fossile pour un usage final (transport, chauffage...) ou non (production d'électricité, raffinage de pétrole...). Ces données sont estimées par l'AIE sur la base des bilans énergétiques. Il existe des différences de périmètre et de mode de calcul (notamment sur les facteurs d'émissions) par rapport aux inventaires des émissions de GES transmis au titre de la CCNUCC, utilisés dans la suite de ce chapitre et au chapitre 4.
2. Les émissions des soutes internationales maritimes et aériennes sont exclues des totaux nationaux.

2.6. CO2 Emissions by region/capita (1990-2011)

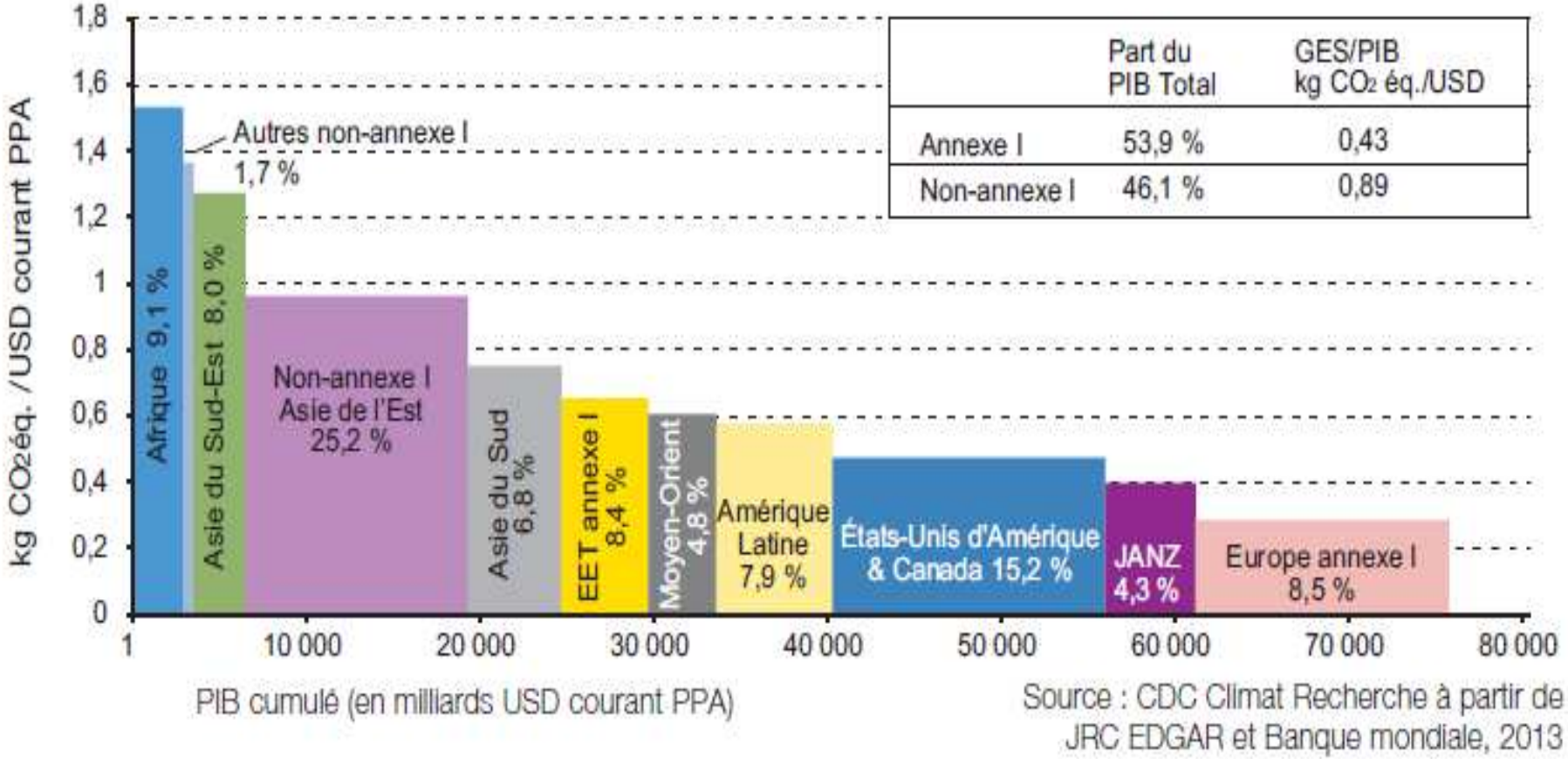
En t CO_2/habitant

	1990	2010	2011	Évolution (%) 2011/2010	Évolution (%) 2011/1990
Amérique du Nord	**15,5**	**14,1**	**13,7**	**– 2,7**	**– 11,5**
dont : Canada	15,5	15,5	15,4	– 0,7	– 0,6
États-Unis	19,5	17,5	16,9	– 3,3	– 12,9
Amérique latine	**1,7**	**2,4**	**2,4**	**+ 0,6**	**+ 42,2**
dont : Brésil	1,3	2,0	2,1	+ 4,1	+ 61,4
Europe et ex-URSS	**9,4**	**7,3**	**7,3**	**– 0,3**	**– 22,9**
dont : UE à 27	8,6	7,3	7,0	– 3,6	– 17,9
ex-UE à 15	8,4	7,5	7,1	– 4,6	– 15,3
dont : Allemagne	12,0	9,4	9,1	– 2,8	– 23,6
Espagne	5,3	5,8	5,9	+ 0,8	+ 11,4
France	**6,1**	**5,5**	**5,0**	**– 8,4**	– 16,9
Italie	7,0	6,6	6,5	– 1,8	– 7,6
Royaume-Uni	9,6	7,7	7,1	– 8,8	– 26,4
12 nouveaux États membres	9,1	6,7	6,7	+ 0,3	– 26,5
dont : Russie	14,7	11,1	11,6	+ 4,9	– 20,7
Afrique	**0,9**	**0,9**	**0,9**	**– 2,2**	**+ 7,7**
Moyen-Orient	**4,5**	**7,6**	**7,7**	**+ 1,4**	**+ 72,0**
Extrême-Orient	**1,6**	**3,3**	**3,5**	**+ 5,9**	**+ 109,8**
dont : Chine	2,0	5,4	5,9	+ 9,2	+ 196,5
Corée du Sud	5,3	11,4	11,8	+ 3,3	+ 120,7
Inde	0,7	1,4	1,4	+ 0,6	+ 110,9
Japon	8,6	8,9	9,3	+ 4,4	+ 8,0
Océanie	**13,7**	**15,9**	**15,7**	**– 1,3**	**+ 14,3**
Pays de l'annexe I	**15,1**	**17,7**	**17,4**	**– 1,3**	**+ 15,1**
Pays hors annexe I	**1,6**	**2,9**	**3,0**	**+ 4,4**	**+ 89,4**
Monde	**4,0**	**4,4**	**4,5**	**+ 1,6**	**+ 13,5**

Source : Agence internationale de l'énergie, septembre 2013

2.7. Energy Efficiency in Production (2010)

Répartition régionale des émissions de GES[1] par unité de PIB en 2010

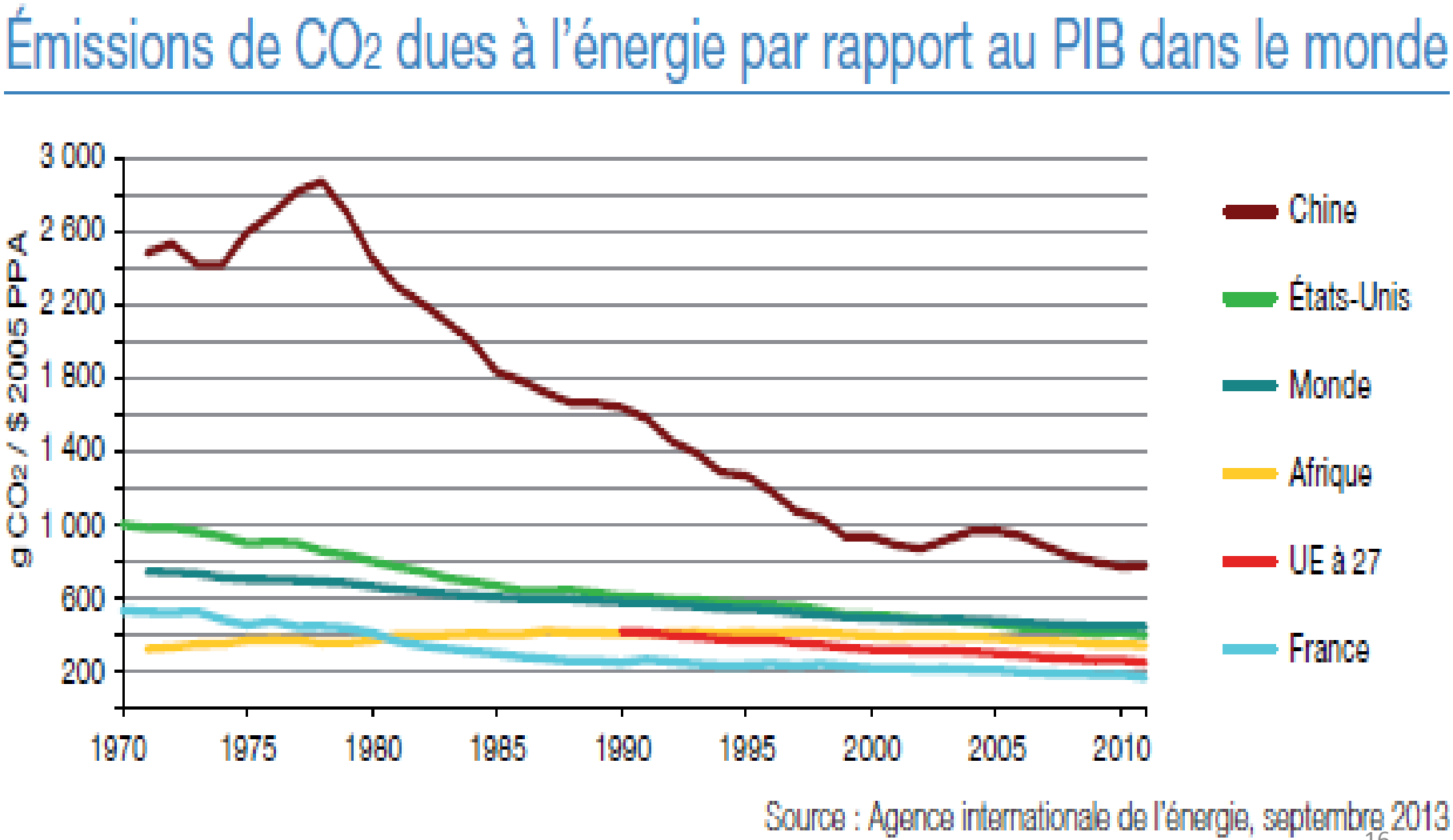


	Part du PIB Total	GES/PIB kg CO_2 éq./USD
Annexe I	53,9 %	0,43
Non-annexe I	46,1 %	0,89

Source : CDC Climat Recherche à partir de JRC EDGAR et Banque mondiale, 2013

Le pourcentage indiqué correspond à la part des régions dans les émissions mondiales de GES.
EET : Économies en transition, JANZ : Japon, Australie, Nouvelle-Zélande.

2.8. Energy Efficiency Increase in Production (1970-2010)



2.9. Energy Efficiency Increase in Production (1900-2011)

En t CO_2/million $ 2005 PPA[1]

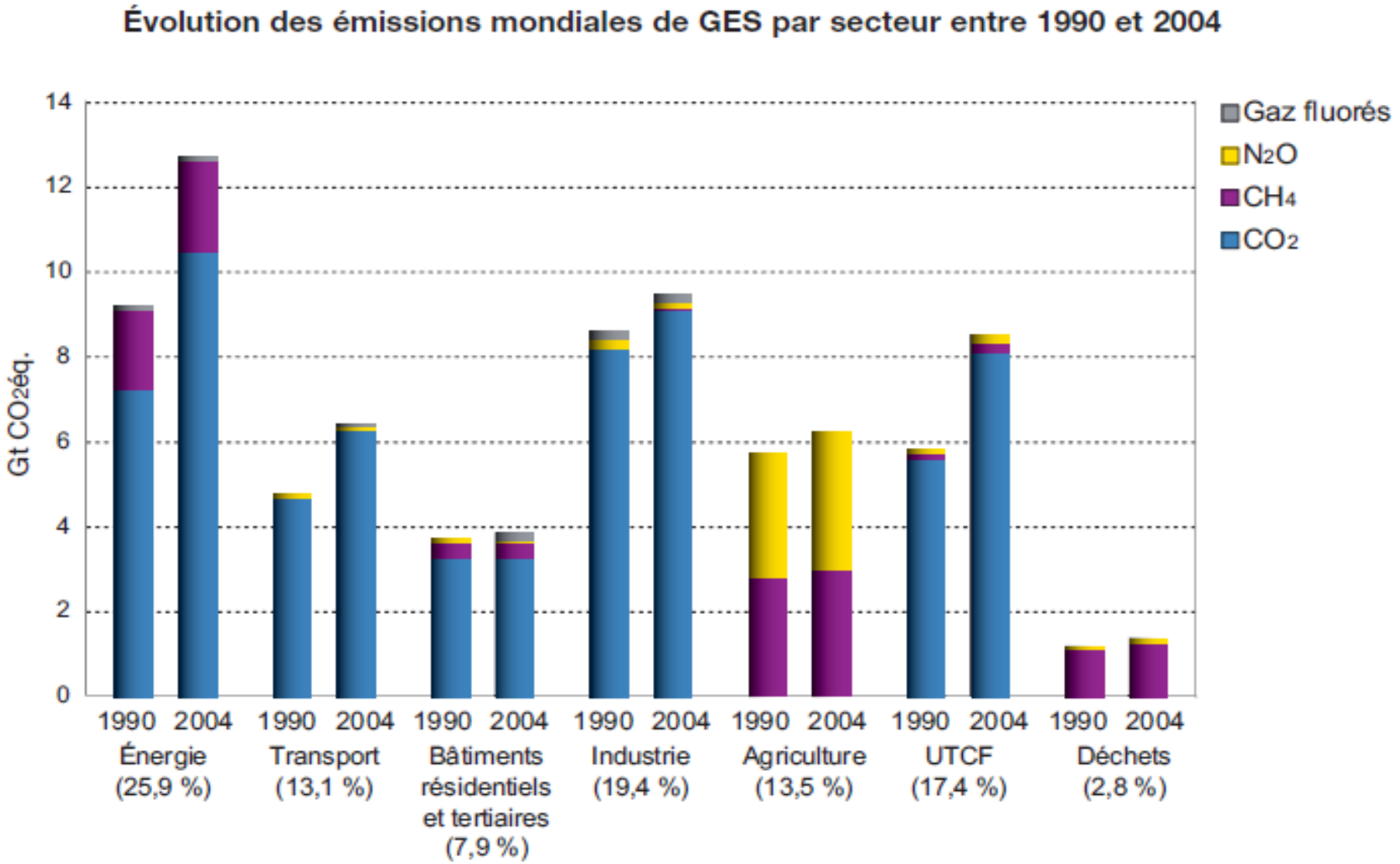
	1990	2010	2011	Évolution (%) 2011/2010	Évolution (%) 2011/1990
Amérique du Nord	**582**	**409**	**392**	**– 3,9**	**– 32,6**
dont : Canada	572	439	430	– 2,2	– 24,9
États-Unis	611	418	400	– 4,3	– 34,6
Amérique latine	**270**	**256**	**249**	**– 2,7**	**– 7,5**
dont : Brésil	179	197	202	+ 2,2	+ 12,7
Europe et ex-URSS	**595**	**351**	**343**	**– 2,3**	**– 42,3**
dont : UE à 27	419	264	251	– 4,9	– 40,2
ex-UE à 15	358	244	230	– 5,5	– 35,8
dont : Allemagne	462	280	264	– 5,6	– 42,8
Espagne	267	216	217	+ 0,5	– 18,7
France	**249**	**186**	**168**	**– 9,8**	**– 32,8**
Italie	295	243	239	– 1,7	– 19,0
Royaume-Uni	421	236	215	– 9,0	– 49,0
12 nouveaux États membres	910	407	396	– 2,7	– 56,5
dont : Russie	1 164	782	786	+ 0,5	– 32,5
Afrique	**408**	**349**	**344**	**– 1,5**	**– 15,7**
Moyen-Orient	**491**	**628**	**621**	**– 1,1**	**+ 26,5**
Extrême-Orient	**605**	**540**	**545**	**+ 0,9**	**– 10,0**
dont : Chine	1 643	774	778	+ 0,5	– 52,7
Corée du Sud	490	427	429	+ 0,5	– 12,6
Inde	551	460	439	– 4,5	– 20,3
Japon	324	288	302	+ 4,8	– 6,9
Océanie	**576**	**459**	**446**	**– 3,0**	**– 22,7**
Pays de l'annexe I	**548**	**365**	**355**	**– 2,6**	**– 35,2**
Pays hors annexe I	**599**	**517**	**516**	**– 0,2**	**– 13,8**
Monde	**580**	**450**	**446**	**– 1,0**	**– 23,2**

1. Parité de pouvoir d'achat.

Source : Agence internationale de l'énergie, septembre 2013

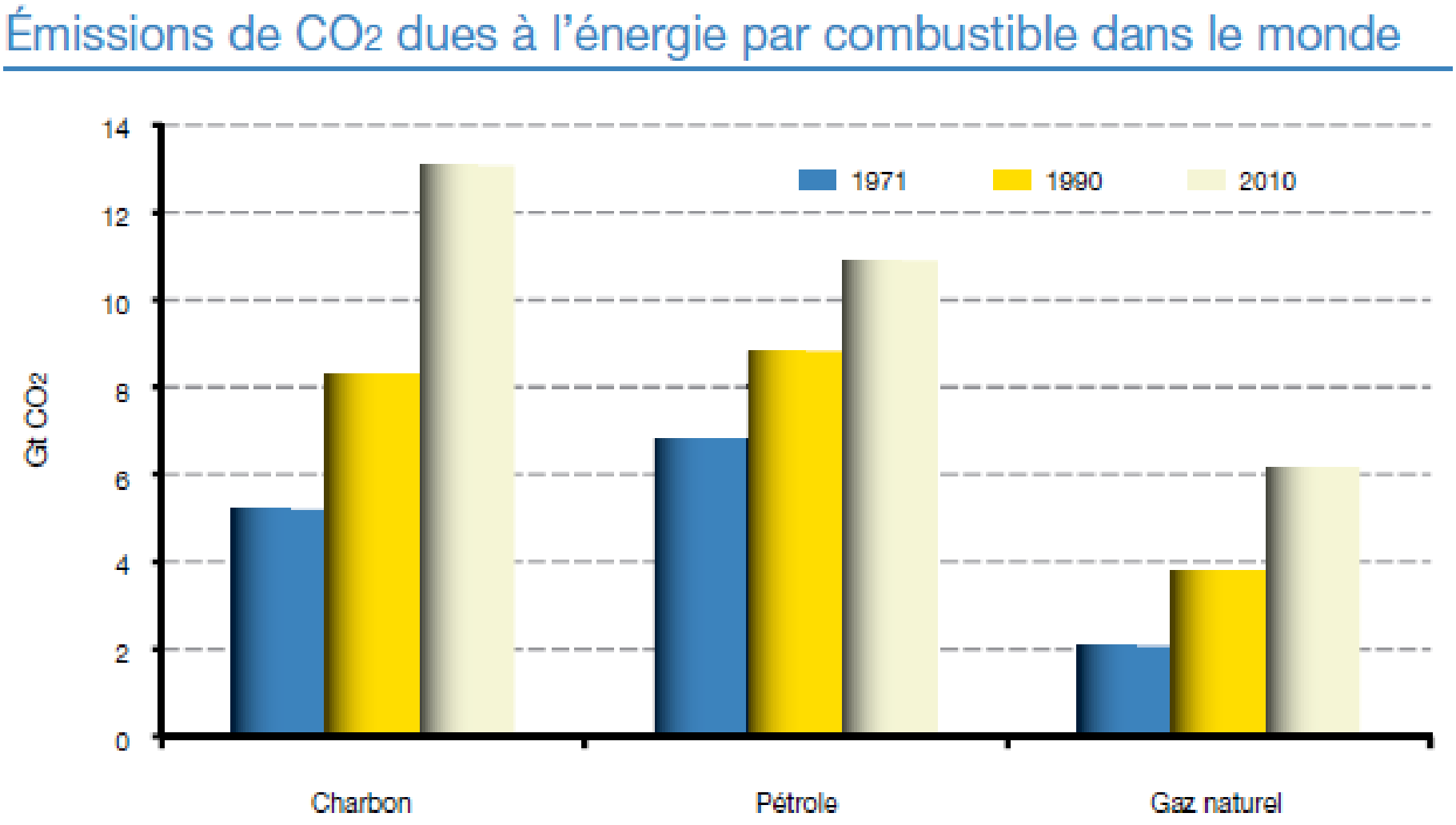
2.10 Global GHG emissions by sector (1990-2004)

Source: Repères - Chiffres clés du climat France et Monde - Edition 2014:



Source : Giec, 3e groupe de travail, 2007

2.11 Change in GHG emissions from Coal, Oil, Gas (1970, 1990, 2010)



Source : Agence internationale de l'énergie, mars 2013

2.12: Change in global energy consumption

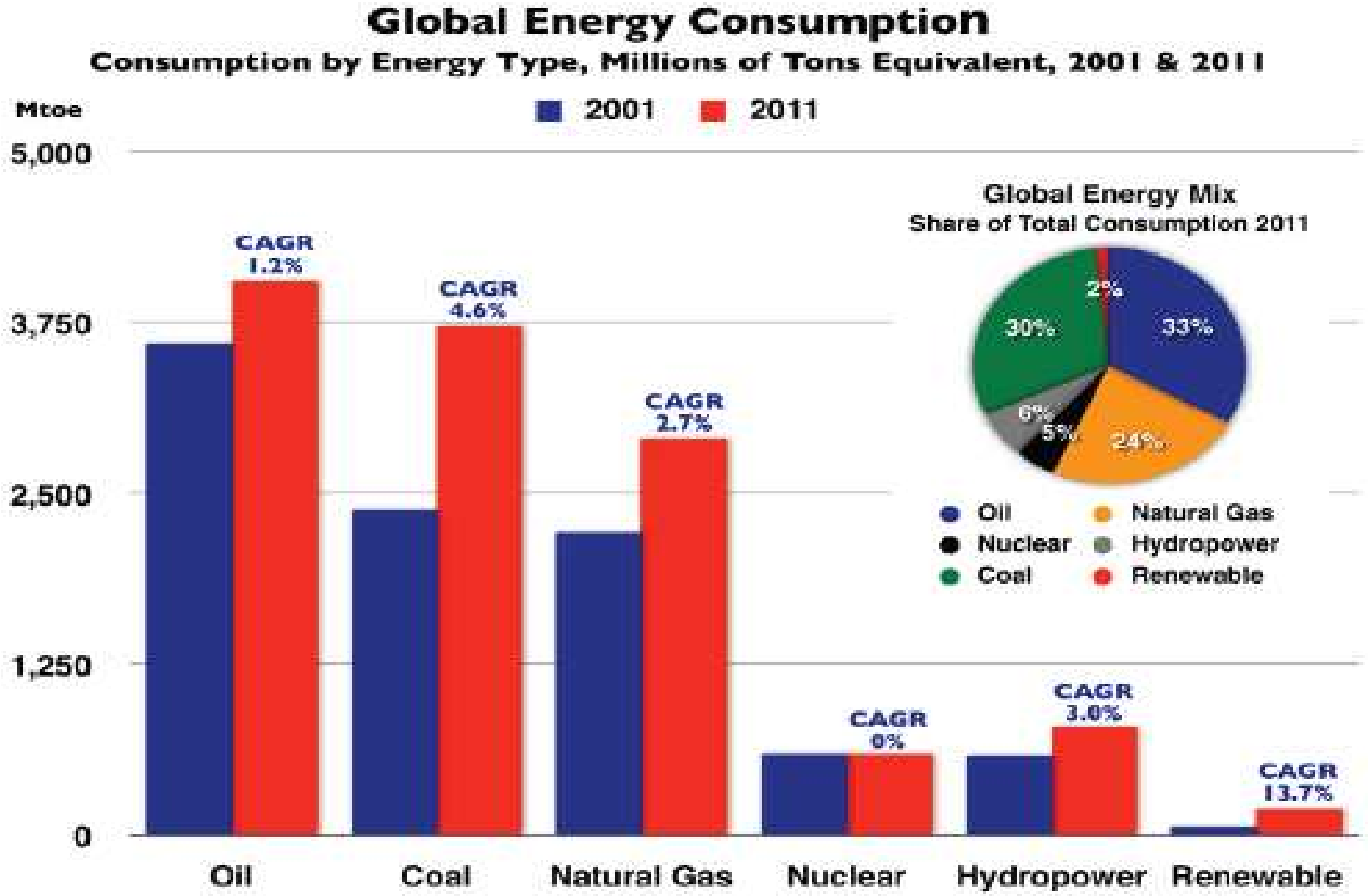


Exhibit 1

BP Statistical Review of World Energy, June 2012

3. Sustainability Transition in the Energy Sector

Six Greenhouse Gases:

CO_2 - Carbon dioxide
CH_4 - Methane
N_2O - Nitrous oxide
PFCs - Perfluorocarbons
HFCs - Hydrofluorocarbons
SF_6 - Sulphur hexafluoride

Major Sectors as Producers of CO2:

–Energy
–Transportation (mobility)
–Industry (production)
–Agriculture (food production)
–Housing (warming, air conditioning)

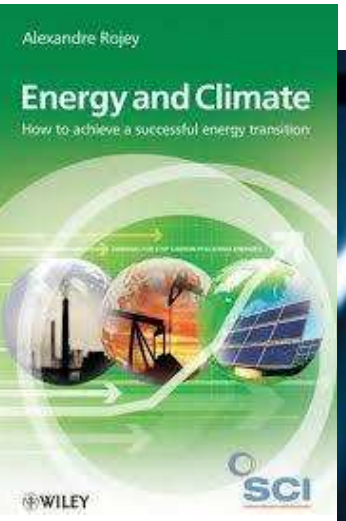
3.1 Sustainability Transition: Four Actors

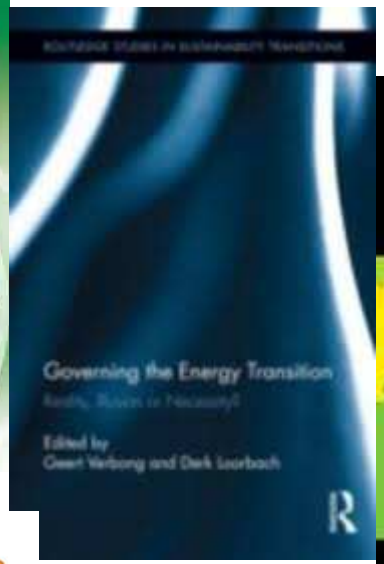
- **Four Key actors: Case of (Renewable) Energy**
  - **Government:**
    - **Setting the Legal Framework,**
    - **Developing and adopting the Development Path and Priorities and**
    - **Resource Allocation for Research, Development, initial subsidies**
  - **International Governmental Organizations: UNEP, OECD, ADB,**
  - **Regional Governmental Organizations: EU and ASEAN**
    - **Global and regional agenda setting: research, publications, debate**
  - **Economic Sector:**
    - **Government Incentives: Innovation & New Products**
  - **Society: Awareness and readiness to act**
    - **Must have options for choice: e.g. public transportation, electric car etc.**
  - **Knowledge: for present & next generation: initiate innovation**
    - **Knowledge Creation (Research)**
    - **Dissemination (Education)**

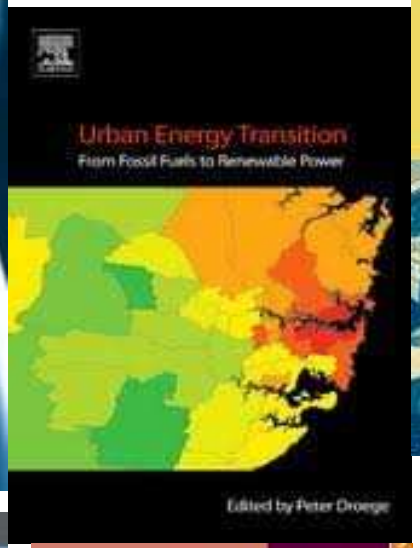
3.2 Top-down vs. Bottom-Up Supply-side vs. Demand-side

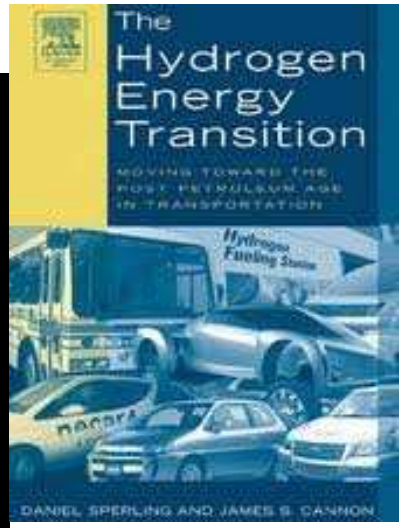
- **Top-down:** Governments, International organization
  - Action by governments are necessary but not sufficient
  - Governments: legal framework & economic incentives
  - Economic interests: often business as usual (money)
  - International gov. organizations: awareness, framework
- **Bottom-Up:** People (society, knowledge)
  - Public awareness, societal support, political pressure
- **Supply-Side: alternative services & goods**
  - **Economic Sector: Industry in niches (renewables)**
  - **Energy sector:** more energy efficient products (bulbs)
  - Hybrid cars, electricity cars (electricity from renewables)
- **Demand-Side: Public acceptance of change**
  - Awareness & willingness to pay more
  - Government: Tax incentives, time limited subsidies

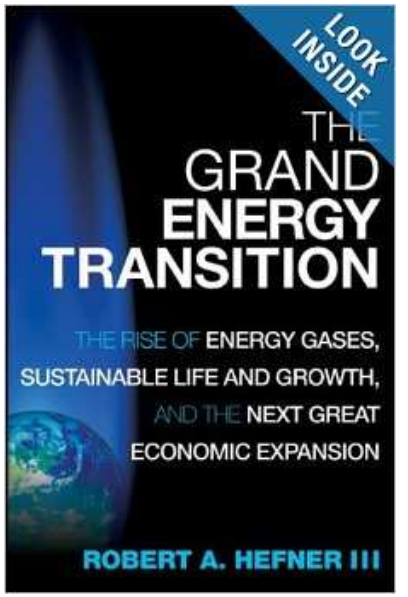
4. Energy Transition: Case Study of Germany

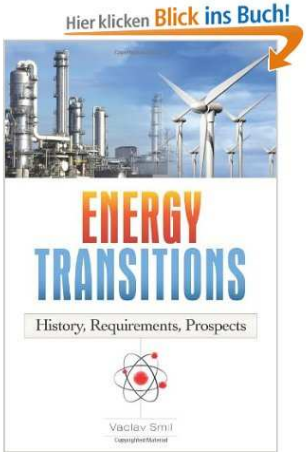


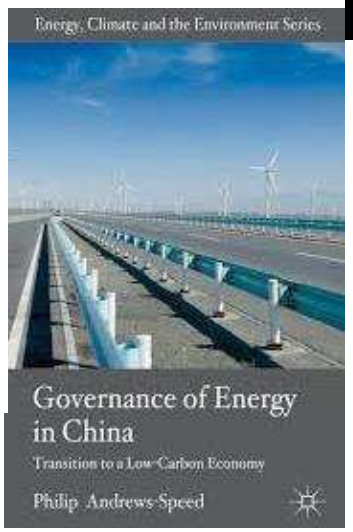


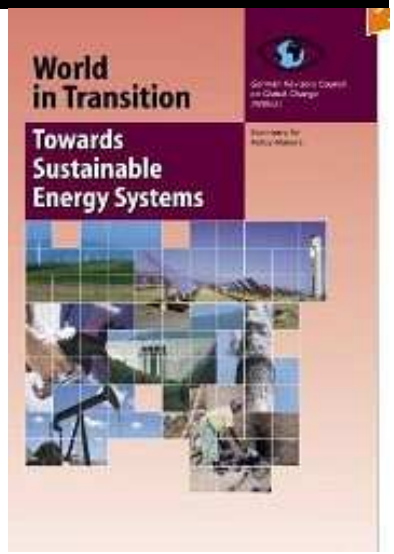


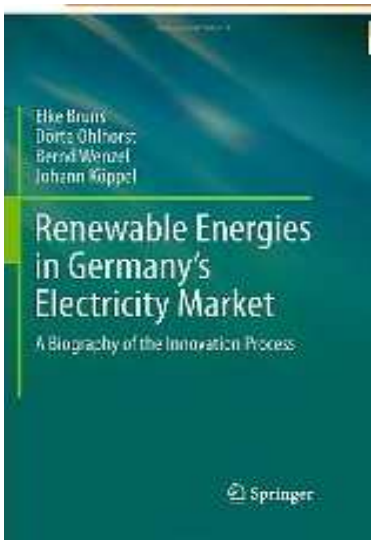


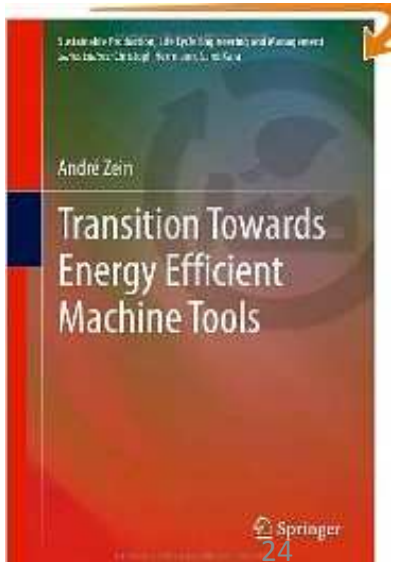












4.1. Energy Transition is Under Way

- Annex-1 countries: Countries with declining GHG e.:
  - Countries: Economy in transition (former soc. countries)
  - countries stressing energy efficiency, renewables, EU-15
- Annex-1 Countries leading the Energy transition
  - **UK: liberalization**
  - **Germany: renewables & energy efficiency**
  - **Sweden: hydropower**
  - **France: nuclear power**
- Non-annex-1 countries
  - China: energy efficiency improvements, renewables
  - Brazil: renewables: hydropower and ethanol (cars)

4.2 Role of Governments: Germany

- **Germany** reduced its GHG emissions by about 25% (1990-2012) without hampering its competitiveness
- **Agenda Setting:** Two Research (Enquete) Commissions of the Parliament (1987-1990, 1991-1994): climate-energy nexus
- **Policy Implementation:** Klaus Töpfer, Environment Minister and later Executive Director of UNEP (10 years): innovative visionary
- **National GHG Reducton Goal: 25-30% adopted in 1990 for 2010**
- **Dual Policy: Implementation Strategy**
  - **Sectoral Approaches: Energy, Housing, Tansportation, Industry**
  - **Energy Efficiency & Renewables**
- **Electricity Feed-in Law (1991)**
  - **Legal basis and framework for investment decisions**
  - **Beginning of the transformation of the German Energy System**
- **Renewable Energy Law (2000):**
  - **Basis of subsidies for solar energy and biomass**
- **From a Latecomer to Leader (1990-2013)**
- **Economic Impact:** creation of about 350.000 new jobs (in 2010)

4.3 Legal Basis for Renewables in Germany

- **1991: Electricity Feed-in Law** (Chancellor Kohl) legal basis for wind industry to feed into the grid at a higher than market price (subsidized by energy consumers), primarily for wind power
- **2000: Act Granting Priority to Renewable Energy Sources (EEG)** (Chanc. Schröder): operators of plants generating electricity from renewable energy sources are entitled to a fixed compensation for electricity fed into the grid from grid operator (included geothermal energy)**.**
- **100,000 Roof Programme (PV)**
- **2004:** Reduction for subsidies for wind power**,** increased subsidies for photovoltaic solar energy
- **2009: (**Chanc. Merkel) goal to increase RE 30% of electricity generation by 2020 and for solar thermal (heating systems), degression of subsidies for PV
- **2011:** reduction of subsidies for PV by 9-13%.
- **2013: Liberals made high electricity prices a campaign issues: did not return to the parliament**
- **New big coalition: Christian Democrats (CDU) and Social Democrats (SPD): goal 40% for renewables in electricity by 2020 (very ambitious goal)**

4.4. Economic Instrument: “Feed in Tariffs”

- Certificates of renewable energy (environmental attributes)
- Incentives based on production
- Incentives based on capacity
- Policy of fixed prices
- Incentives based on real costs of renewable energy

- Tariffs of RE
- Costs (in real time per site; long-term projections for enterprises
- Fiscal credits for investments
- Fiscal credits for production

4.5. Politics: High Consensus on Climate Change and Renewables

- **Despite many disputes on details, there was a high level of support for climate change goals and renewable energy since 1990**
- Chancellor **Kohl** (1983-1997): cons., liberal
- Chancellor **Schröder** (1997-2005): left, green
- Chancellor **Merkel** (2005-2009): conservative, left
- Chancellor **Merkel** (2009-2013): conservative, liberal
- Chancellor **Merkel (2013-?):** conservative, left
- **Major dispute on nuclear energy (1997-2011)**
  - **Schröder for moving out of nuclear energy by 2020**
  - **Merkel** extended running time for reactors to 2030s.
  - **Part of profits of electricity companies for renewables!**
  - **After Fukushima: Ethics committee (end of nuclear energy by 2022)**

4.6. Implementing GHG Reduction Goals

- Preparation: Parliamentary Commission on Climate Change (1987-1990, 1991-1994)
- Pioneer: Environment Ministry: Töpfer/Merkel
- Initial goal: -25% by 2005, later by 2010 (1990)
- COP 1 (1995) in Berlin: Berlin Mandate
- COP 3 (1997) in Kyoto: -5,1% (2008-12) (1990)
  - Legal obligation: -8% until 2012 based on GHG in 1990

EU goals (solidarity principle): Germany – 21%

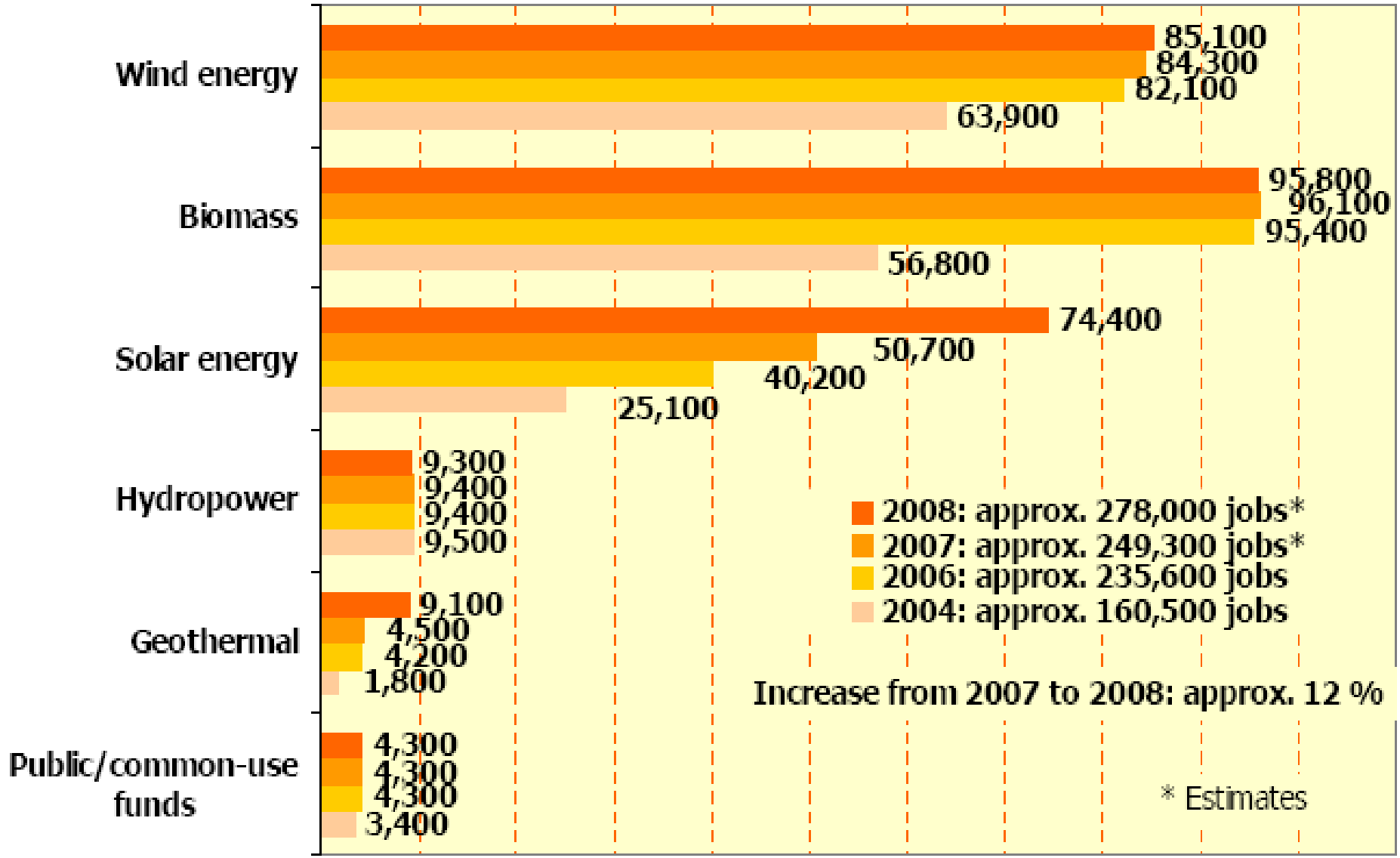
By 2007 (a reduction of 20% was achieved)

By 2011 (a reduction of 27% (EEA Rep., March 2013)

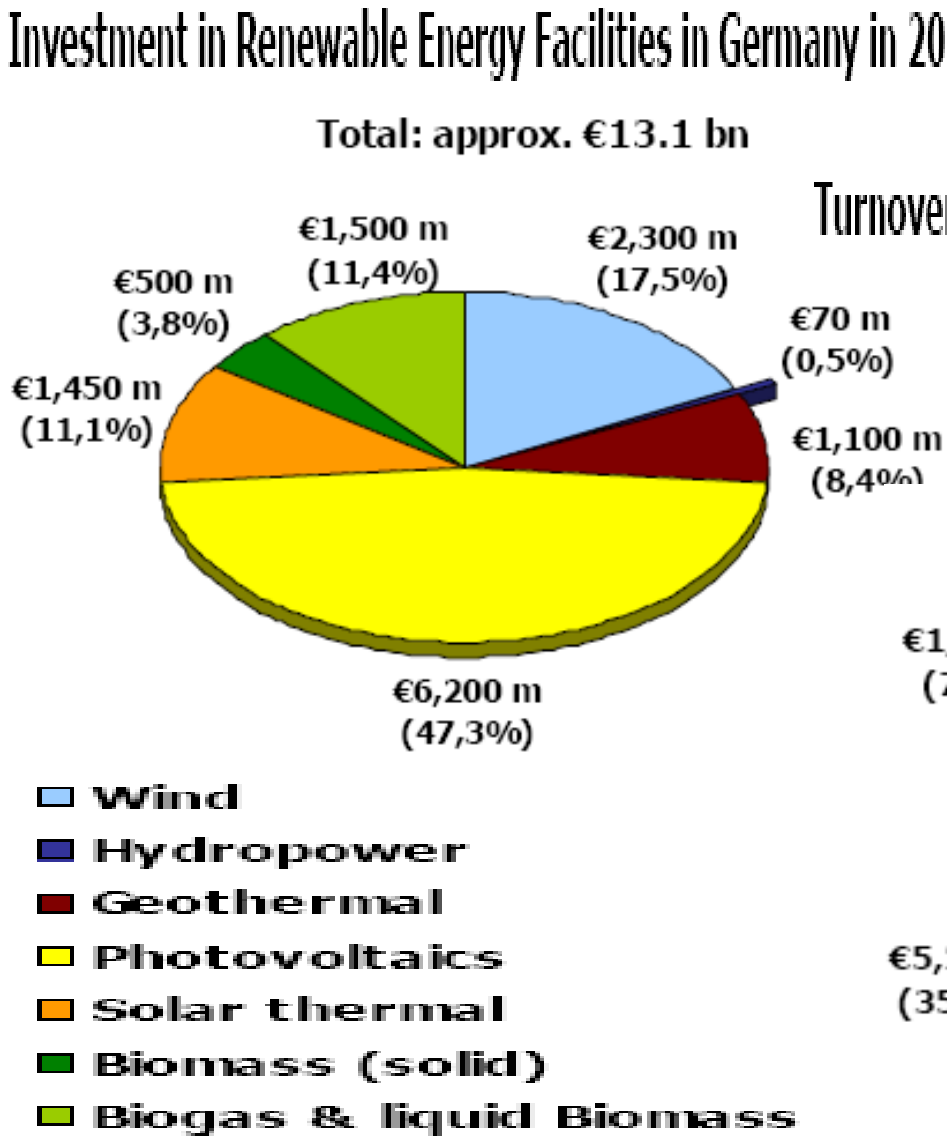
4.7. Second Integrated Climate and Renewable Energy Package (2008)

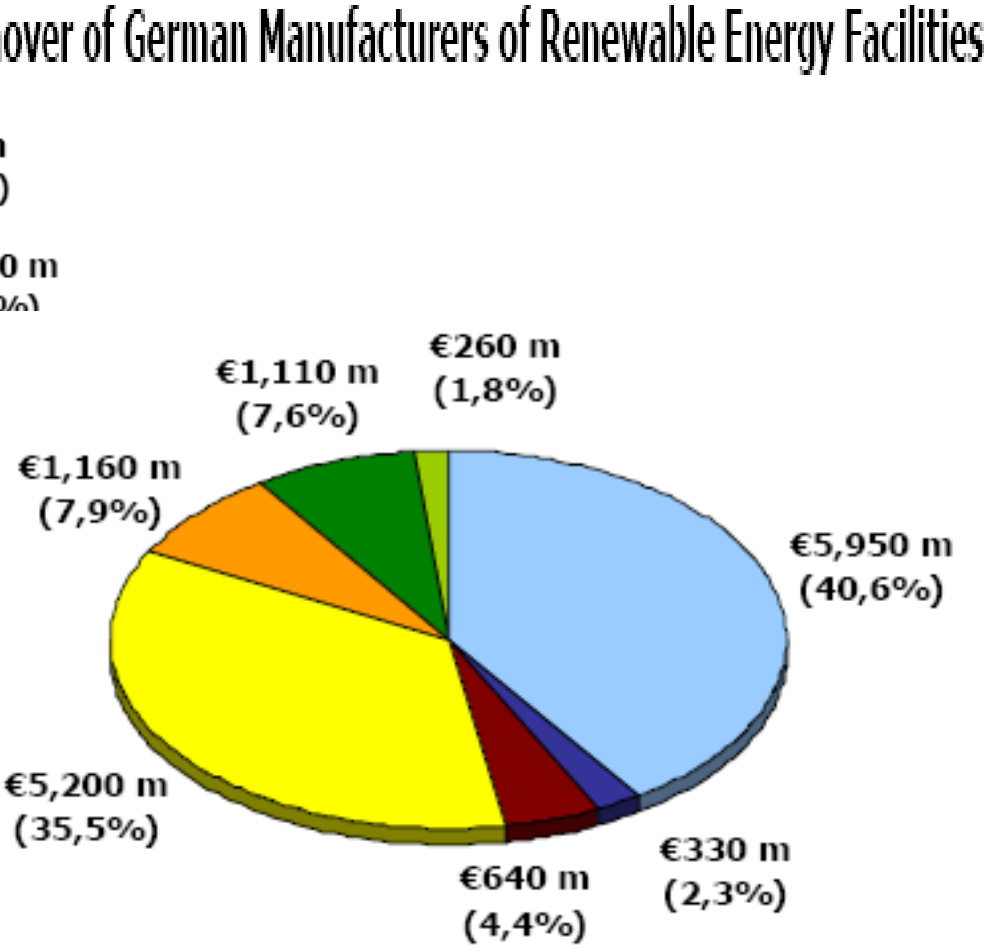
- 7 acts & ordinances: increase energy efficiency:
  - **Energy Conservation Act and Energy Saving Ordinance**
  - **Energy Grid Expansion Act**
  - **Act on the Levying of Distance-Related Charges for the Use of Fe-deral Motorways by Heavy Goods Vehicles/Toll Level Regulations**
  - **Ordinance on electricity and gas meters**
  - **Amendment to Heating Costs Ordinance**
  - **Key elements for changing basis of vehicle tax**

4.8. Development of Jobs (2004-2008)



4.9. Investment and Turnover (2008)





4.10. Renewables in Germany (2013)

- **Share of electricity produced from renewable energy has increased from 6.3 % of national total in 2000 to 25 % in first half 2012.**
- **In 2011 20.5% (123.5 TWh) of Germany's electricity supply (603 TWh) was produced from renewables, more than 2010 contribution of gas-fired power plants.**
- **In 2010, investments 26 billion € in Germany's renewable energies sector.**
- Germany " world's first major renewable energy economy".
- More than **21,607** **wind turbines** are located in the German federal area and the country has plans to build more wind turbines. In 2011, Germany's fed.government is working on a new plan for increasing **renewable energy commercialization**, with a particular focus on **offshore wind farms**.[A major challenge is the development of sufficient network capacities for transmitting the power generated in the North Sea to the large industrial consumers in southern Germany.
- **According to official figures, some 370,000 people in Germany were employed in the renewable energy sector in 2010, especially in small and medium sized companies. This is an increase of around 8 % compared to 2009 (around 339,500 jobs), and well over twice the number of jobs in 2004 (160,500). About two-thirds of these jobs are attributed to the Renewable Energy Sources**

4.11. German Renewable Energy Targets

- Since the passage of Directive on Electricity Production from Renewable Energy Sources in 1997, Germany and the other states of the European Union have been working towards a **target of 12% renewable electricity by 2010**. Germany passed this target early in **2007 when the renewable energy share in electricity consumption in Germany reached 14%.**

September 2010 German government announced these new energy targets:

- **Renewable electricity** - 35% (2020), 50% (2030,) 65% (2040), 80% (2050)
- **Renewable energy** - 18% (2020), 30% (2030), and 60% (2050)
- **Energy efficiency** - Cutting total energy consumption by 20% from 2008 by 2020 and 50% less by 2050

Total electricity consumption - 10% below 2008 level by 2020 and 25% by 2050

- The German Government reports that in 2011 renewable energy (mainly wind turbines and biomass plants) generated more than 123 TWh (billion kilowatt-hours) of electricity, providing nearly **20% of the 603 TWh of electricity supplied.**
- In 2012, all renewable energy accounted for 21.9% of electricity, with wind turbines and photovoltaic providing 11.9% of the total.[

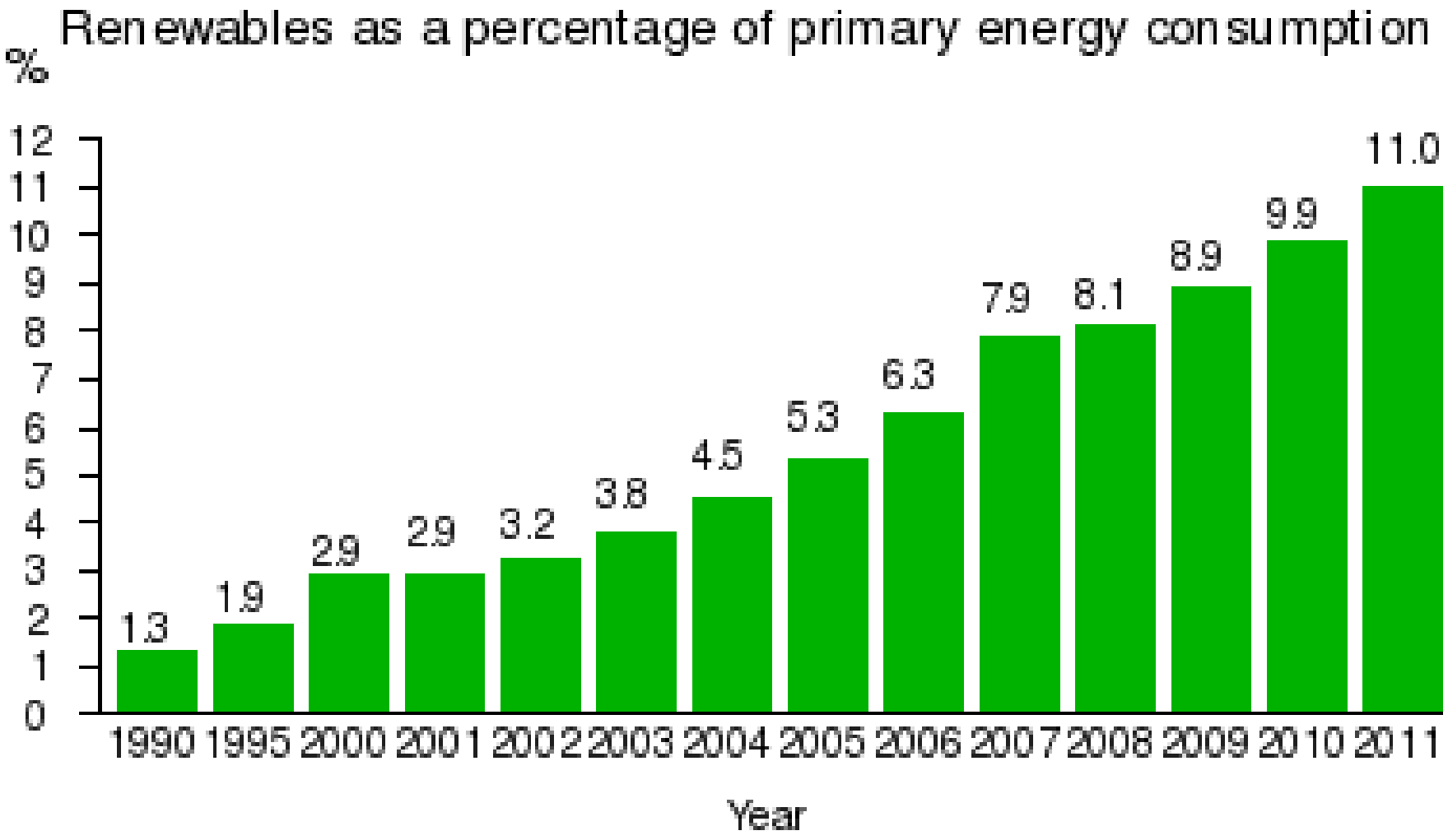
4.12. German Renewable Energy Policy

- Renewable energy benefited from Left/Green coalition (1998- 2005).
- **Renewable Energy Sources Act (2000**) promotes renewables energy by feed-in tariffs that grid operators must pay for renewable energy fed into the power grid. People who produce renewable energy can sell their 'product' at fixed prices for a period of 20 or 15 years. This has created a surge in the production of renewable energy.
- For the 2005–2010 period the **Federal Government** set aside nearly **800 million € for scientific research in the country**. That research will be earmarked for policies of long-term development. Additionally, in **2001 a law was passed requiring the closing of all nuclear power plants within a period of 32 years**. The shutdown time was extended to 2040 by a new government in 2010. **After the Fukushima incident, the law was abrogated and the end of nuclear energy was set to 2022**.
- The German energy policy is framed within the European Union, and the March 2007 European Council in Brussels approved a mandatory energy plan that requires a 20% reduction of carbon dioxide emissions before the year 2020 and the consumption of renewable energies to be 20% of total EU consumption (compared to 7% in 2006).[The accord indirectly acknowledged the role of nuclear energy — which is not commonly regarded as renewable, but emissions-free — in the reduction of the emission of greenhouse gasses, allowing each member state to decide whether or not to use nuclear generated electricity.[
- Also a compromise was reached to achieve a minimum quota of 10% Biofuels in the total consumption of gasoline and diesel in transport in 2020.

4.13. Energy Transition Goals

- "Energy transition" designates a significant change in energy policy: a reorientation of policy from demand to supply and a shift from centralized to distributed generation (e.g. producing heat and power in very small cogeneration units), which should replace overproduction and avoidable energy consumption with energy-saving measures and increased efficiency.
- key policy document outlining the *Energiewende* was published by the German government in September 2010, some six months before the Fukushima nuclear accident.[Legislative support was passed in 2011. Important aspects include:
  - greenhouse gas reductions: 80–95% reduction by 2050
  - renewable energy targets: 60% share by 2050 (renewables broadly defined as hydro, solar and wind power)
  - energy efficiency: electricity efficiency up by 50% by 2050
  - an associated research and development drive
- The policy has resulted in a huge expansion of renewables wehre Germany's share increased from around 5% in 1999 to 22.9% in 2012, reaching close to the OECD average of 18% usage of renewables. Energy co-operatives were created, efforts were made to decentralize control and profits. Large energy companies have a disproportionately small share of renewables market. Nuclear power plants were closed, and existing 9 plants will close earlier than planned for, in 2022.
- In May 2013, the International Energy Agency commended Germany for its commitment to developing a comprehensive energy transition strategy, ambitious renewable energy goals and plans to increase efficient energy use and supported this approach. Scale of Germany's energy policy ambitions, coupled with the large size and energy intensity of its economy, and its central location in Europe's energy system, further policy measures need to be developed if the country's ambitious energy transition, is to maintain a balance between sustainability, affordability and competitiveness. [
- To date, **German consumers have absorbed the costs**, but the IEA says that the debate over the social and economic impacts of the new approach has become more prominent as the share of renewable energy has continued to grow alongside rising electricity prices.
- The **transition to a low-carbon energy sector requires public acceptance**, and, therefore, retail **electricity prices** must remain at an affordable level. Presently, German electricity prices are among the highest in Europe, despite relatively low

4.14. Renewables as % of primary energy consumption in Germany



4.15 CDU/SPD Coalition Contract (2013)

- **Both parties agree that climate change remains a major policy goal**
- **Goal to reduce national GHG by at least 40% by 2020**
- **Within the EU they will support the goal of a 40% GHG reduction by 2030 as part of: GHG emission reduction, icnrease of reneables, efficiency improvements.**
- **In Germany the goal is to reduce GHG emissions by 80-95% by 2050.**
- Goal for expansion of renewables in Germany within a legally binding agreement is : 40-45 % by 2025, 55-60 % by 2035.
- Annually there will be a monitoring of achievements of goals, expansion of the network & affordability for the people.
- Until 2022 Germany will move out of nuclear energy.
- On the EU level Germany will support an energy transition.

5. Climate Policy & Energy Transition Goals in EU & Global Capacity Wind, Solar

- Energy transition is fully under way
- Leading country: has been Germany since 1995
  - Wind power until 2007 (highest installed capacity): China, USA, Germany, Spain
  - Solar photovotaic energy 2012: Germany, China, US
  - Concentrated solar power (CSP): Spain, USA
  - Geothermal: negat. implications, local earthquakes
  - Biomass & Biofuel: competition with food production and environmental impacts (small, dust)
- Introduction is due to interaction Top-down (supply) & Bottom-up (Demand)

5.1. European Union: Climate Change Goals and Commitments until 2020

- **Achievements of Kyoto Goals of EU countries according to internal division**
- **EU Climate Policy Goals for 2020:** (2013ff.)
  - 20 % GHG reductions by 2020 (by 30% if other countries make major commitments)
  - **20 % increase in energy efficiency**
  - **20 % share of renewables**
- EU Green Paper on Renewables
- EU Union for the Mediterranean: Solar Plan

5.2. EU Renewables Policy Goals for a Sustainable Energy Policy by 2020

New Energy Strategy Focuses on Five Priorities:

1. **Achieving an energy-efficient Europe (4 key actions)**
   - **1: Tapping biggest energy-saving potential (buildings, transport)**
   - **2: Reinforcing industrial competitiveness by making industry more efficient**
   - **3: Reinforcing efficiency in energy supply**
   - **4: Making the most of National Energy Efficiency Action Plans**
2. Building a truly pan-European integrated energy market;
3. Empowering consumers, highest level of safety and security;
4. Extending Europe's leadership in energy technology/innovation;
5. Strengthening the external dimension of the EU energy market.

International and interregional Policies:

- **Barcelona Process (Union for the Mediterranean)**
- **Cooperative Projects (Research, Development)**

5.3. Global Development of Renewables

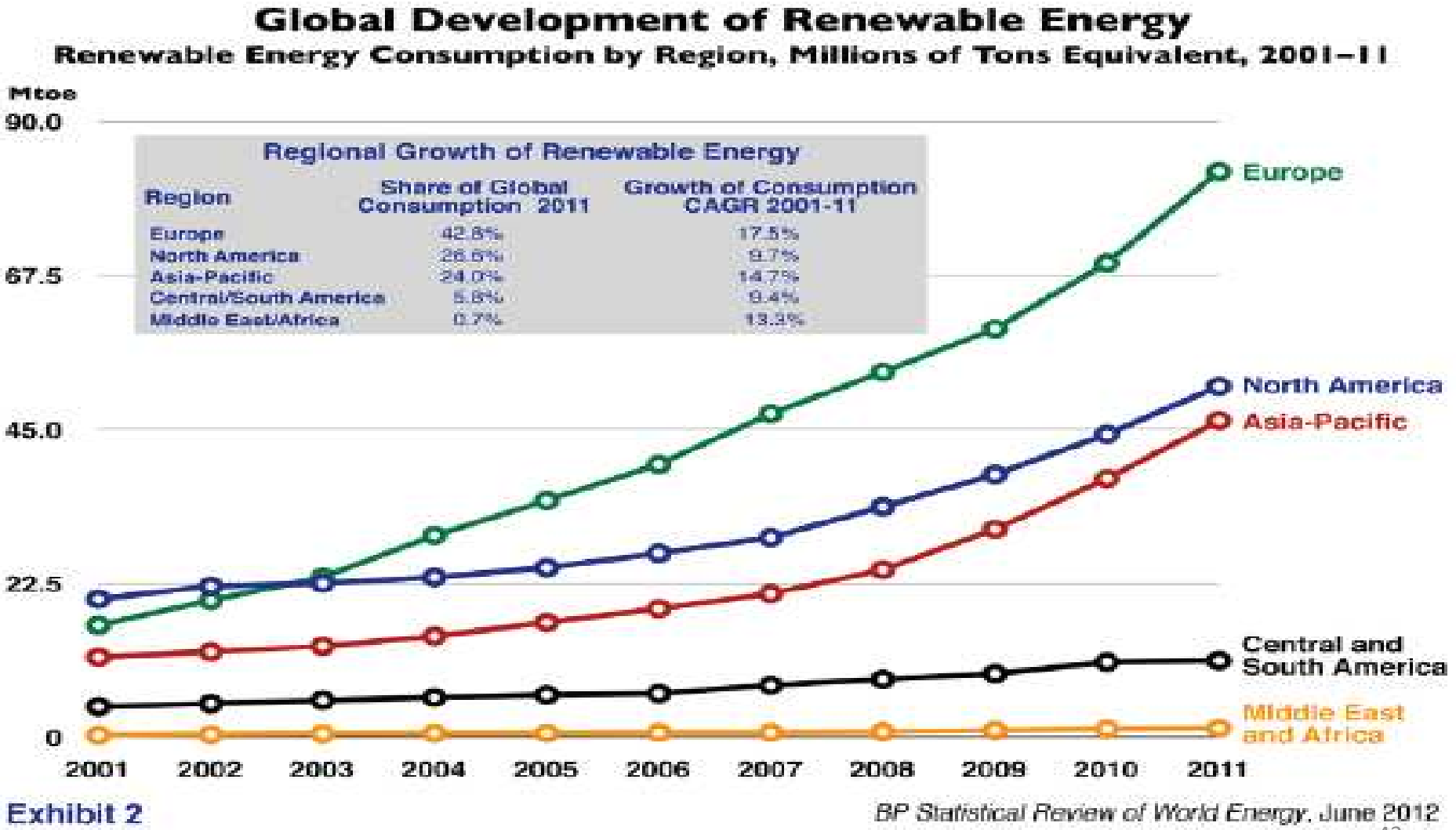
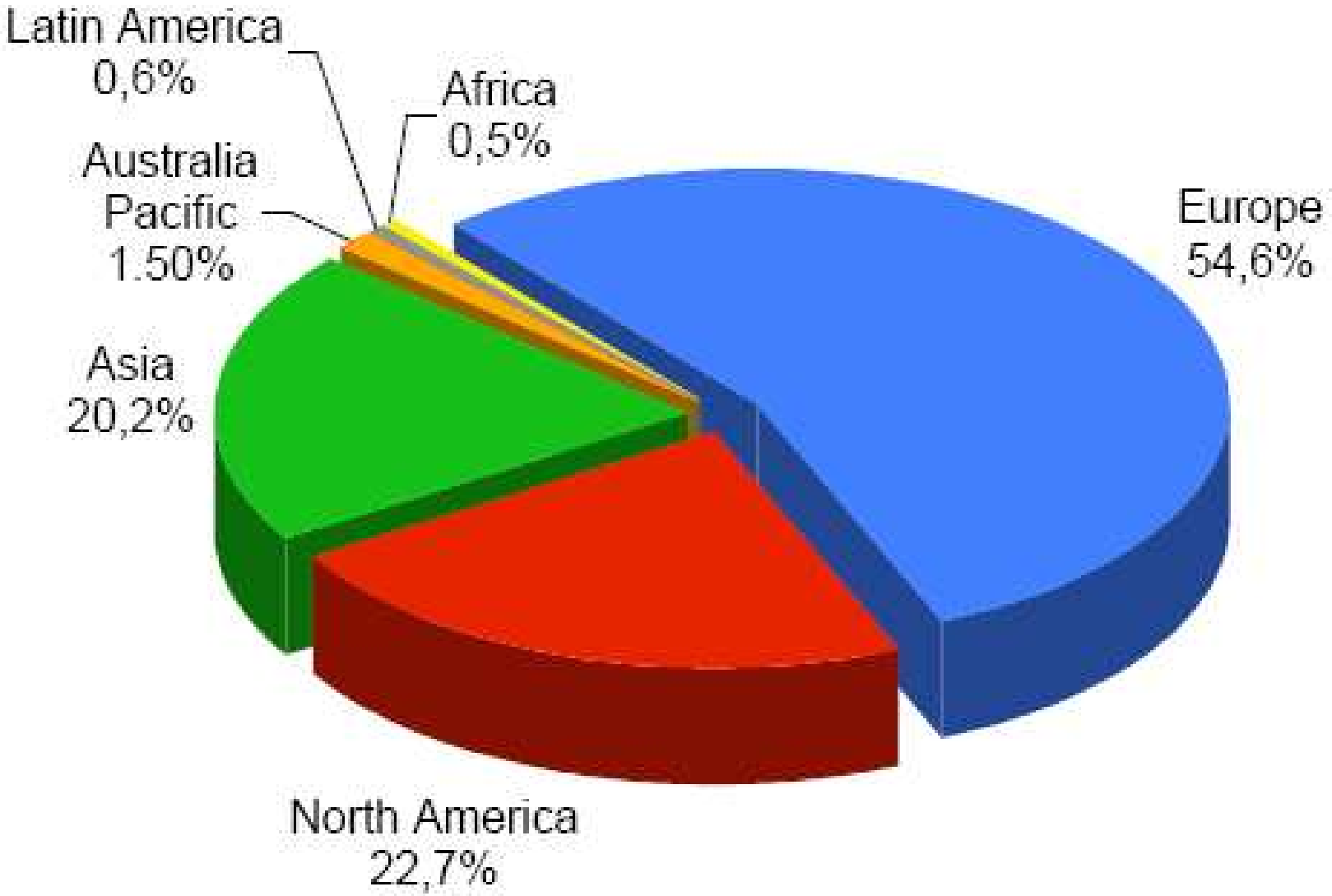


Exhibit 2

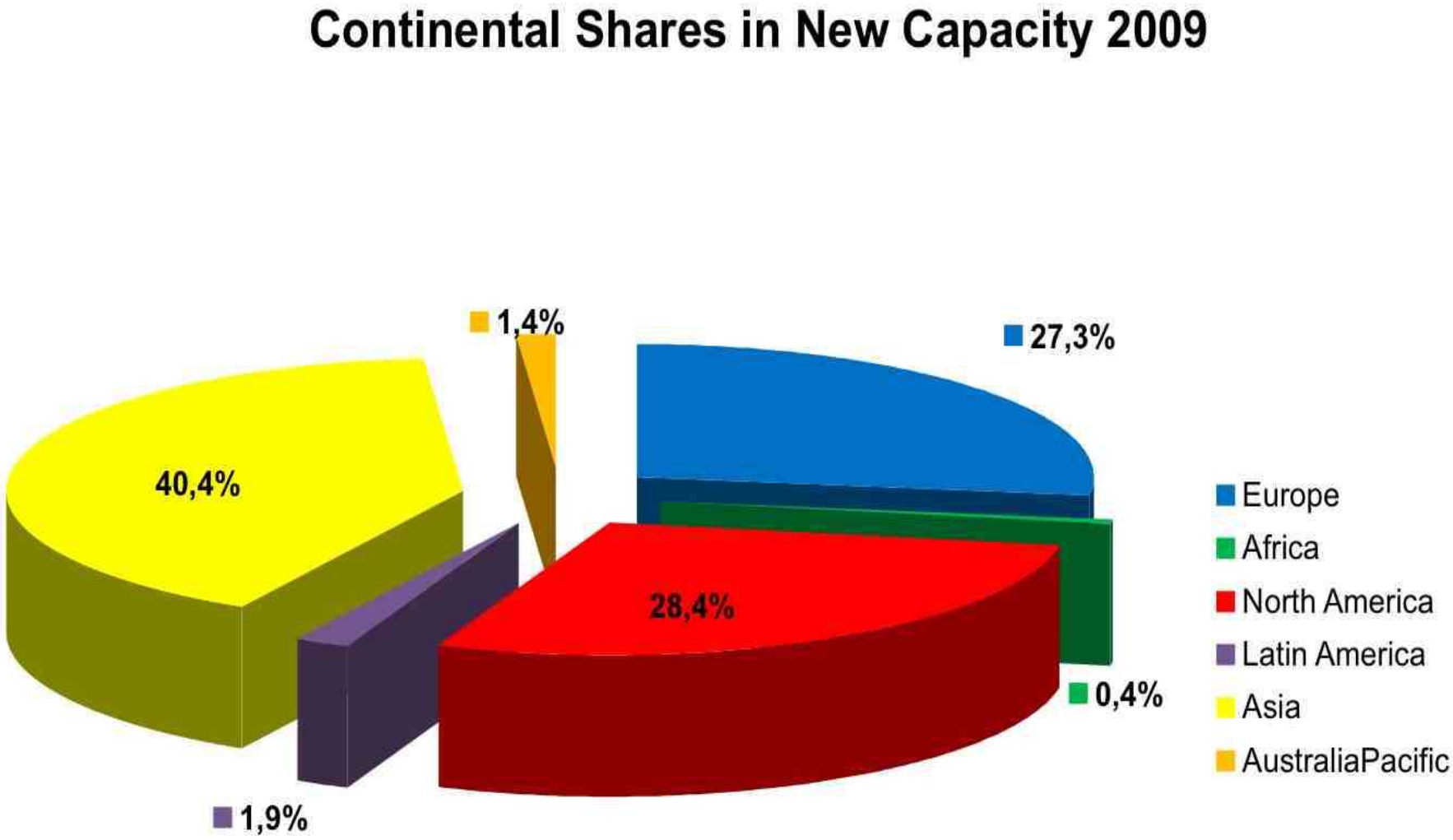
BP Statistical Review of World Energy, June 2012

5.4. Continental Shares of Total Globally Installed Capacity of Renewables (2010)



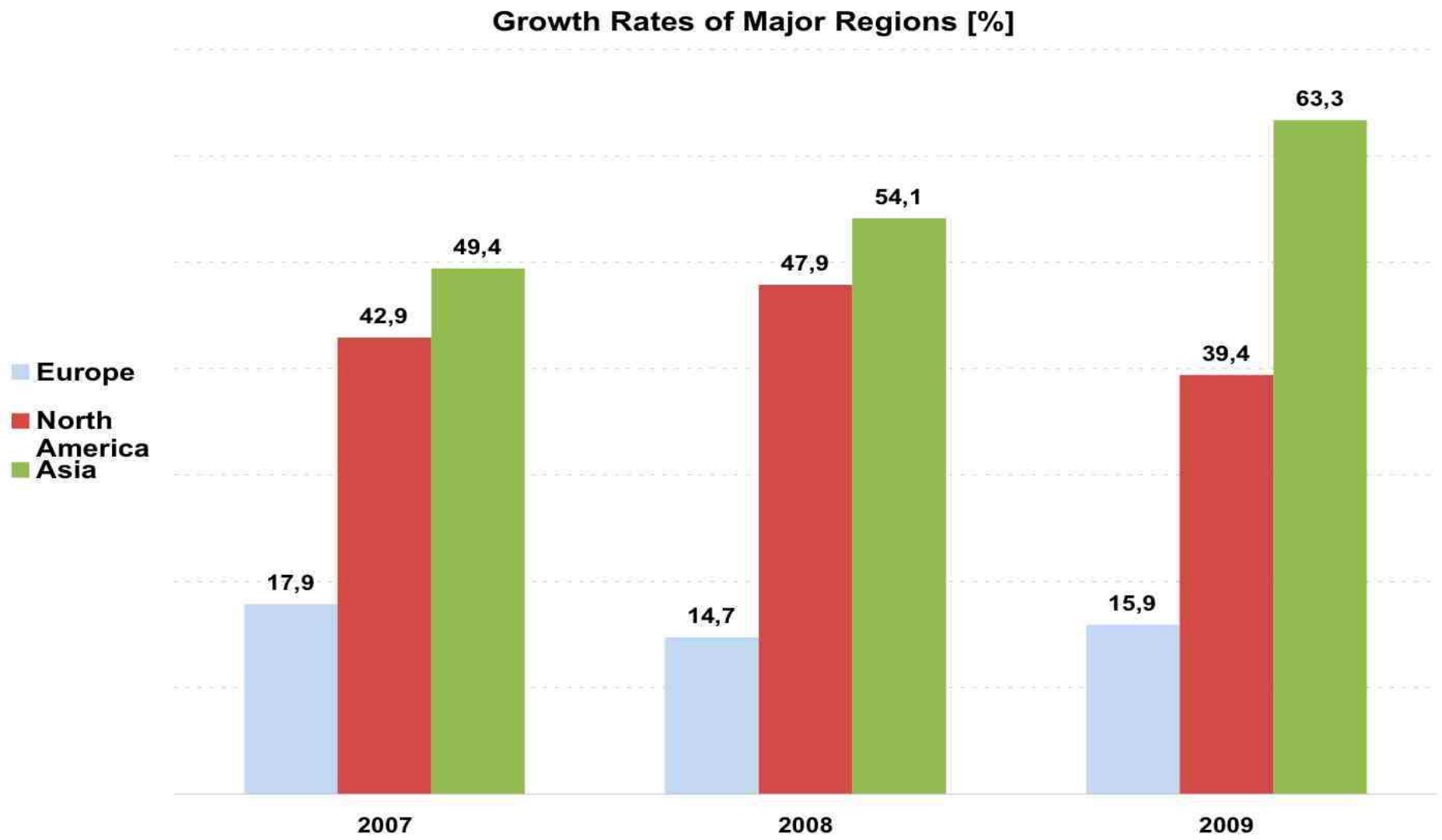
5.5. Continental Shares of Wind

Source: World Wind Energy Report 2009 (10 March 2010)



5.6. Growth Rates of Regions

Source: World Wind Energy Report 2009 (10 March 2010)



5.6. Renewable Energy Investments

Source: David Bartlett, Economic Advisor, RSM (BP)

Leading Recipients of Clean Energy Investments

Billion USD, 2012

Rank	Country	Amount	Change from 2011
# 1	China	$ 65.1	+ 20.3%
# 2	United States	35.6	– 37.3%
# 3	Germany	22.8	– 27.2%
# 4	Japan	16.3	+ 75.3%
# 5	Italy	14.7	– 51.2%
# 6	United Kingdom	8.3	– 17.0%
# 7	India	6.9	– 44.8%
# 8	South Africa	5.5	+ 18,233%
# 9	Brazil	5.3	– 32.1%

5.7. Leading Clean Energy Investments

Source: David Bartlett, Economic Advisor, RSM

Growth of Clean Energy Investments

Leading Countries

Rank	Country	Growth Rate 2007–11
# 1	South Africa	226%
# 2	Japan	46%
# 3	Italy	35%
# 4	China	35%
# 5	Turkey	26%

Types of Clean Energy Investments

Billion USD, 2012

Technology	Amount	Change from 2011
Solar	$ 126.0	– 16.0%
Wind	72.7	– 14.5%
Biofuels	2.6	– 47.0%
Other	13.5	– 32.5%

- Geothermal
- Marine
- Small Hydro
- Waste-to-Energy

5.8. Global Leaders in Renewables

Source: David Bartlett, Economic Advisor, RSM (BP)

Total Installed Capacity
Gigawatts, 2012

# 1	China	152 GW
# 2	United States	133 GW
# 3	Germany	71 GW
# 4	Spain	34 GW
# 5	Italy	31 GW
# 6	India	30 GW
# 7	Japan	27 GW
# 8	Brazil	16 GW
# 9	United Kingdom	15 GW
#10	France	14 GW

Installed Solar Capacity
Megawatts, 2011

# 1	Germany	24,820 MW
# 2	Italy	12,782 MW
# 3	Japan	4,914 MW
# 4	United States	4,389 MW
# 5	Spain	4,270 MW
# 6	China	3,000 MW
# 7	France	2,576 MW
# 8	Czech Republic	1,959 MW
# 9	Belgium	1,820 MW
#10	Australia	1,345 MW

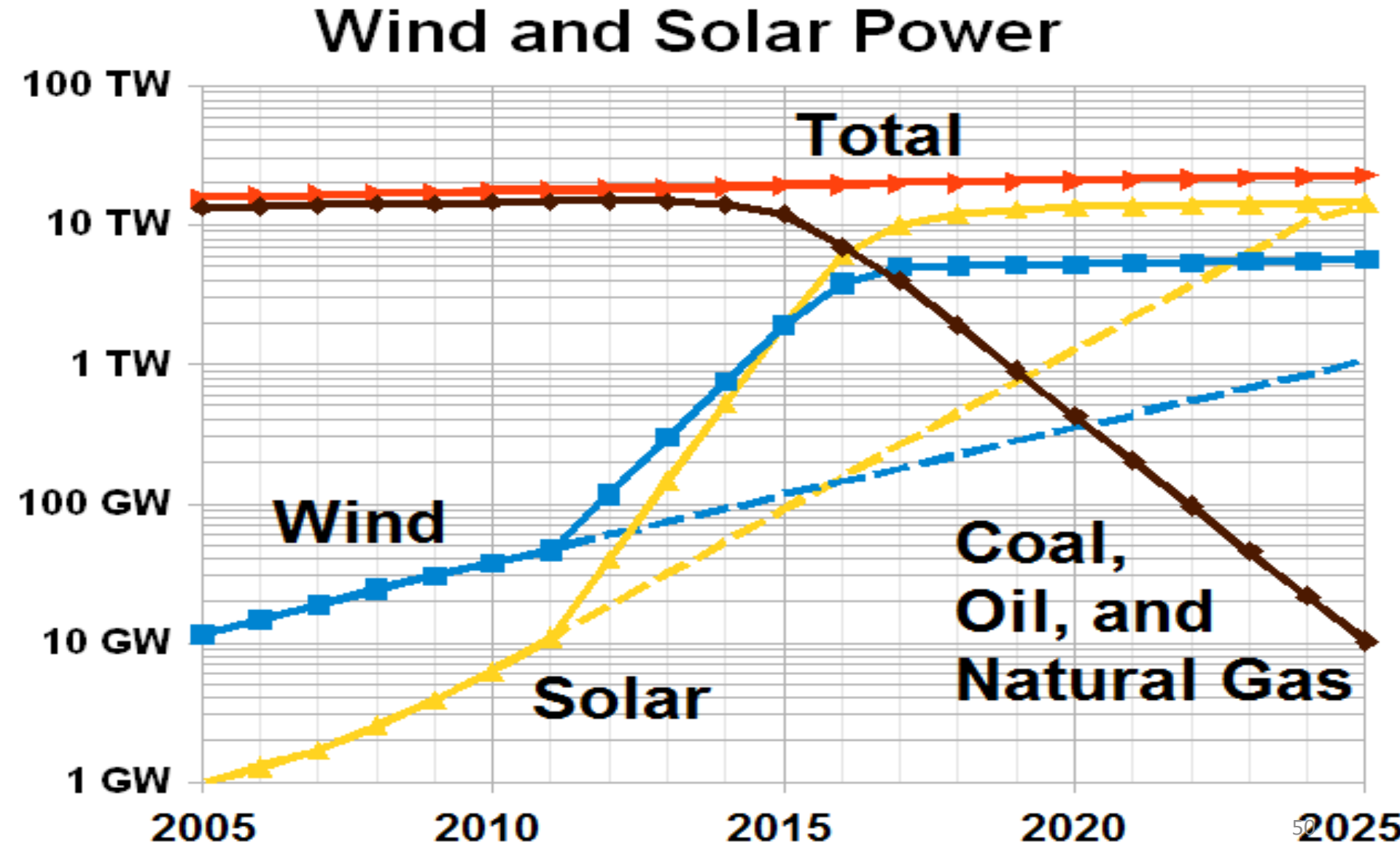
Installed Wind Capacity
Megawatts, 2011

# 1	China	62,412 MW
# 2	United States	47,084 MW
# 3	Germany	29,075 MW
# 4	Spain	21,726 MW
# 5	India	16,078 MW
# 6	France	6,836 MW
# 7	Italy	6,743 MW
# 8	United Kingdom	6,470 MW
# 9	Canada	5,278 MW
#10	Portugal	4,214 MW

Biofuels Production
Thousand Tons of Oil Equivalent, 2011

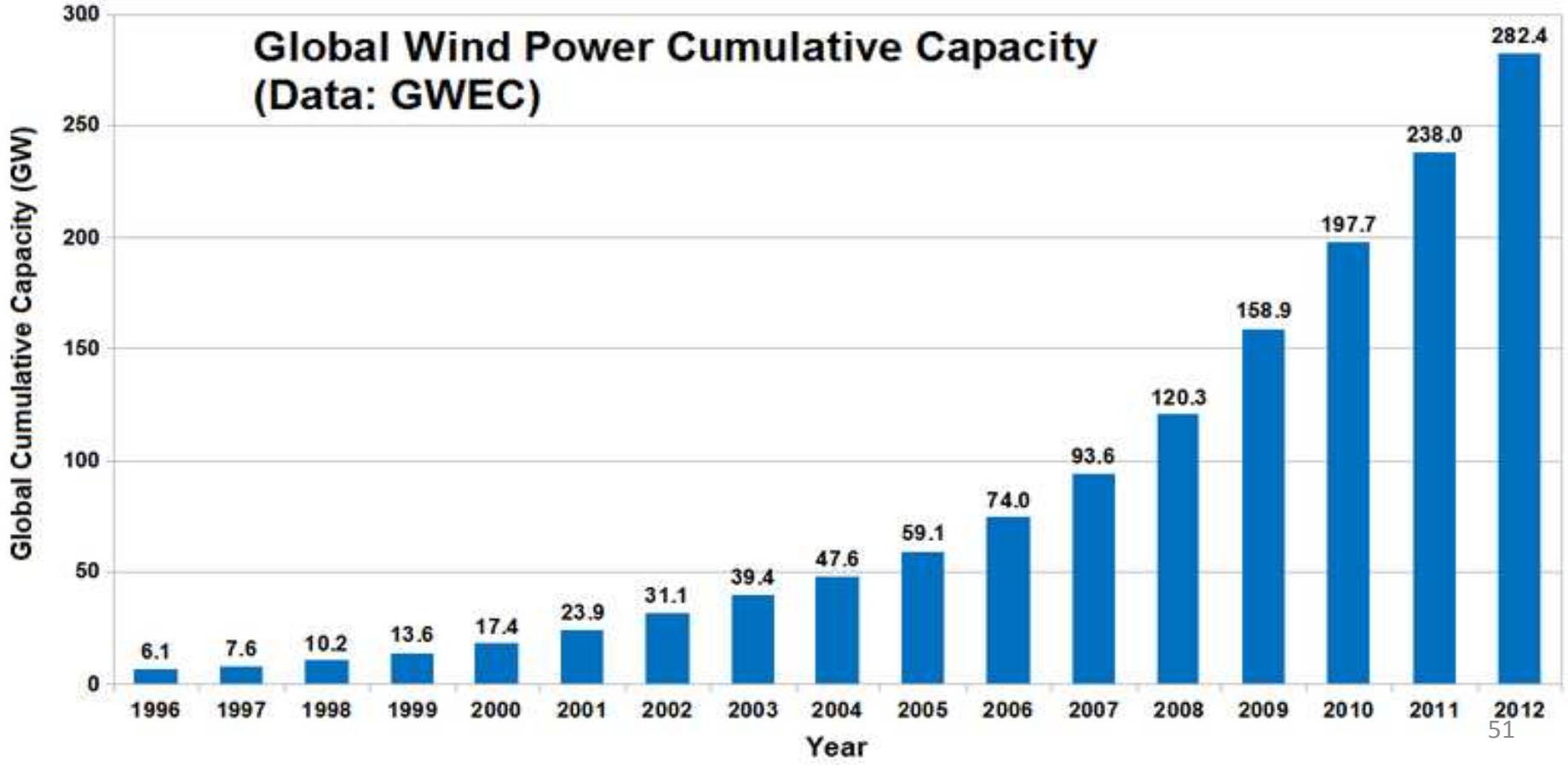
# 1	United States	28,251 TOE
# 2	Brazil	13,196 TOE
# 3	Germany	2,839 TOE
# 4	Argentina	2,233 TOE
# 5	France	1,720 TOE
# 6	China	1,149 TOE
# 7	Canada	961 TOE
# 8	Thailand	915 TOE
# 9	Spain	774 TOE
#10	Belgium	503 TOE

5.9. A Projection of Fossil, Wind & Solar Power

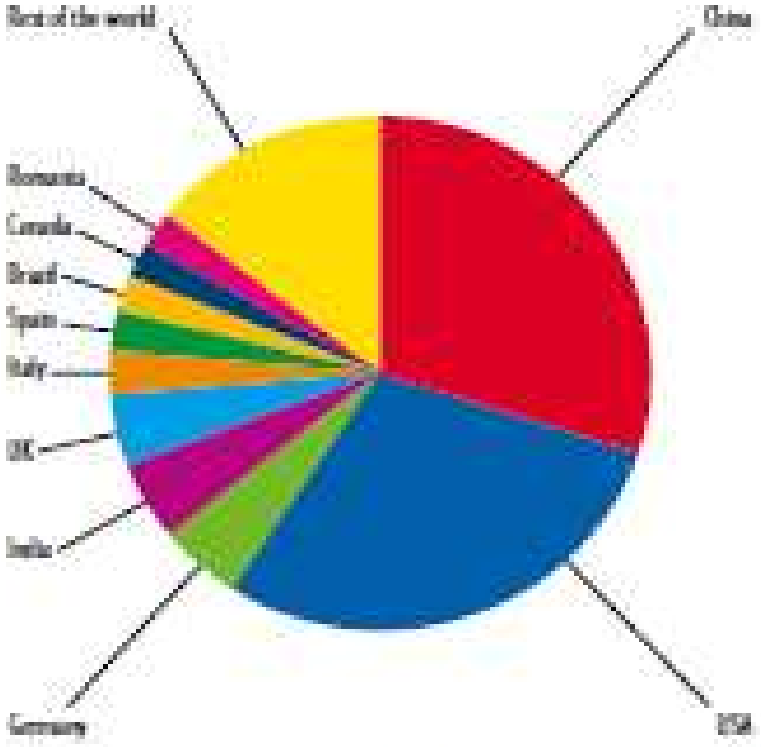


5.10. Global Wind Power Capacity

- Until 1997: USA was in the lead; until 1993: Denmark was in the lead in Europe, from 1997-2007: Germany in the lead, 2008-2009: USA & since 2010 China had highest installed capacity of wind power

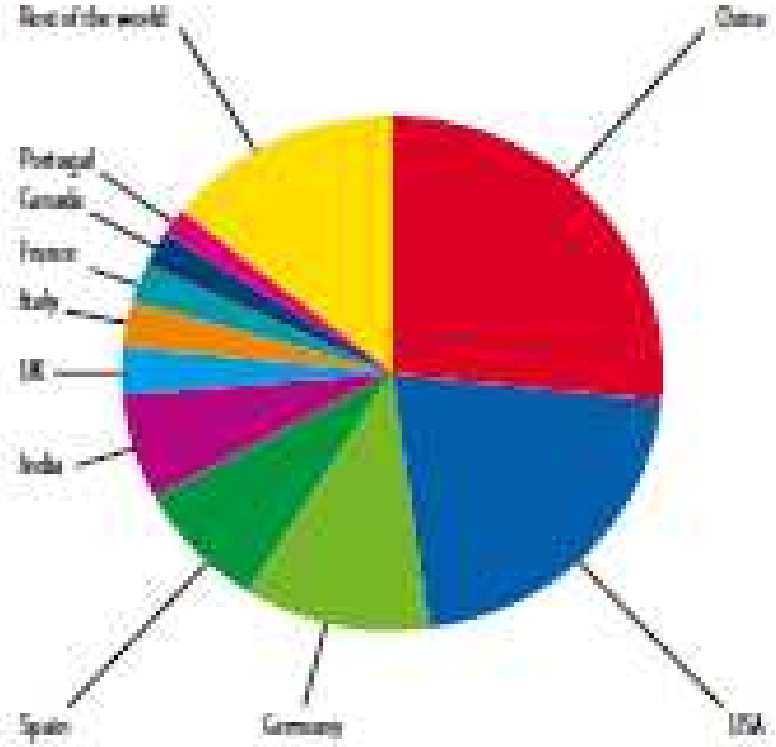


TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2012



Country	MW	% SHARE
PR China**	13,200	30
USA	13,329	29
Germany	2,900	6
India	2,336	5
UK	1,897	4.2
Italy	1,273	2.8
Spain	1,102	2.5
Brazil	1,077	2.4
Canada	935	2.1
Romania	923	2.1
Rest of the world	6,385	14.3
Total TOP 10	38,336	85.7
World Total	44,721	100.0

TOP 10 CUMULATIVE CAPACITY DEC 2012



Country	MW	% SHARE
PR China**	75,564	26.8
USA	60,007	21.3
Germany	31,332	11.1
Spain	22,796	8.1
India	18,421	6.5
UK	8,445	3.0
Italy	8,144	2.9
France**	7,196	2.5
Canada	6,200	2.2
Portugal	4,525	1.6
Rest of the world	39,853	14.1
Total TOP 10	242,638	85.9
World Total	282,492	100.0

5.13 Solar Energy: Germany, USA; China

- **2012: Germany (32,5), Italy (16,9), China (8,0), USA (7,7), Papan (6.7) PV peak power capacity in GW**
- **Concentrated Solar Power (CSP):** -2009: US in lead, since 2010: Spain; 2011: global: 1707, Spain: 1102, USA: 517 MWp (Algeria, Morocco, Egypt, Italy)
- **Germany** is world's top PV installer, PV capacity of 25 GW (2011). German PV industry installed 7.5 GW in 2011, solar PV provided 18 TW·h of electri-city in 2011, about 3% of total electricity. Some market analysts expect this could reach 25 percent by 2050.

6. What triggered energy transition?

- USA: President Carter‘s Project Interdependence was a response to OPEC‘s oil shocks 1973, 1979
- Response to popular vote against nuclear energy: Denmark (Windpower) & Austria (Wood, Biomass)
- Brazil: potential of hydropower for electricity and ethanol
- **Which factors contributed to energy transition in Germany?**
  - **Bottom-up:** Broad social & political protest of social movements & NGOs against construction of nuclear reactors: prior (1978) & after Chernobyl (1986)
  - Es**tablishment of the Green Party in 1980, election to state parliament in Hessen (1982) and to Fed. Parl. (1983**) representing peace and enviornmental movements
  - **Bottom-up:** Renewable Energy (Wind power): Small scale industruy: Enercon (Wibben, renewable energy research community)
  - Initiative of the German Federal Parliament: Awareness raising
  - **Top-Down:** Environment Ministry: since 1988 (Klaus Töpfer, Angela Merkel): goal of 25-30% of GHG emissions reduction by 2012)
  - **Concern on loosing voters:** greening of the party system: upgrading of environmental goals in order not to loose voters to the green
  - **German Reunification (1990)**: Collapse of the Economy in East Germany. Modernization of Energy, and production sector to EU, West German standards

7. Top Down Initiatives: Governments

- **Environment Ministry**: responding to ecologocal debates, especially on the climate change by natural scientists (Physicists), media, Parliament
- **Klaus Töpfer**: Issue leadership, personal mission, setting high national targets, convincing Chancellor Kohl (1990) to 25-30% GHG reduction target 2010
- **Strategic Law: Electricity Feed-in Law (1990)**
  - **Decentralization of power supply (small producers)** Network for the Decentralised Use of Energy (propoents)
  - **Opposed big electric power companies, government**
  - **Leading role of MP Hermann Scheer, EUROSOLAR**
  - **Family owner developers and producers of wind Power (Wibben, ENERCON)**

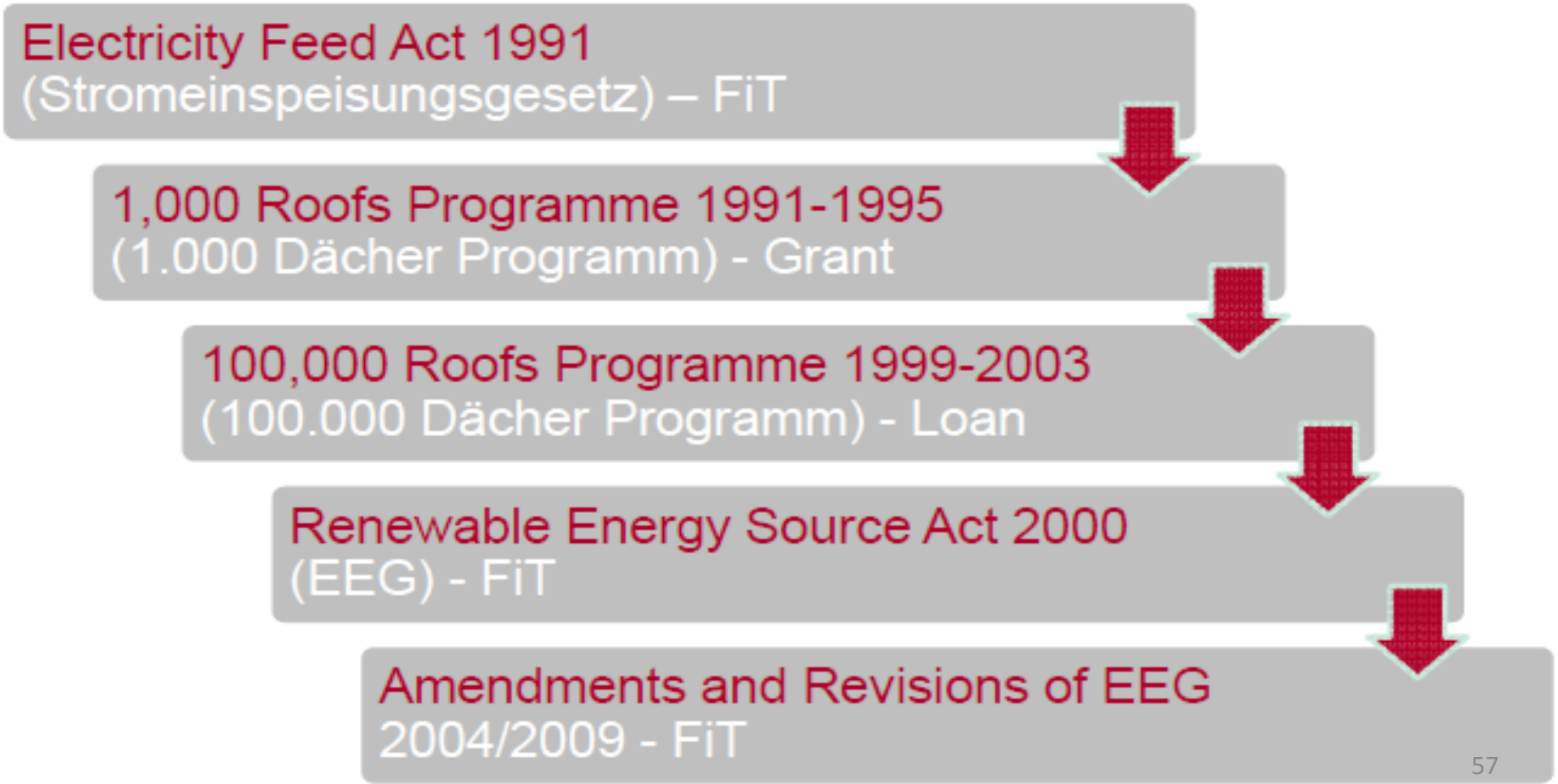
7.1. Strategic Role: of Electricity Feed-in Law

- **Sustainable Energy Transition** requires both decentralized (bottom-up) and centralized (top-down) policy initiatives
- **Electricity Feed-in Law**
  - challenged the energy supply monopoly of big energy electric power companies (RWE, EON et al.)
  - Feed-in: implies a decentralized system of supply where small energy suppliers (wind mill owners) could supply power without going through a broker (nobody had to give a permission)
  - Law offered a stable investment climate: for (public) banks and small investers
  - Important role of city local owned power distribution companies
  - This created a framework for small- and medium sized businesses (personal and family owned companies, like Aloys Wobben, ENERCON), since 1.10.2012 transferred to **Aloys-Wobben-Foundation**
  - Publicly owned Federal bank **(KfW)** played a key role together with local banks to obtain credits both for windmills or solar PV, or solar thermal panels on roof tops.
- **From a 1.000 to a 100.000 roof programme**:
- Eurosolar, Hermann Scheer modelled after a Japanese initiative (spread the demand to many house owners across the country, local banks managed federal credit programme at reduced interest rate.

7.2. German Roof Top Policy

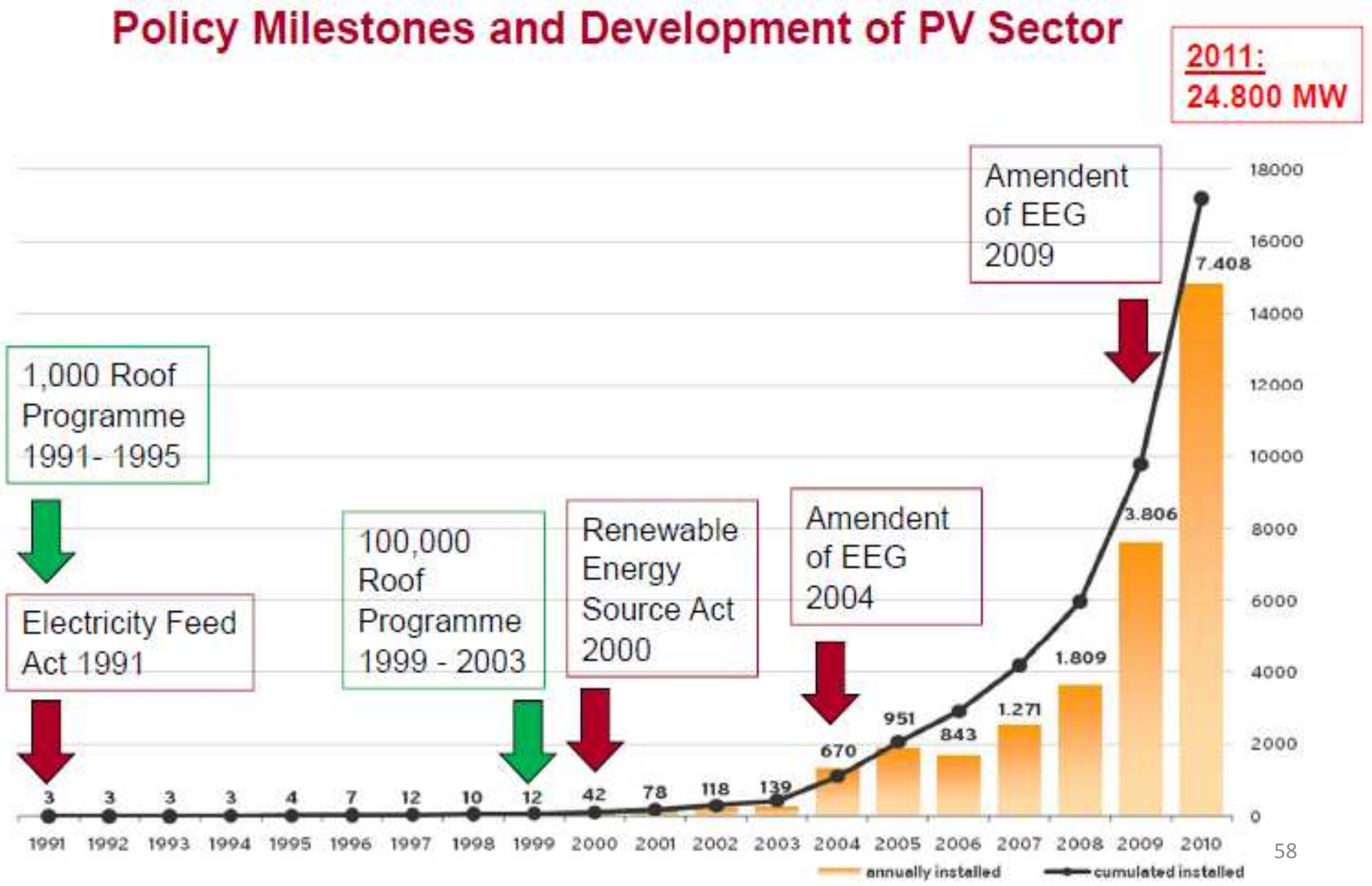
Source: Eichelbrönner/Spitzley, GIZ (2012)

Milestones of the German Roof Top Policy



7.3 Milestones of German PV Sector Development

Source: Eichelbrönner/Spitzley, GIZ (2012)

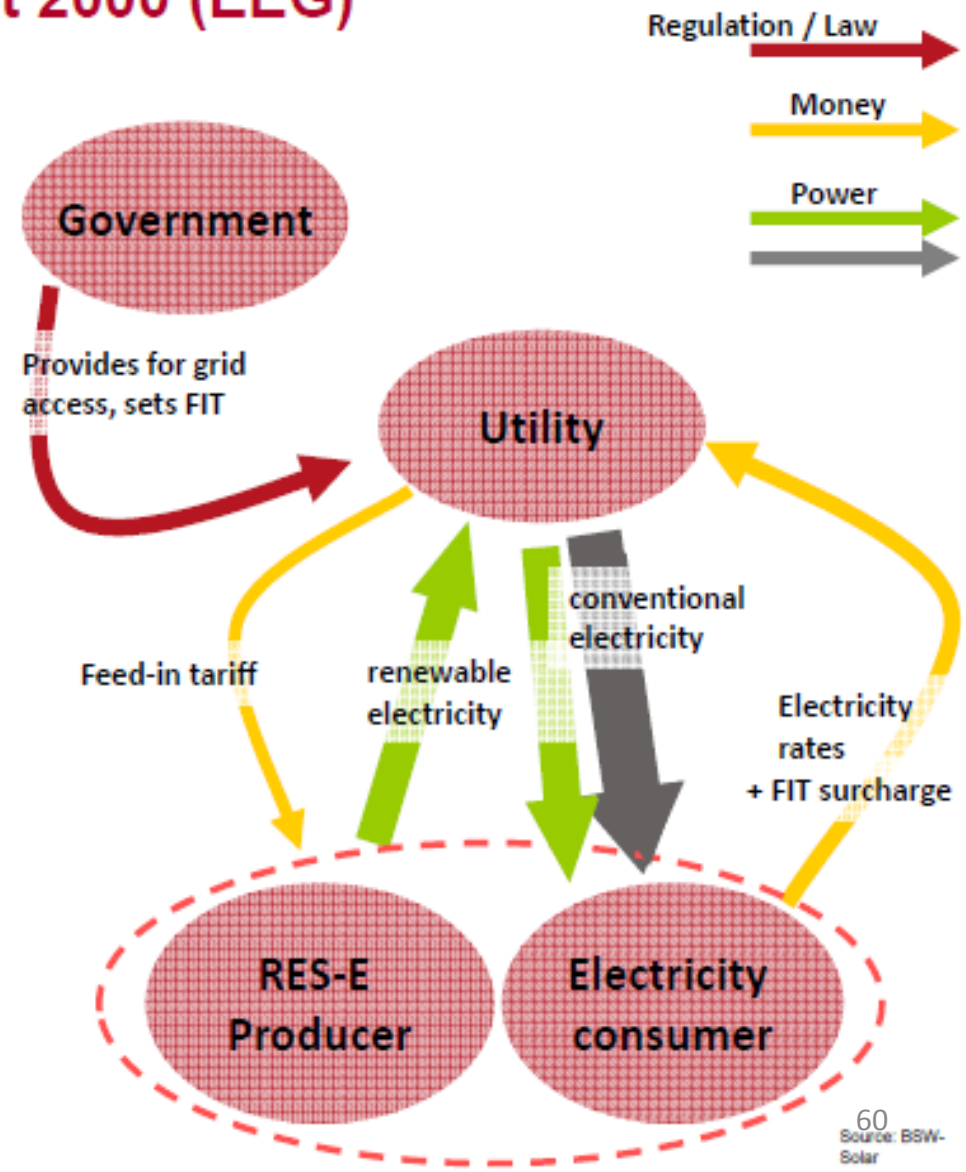


7.4. **Source: Eichelbrönner/Spitzley, GIZ**

7.5 **Source: Eichelbrönner/Spitzley, GIZ (2012)**

Renewable Source Energy Act 2000 (EEG)

- 20% RES Share of Elect. Supply by 2020
- Priority Uptake Obligation for Utilities of produced Electricity from RES
- Each kWh from RES must be purchased by the Utility (higher Tariffs than 1991)
- Fixed feed-in Tariff Payment over 20 Years
- Reduction of the Feed-in Tariff each year for newly installed RES Systems (Degression)
- Feed-in Tariffs are no State Subsidy, Costs are redistributed to the Final Consumer via the Electricity Bill
- Aim: to trigger a broad Demand and create a national RES Industry



7.6. Bottom-up: Change at the Local level: Case of my own rural small town (25.000)

- This Example shows that an energy transition is possible but must overcome economic opposition, old mindsets
- Renewable energy alternative is feasible, workable, profitable for small investors (We are the solution!) and has created nearly 400.000 new jobs and tasks of producers, installation and maintenance
- Energy Efficience control: chimney sweeper measure CO2 emission of central heat system
  - If emissions are above permitted level must be fixed other wise house owner will be fined
- New buildings need for permit a renewable component: Requirement of the State gov. of Baden-Württemberg

7.7. Change at the State Level

- Baden-Württemberg (state)
- Until 2011: 58 years a CDU (conservative) governor/PM
- Since 30 March 2011: first green governor
- My county: Neckar-Oden-wald (rural, lower income)
- My town: Mosbach (25.000 in town and 6 villages)
- All are conservative strongholds (absolute majority for CDU)
- Many research centres on renewables: Freiburg, Suttgart, Ulm

7.8. Changes at the local level

- **Neckar-Odenwald:** rural
- Had the oldest nuclear reactor: cutoff, dismantled
- My town: Mosbach: Electricity comp: city-owned
- Only renewable electricity
- One part of town heated with biomass crops
- My high-school. Contracting by electric company: profits form energy savings into the budget of the town

7.9 Awarness raising: Women teachers

- Every 2 years Climate Fair organized by an NGO. SUN
- 2013 8th climate fair: talks renewables, craftsmen Lectures,

KlimaMesse Aglasterhausen

- Major innovative force. Local greens: female elementary school teacher, chair of sun
- Organizer of cliamte fairs,

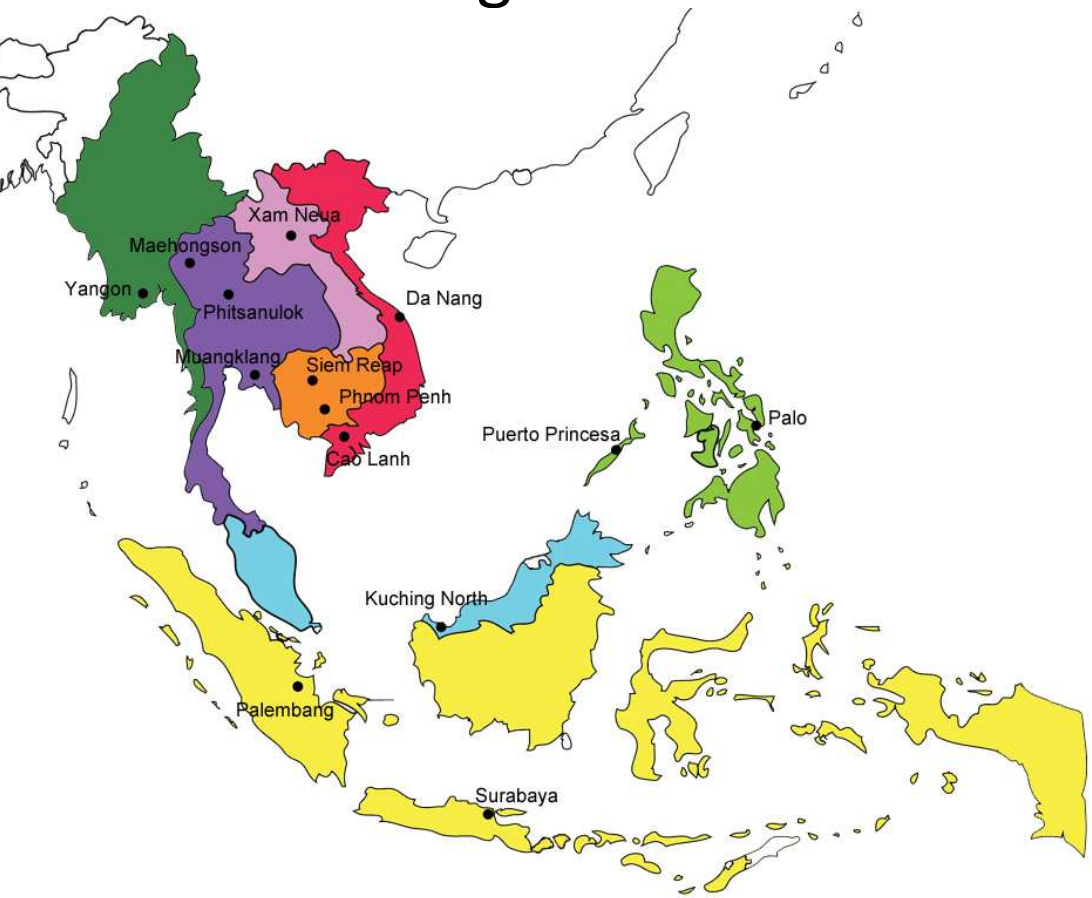
Invester: 60 members: soalr panels on roofs of public buildings, schools

My high school: cliamte and energy day: opening lecture & visits to reneable energy sites

- Part of the teaching: in natural & social sciences: awareness raising

8. Climate Change Impacts: Sustainable Energy Transition: Relevance for ASEAN?

- ASEAN: High vulnerability to climate change induced hazards



8.1. ASEAN Climate Change Initiative

- **ASEAN Climate Change Initiative** formed (2010): policy coordination, policy & strategy formulation, capacity building, technology transfer, support of IPCC and UNFCCC negotiations
  - Natural Resource Uase
  - Extreme Events
  - **Energy Policy**
  - Transport sector
  - Sustainable cities
- Climate change on Agenda of ASEAN summir in 2011, mentioned in 2012
- No common position on climate ch.
- Will to build a green ASEAN

8.2. Climate Change & Energy Policy

Climate change and the environment appear as key factors in the "*ASEAN Plan of Action for Energy Cooperation2010-2015*", adopted by the ASEAN Ministers on Energy in 2009, that defined three priorities for the energy sector, namely energy efficiency and conservation (enhance energy efficiency through regulatory and market approaches, reducing regional energy intensity,[15] and developing new energy efficiency technologies), renewable energies (achieving 15% of renewable energy on the total power installed capacity through the development and promotion of alternative sources and public-private cooperation), and clean coal technologies (strongly encouraging the use of clean coal technologies through regional cooperation).

The multi-sectoral framework for climate change is supported by a series of ASEAN-wide cultural and training activities, such as the *ASEAN Environment Year*, that aims to promote environmental awareness in the member countries and deepen the dialogue among the stakeholders at all levels, and the *ASEAN Environmental Education Action Plan*, that aims at promoting environmental education and civic responsibility at all levels.

According to the regional coalition A-FAB[25], climate change is a critical challenge for Southeast Asia, particularly because it will have far reaching social and economic consequences, exacerbating the economic disparity between and within nations, crippling the ASEAN goal of economic integration by 2015.

8.3. Final document of ASEAN Summit in Brunei, 2013

- 12. We also encouraged the various mechanisms related to **disaster management in ASEAN** … using the **ASEAN Agreement on Disaster Management and Emergency Response (AADMER)** as the common platform for disaster management. In this regard, we looked forward to the convening of the **ARF Disaster Relief Exercise (DiREx) in Thailand on 7-11 May 2013, the Mentawai Megathrust Exercise 2013-2014 in Indonesia, involving the East Asia Summit (EAS) Participating Countries, and the Disaster Emergency Response Exercise (ARDEX), in Viet Nam in October 2013**.

ASEAN Economic Community

- 27. We are determined to enhance **ASEAN energy cooperation in order to address major energy challenges and thus to ensure a secure and reliable energy supply to the ASEAN region**. We aimed to strengthen coordinating efforts between ASEAN Member States to accelerate the implementation of the **ASEAN Plan of Action for Energy Cooperation 2010-2015.**

ASEAN Socio-Cultural Community

- 43. **We acknowledged the significance of prioritising our efforts to address climate change and disaster management in 2013.** We recognised that the **human impact of climate change** is related to adaptation issues that are directly linked to the **Socio-Cultural Pillar of the ASEAN Community. We encouraged efforts to develop an ASEAN Climate Change Initiative (ACCI) and to consider an ASEAN Action Plan on Joint Response to Climate Change.**
- 44. We agreed that disaster preparedness is crucial as ASEAN Member States continue to face challenges of increasing global temperatures, more severe floods and droughts, as well as rising sea levels. We welcomed the progress in the implementation of the first phase of the AADMER Work Programme during 2010-2012 and committed to support the launching of the second phase of the Work Programme for 2013-2015.

Asia-Pacific Economic Cooperation (APEC)

- 64. … we fully support the APEC 2013 chairmanship of Indonesia … to further these objectives, through its three priorities of 'Attaining the Bogor Goals', '**Achieving Sustainable Growth with Equity' and 'Promoting Connectivity'.**

8.4. ASEAN Action Plan on Joint Response to Climate Change

- The ASEAN Leaders' Statement on Joint Response to Climate Change which was adopted on 9 April 2010 at the 16th ASEAN Summit *recognizes* that the Southeast Asian region is vulnerable to climate change which will seriously affect most of aspects of livelihood and limit ASEAN development options for the future, including regional efforts towards the achievement of the Millennium Development Goals; … (Paragraph 21).

Strategic Objectives for Addressing Climate Change in the Region

- **To enhance research collaboration on climate change science in ASEAN.**

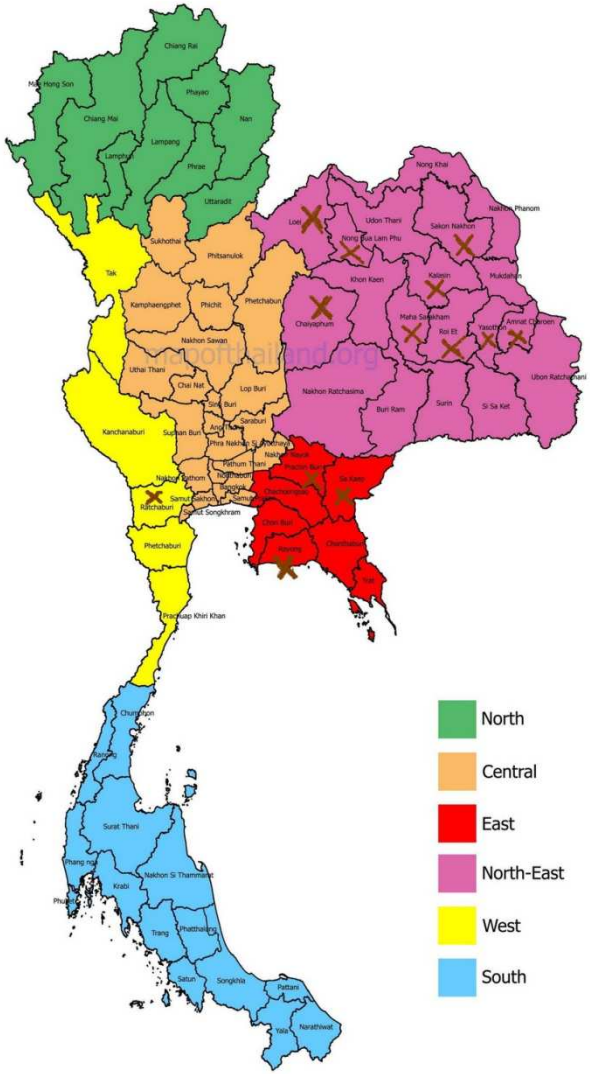
Programme of Action for Addressing Climate Change in the Region

- Sharing information on R&D in hydrological. agricultural management & practices that aim to enhance food security, agricultural productivity and **water resources sustainability;**
- Sharing information on ongoing 6 planned adaptation efforts in urban, rural, coastal areas;
- Enhancing existing ASEAN climate/meteorological/oceanographical centers
- Developing ASEAN work programme to address loss and damage, & options for risk management.

C.4 Technology Transfer

- Facilitating international support for, **technology transfer to ASEAN**
- **Sharing inform. & experiences on interface towards low carbon development & green economy;**
- **Establishing strategic alliances with private sector to promote R&D collaboration and technology transfer and commercialisation.**
- **There is no reference to the need for a sustainable energy policy!**

8.5. Sustainable Energy Transition Relevance for Thailand



- For the past decade, Thailand has experienced significant economic growth, moving into the World Bank's upper middle income bracket.
- This period of growth has led to an ever-growing demand for resources: over the last 25 years energy consumption has grown at 6.2 per cent per annum.
- Looking forward, meeting this demand will become increa-singly challenging, making energy security a focus for the coming years.

8.6. Thaland‘s New Energy Architecture

Ministry of Energy & World Economic Forum explore how Thailand can create a new energy architecture that is secure, sustainable and affordable. Three key steps:

•Improving efficiency through energy literacy

The Ministry of Energy has set a target of reducing energy intensity by 25 per cent in 2030, compared with that in 2005, or equivalent to reduction of final energy consumption by 20 per cent in 2030.

Promoting behavioural change through improved energy literacy will be central to achieving this. The public needs to better understand the true costs and challenges involved in securing supplies, and the implications of government targets for their everyday lives. Lessons can be learnt from Japan's post-Fukushima efficiency gains, where a national drive for setsuden (conserving energy) galvanised the population into action.

•Increasing diversification to spread risks

Thailand's transportation sector is dominated by the use of **petroleum products sourced from overseas**, while the country's power generation is dependent on natural gas. This dual threat has seen its energy import bill balloon to Bt847 billion in 2011, a 26.2 per cent increase on 2010. Thailand is pursuing a policy of diversification, with the shares of coal, nuclear and renewables slated to rise over the coming decades. Meeting government targets for a new energy mix requires taking an inclusive, collaborative approach, in which policies are shaped across stakeholder groups in public-private partnerships, with benefits, such as job creation, shared with local communities.

•Playing a central role in regional energy integration

The formation of the Asean Economic Community (AEC) … can bring significant energy security benefits, competitive advantage of the Asean market. Thailand has the opportunity to become a hub for energy trade in a number of different sectors, including gas, electricity and biofuels. Central to achieving this ambition will be the expansion of Thailand's internal energy infrastructure, such as its gas pipeline network, as well as its connections with its neighbours, as through the **Trans-Asean gas pipeline.**. Potential obstacles may slow the pace of integration, including permitting processes, finance requirements, and the need for harmonised technical standards across countries.

To overcome such challenges requires a robust strategy, and strong leadership. Striking the balance between economic growth, environmental sustainability and energy security will entail trade-offs and difficult choices to be made. If Thailand is to retain its regional competitiveness in AEC, bold decisions needed to position it effectively for tomorrow.

8.7. Thailand‘s renewable energy policy

Source: Dr. Sopitsuda Tongsopit and Dr. Chris Greacen, 31.5.2012

- Thailand was one of the first Asian countries with a **compre-henive feed-in tariff** (adder). The program in place since 2006 and gone through successive phases of adjustment, in particular in response to **higher-than predicted response by industry** in the form of applications submitted for interconnection.
- As of **December 2011, Thailand has about 8,000 megawatts of renewable energy projects in the pipeline** seeking adder & about 1,000 megawatts already connected and selling power to the grid.
- Overview of Thailand’s grid-connected renewable energy support focus on **adder measure**, which has been the **major mechanism that drives the growth in Thailand’s renewable energy capacity.**
- Strengths and weaknesses of adder program and recent policy and regulatory changes that have reduced the program’s effectiveness.

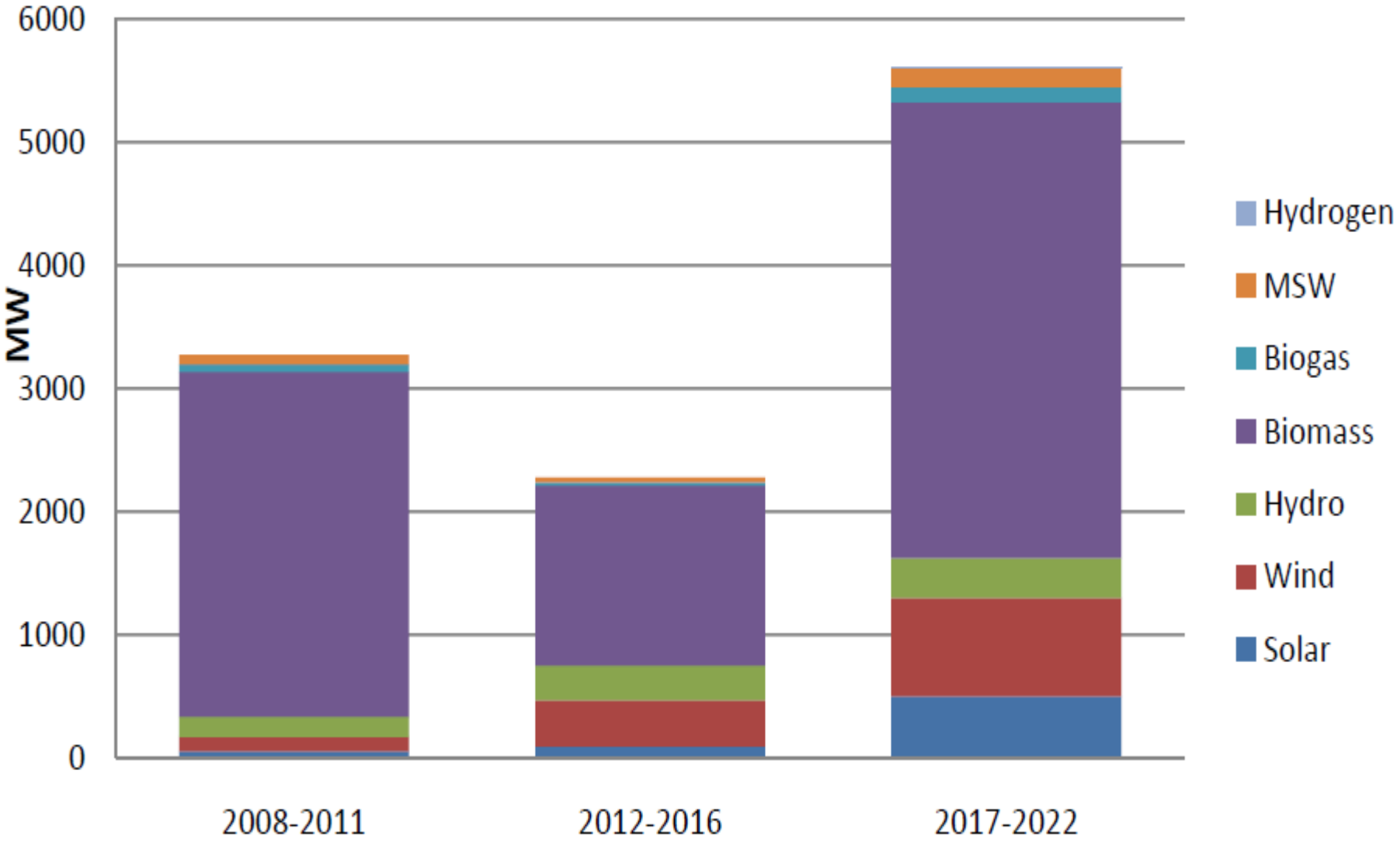
8.8. Renewable Energy Capacity in Thailand

Energy Type	Technical Potential	Capacity at 2008[2]	2008-2011 Targets		2012-2016 Targets		2017-2022 Targets	
(Electric Power)	MW	MW	MW	Ktoe	MW	ktoe	MW	Ktoe
Solar	50,000	32	55	6	95	11	500	56
Wind	1,600	1	115	13	375	42	800	89
Hydro	700	56	165	43	281	73	324	85
Biomass	4,400	1,610	2,800	1,463	3,220	1,682	3,700	1,933
Biogas	190	46	60	27	90	40	120	54
MSW	400	5	78	35	130	58	160	72
Hydrogen			0	0	0	0	3.5	1
Total	57,290	1,750	3,273	1,587	4,191	1,906	5,607.5	2,290

Table 1: Renewable Power Goals in Thailand's 15-year Renewable Energy Development Plan (2008-2022)

8.9. Thailand‘s renewable energy targets

Thailand’s renewable energy targets according to the 15-Year Renewable Energy Development Plan (REDP 2008-2022)



9. Bottom Up: Transform Way of Life, Values, Preferences, Attitudes

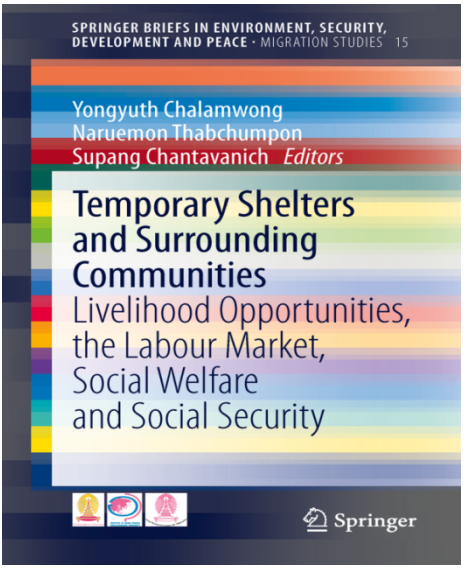
- The discussion on the bottom-up approaches to Sustainability Transition refers to social and cultural dimension on human values, preferences, attitudes that influence our behaviour as consumers of energy products (with a high carbon footprint)
- While sustainable production refers to the supply side, sustainable conumption refers to the demand side.
- As a close interaction between top-down and bottom-up initiatives on sustainable energy transition is needed both the hard (supply) and soft side (demand) matter.
- The proposal for a sufficiency economy reflects this link.

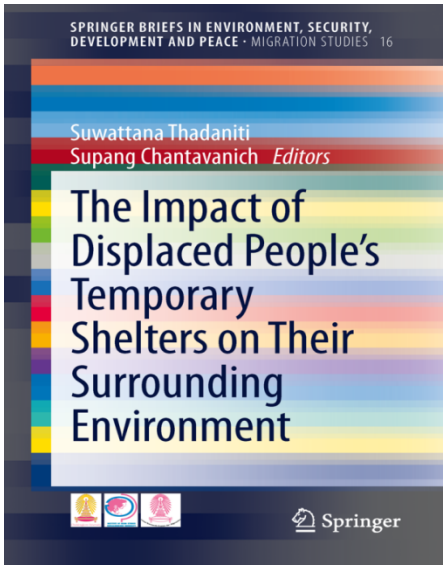
Thank you for your attention and patience

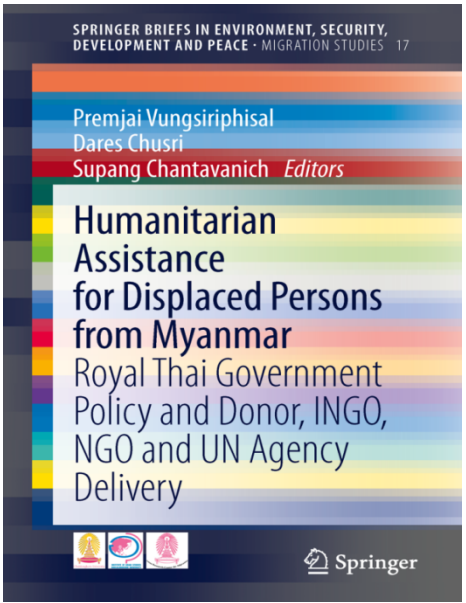
Text soon for download at:

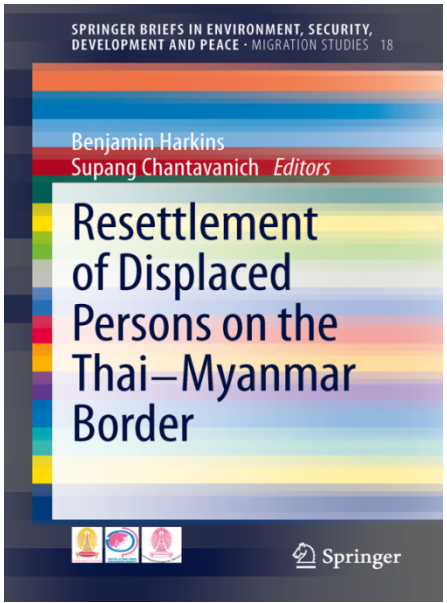
http://www.afes-

Possible Venue for Winter School Results









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