DEVELOPING RENEWABLES
Renewable Energy that benefits all

RTD4EDC project – Final Report

Project summary

The RTD4EDC project provides recommendations and a synthetic and accessible information basis on lessons learned regarding the implementation of renewable energy technologies in emerging and developing countries, the impact of RTD&D in this perspective and the opportunities for EU industry.

The potential for renewable energy in emerging and developing countries is high and RTD&D is an enabling factor in:

- **furthering the implementation of renewable energy in emerging and developing countries**
- **facilitating the EU industry to access these high potential markets**

but these impacts should be improved.

Partners for Innovation BV, Amsterdam, November 2008

SIXTH FRAMEWORK PROGRAMME PRIORITY 3
Underpinning the economic potential and cohesion of a larger and more integrated EU

SPECIFIC SUPPORT ACTION

Project Acronym:	RTD4EDC
Project full title:	RTD&D to increase the share of renewables in emerging and developing countries with European technologies; Policy Assessment, Stakeholders opinions, Best-practices & Recommendations
Contract number:	under negotiation
Start date of contract:	January 2007

Acknowledgement

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We also like to thank for their valuable input as members of the Advisory Board: Dr. Rolf Linkohr (director of CERES, the Centre for European Energy Strategy), Mr. Ugo Farinelli (Secretary General, Associazione Italiana Economisti dell'Energia), Mr. Hans Schneider (Senior Adviser, Builddesk) and Prof. Eberhard Jochem (Fraunhofer ISI).

The project team,

Amsterdam, November 2008

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Management summary

The future energy demand worldwide will increase by 45% in 2030[1]. To be able to meet this demand, respond to the threats of Climate Change and also improve access to energy for the very poor in emerging and developing countries (especially in rural areas) renewable energy technologies play a crucial role.

The European Union envisions a thriving and sustainable future economy, with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies as a motor for prosperity and a key contributor to growth and jobs.
Strengthening of the international dimension in European Technology Platforms and in Joint Technology Initiatives is a priority in the EU. The demographic trends in Europe coupled with an ambitious strategy of growth based on the Lisbon agenda provide a new context for considering international co-operation in Science and Technology. No fortress Europe, but an open Europe - building open 'win-win' S&T relations with EDCs.

The RTD4EDC project is focussed on the role of research, technological development and demonstration (RTD&D) in the implementation of renewable energy technologies in Emerging and Developing Countries (EDCs). The project is executed by a consortium of four partners based in Europe (Belgium/The Netherlands), and in Emerging and Developing Countries (Paraguay, South-Africa and India).

The project consisted of desk research on relevant policies and developments, interviews with policymakers, representatives from EU RE industries and development cooperation agencies, a survey amongst EU RE industry representatives and analysis of 74 cases of RE implementations in EDCs.

In this report the overall results are presented. Other deliverables are three reports with background material (policies, case studies and market potential for EU RE industry) and a website (www.developingrenewables.org) containing all information as reported and with a database containing the 74 cases of RE implementations in EDCs.

Conclusions

1. The potential for renewable energy in emerging and developing countries is high.

- Market growth (up to 2020) of Renewable Energy in EDCs is the same size as in developed countries.
- EU RE Industry representatives perceives EDCs as (highly) attractive markets but there are big differences between different regions and RE technologies.
- In some EDCs, especially China and India, renewable energy is outpacing the expectations of a few years ago.

2. RTD&D is an enabling factor in furthering the implementation of renewable energy in emerging and developing countries.

- Research and demonstration activities in the area of (renewable) energy are crucial in international cooperation.
- Research and technological development furthers the implementation of renewable energy technologies.

[1] World Energy Outlook 2008, International Energy Agency, Paris

- Renewable energy demonstration projects with high visibility and long-term sustainability enhance the implementation of renewables.

3. RTD&D plays an important role in facilitating the EU industry to access these high potential markets.

- RTD&D can help to solve the barriers obstructing large-scale deployment of renewables.
- RTD&D cooperation can have advantages for EU industry and local actors.
- RTD&D can assist in acquiring market access.

4. These impacts of renewable energy RTD&D should be improved.

- Public and private budgets for Energy research and technological development have declined in the last 25 years.
- The EU RE sector still has a prominent role but is under pressure.
- Current EU policy framework provides many possibilities for Renewable Energy RTD&D related to EDCs but actual activities are still limited.
- EU RTD&D instruments and activities related to EDCs lack focus on Renewable Energy.

Recommendations:

1. Building strong, durable partnerships between EU and EDC research communities

- Increase participation of EDC partners in Framework Programmes.
- Initiate EU-EDC Technology Platform on Renewable Energy.

2. Building strategic partnerships between EU industry and local stakeholders

- Organize partnership events with EU Renewable Energy and local EDC stakeholders in different regions and countries.
- RTD and Demonstration projects can be helpful to enter markets in EDCs and to raise awareness and trust, but follow-up is needed to achieve multiplication.
- Support the implementation of financial policies & instruments, such as Feed-in Tariff and Investment Funds. These are very effective ways to get RE to EDCs.

3. RTD&D efforts should be focussed on specific local needs and socio-economic circumstances

- Stimulate market orientated and policy research;
- Improve the information basis and its accessibility;
- Increase local ownership;
- Stimulate large scale and sustainable best practices;
- Create and develop knowledge networks between different actors in EU and EDCs;
- Improve capacity development;
- Improve involvement of local RTD stakeholders;
- Strengthen the awareness and knowledge levels of policy makers;
- Stimulate policy and funding for public R&D by S&T cooperation dialogues.

4. Improving the learning curve by ensuring previously acquired knowledge is available and accessible

- Increase the knowledge base of - and accessibility to information on actual RE implementations.
- Improvement of knowledge management within the donor organisations.
- Bring together experiences from different sources.
- Create a toolbox and knowledge network for local policymakers.

List of Acronyms

ACORE	American Council on Renewable Energy
ADB	Asian Development Bank
AfDB	African Development Bank
AMKN	African Micro hydro Knowledge Network
APEC	Asia Pacific Economic Cooperation
AREED	African Rural Energy Enterprise Development
APPCDC	Asia-Pacific Partnership on Clean Development and Climate
APRM	African Peer Review Mechanism
ASTAE	Asia Alternative Energy Unit
BIREC	Beijing International Renewable Energy Conference 2005
CDM	Clean Development Mechanism
CERs	Certificates of Emission Reductions
CHP	Combined Heat and Power
CO2	Carbon Dioxide
CPV	Concentrating Photovoltaic
CRED	Chinese Centre for Renewable Energy Development
CRESP	China Renewable Energy Scale-Up Program
CSD	Commission on Sustainable Development
CSP	Concentrating Solar Power
CTI	Climate Technology Initiative
CYTED	Science and Technology Development Program
DFID UK	Department for International Development UK
DGIS	Netherlands Directorate General of International Cooperation
EAP	Environmental Action Program
EBRD	European Bank for Reconstruction and Development
ECAs	Export Credit Agencies
EDC(s)	Emerging and Developing Countries
EEA	European Environment Agency
EGNRET	Expert Group on New and Renewable Energy Technologies
EGS	Enhanced Geothermal Systems
EJEDSA	Empresa Jujeña de Sistemas Energeticos Dispersos
EPA	Environmental Protection Agency
ESMAP	Energy Sector Management Assistance Program
ETP	Energy Technology Platform
ETS	Emissions Trading System
EU	European Union
EUEI	European Union Energy Initiative
EWEA	European Wind Energy Association
EWG	Energy Working Group
FDI	Foreign Direct Investment
FP	(EU Research) Framework Programme
GEF	Global Environment Facility
GHG	Greenhouse Gases
GMI	Global Market Initiative
GNESD	Global Network on Energy for Sustainable Development
GREFF	Global Renewable Energy Fund of Funds
GVEP	Global Village Energy Partnership
GW	Giga Watts
IA	(EIA) Implementing Agreement (Program)
IAP	International Action Program
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IDB	Inter-American Development Bank
IEA	International Energy Agency
IIA	International Investment Agreements
IPO	Initial Public Offering
IPP	Independent Power Purchase
IREDA	Indian Renewable Energy Development Authority
JI	Joint Implementation
JPoI	Johannesburg Plan of Implementation
JREC	Johannesburg Renewable Energy Coalition
JTI	Joint Technology Initiative
kW(h)	Kilowatt (hours)
MDGs	Millennium Development Goals
MFI	Micro Finance Institution
MIGA	Multilateral Investment Guarantee Agency
Mtoe	Million tons of oil equivalents
MW(h)	Megawatt (hours)
NEPAD	New Partnership for Africa's Development
NGO	Non Government Organization
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PPA	Power Purchase Agreements
PTC	Production Tax Credit
PV	Photovoltaic
RE	Renewable Energy
REEEP	Renewable Energy and Energy Efficiency Partnership
REIA	Renewable Energy in the Americas
REN21	Renewable Energy Network 21
REPIN	Regulatory Environmental Program Implementation Network
REPSO	Renewable Energy Program Support Office
RET	Renewable Energy Technology
RTD(&D)	Research and Technological Development and Demonstration
SHS	Solar Home Systems
SMEs	Small and Medium Enterprises
S&T	Science and Technology
SWH	Solar Water Heating
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
UNFCCC	United Nations Framework Convention on Climate Change
UNSO	United Nations Statistical Office
UNIDO	United Nations Industrial Development Organization
USAID	US Agency for International Development
USDOE	United States Department of Energy
VAT	Value Added Tax
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization

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PART I: Introduction

Setting the scene

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Setting the scene

The future energy demand worldwide will increase by 45% in 2030[2]. To be able to meet this demand, respond to the threats of Climate Change and also improve access to energy for the very poor in emerging and developing countries (especially in rural areas) renewable energy technologies play a crucial role.

The European Union envisions a thriving and sustainable future economy, with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies as a motor for prosperity and a key contributor to growth and jobs.
The European Union is one of the frontrunners in developing pro-active policies in the field of energy security and climate change and in supporting the development of new clean technology that can reduce global emissions of greenhouse gases.

- Energy security and access to reliable, affordable, and clean energy are key issues on the global agenda and of paramount importance to economic growth and development in emerging and developing countries.
- Climate change is an environmental problem and also poses a clear risk to economic development and international stability and security. Developing countries and the poorest populations are likely to be hit disproportionately.

RTD&D addresses the earlier phases in the innovation processes that can pave the way towards large-scale implementation of new technological products and systems.

The EU gives priority to strengthening of the international dimension in European Technology Platforms and in Joint Technology Initiatives. The demographic trends in Europe coupled with an ambitious strategy of growth based on the Lisbon agenda provide a new context for considering international co-operation in Science and Technology. No fortress Europe, but an open Europe - building open 'win-win' S&T relations with EDCs.

RTD4EDC project

The RTD4EDC project is focussed on the role of research, technological development and demonstration (RTD&D) in the implementation of renewable energy technologies in Emerging and Developing Countries (EDCs). The project is executed by a consortium of four partners based in Europe (Belgium/The Netherlands), and in Emerging and Developing Countries (Paraguay, South-Africa and India).

The RTD4EDC project aims at providing:

1. Clear 'recipes' for future RTD&D activities for the European Commission, based on a better understanding of:
2. Increased opportunities for European renewables industry to export to EDCs due to:

The main target group for this report are relevant policymakers within the European Commission.

For executing the project, the project team has used the following methodologies:

Work package 1	- General information gathering and desk research on relevant policies, programmes and partnerships; - In-depth interviews with policy makers and experts;
Work package 2	- Analysis of 75 best and worst practices;
Work package 3	- Survey amongst EU Renewable Energy industry representatives;

[2] World Energy Outlook 2008, International Energy Agency, Paris

Work package 4 - Confronting, integrating and synthesising of findings;
- Organisation of a workshop for validation of results and recommendations.

The main output of the project will include reports on the above-mentioned results, but also a website (www.developingrenewables.org), fully disclosing all gathered data, information and results.

RTD4EDC will deliver this "overall final report" and three underlying reports:
- WP 1: The role of EU RTD&D policy to increase implementation of renewables in EDCs;
- WP 2: Compilation and analysis of 74 Renewable Energy case studies in Emerging and Developing Countries;
- WP 3: Evaluation of export potential for EU RE industry and identification of effective RTD&D policies.

The management summaries of above three reports are included as annexes of this report, respectively Annex B, C and D.

Scope of the RTD4EDC project

The scope of the RTD4EDC project is a very specific one: renewable energy, EDCs and focussed on RTD&D policies. The following paragraphs describe in more detail these three aspects.

Renewable Energy: Market-technology-equipment combinations

Renewable Energy is a broad subject that includes a wide range of technologies (e.g. solar thermal, photovoltaic and wind), markets (e.g. residential, industrial, grid-connected) and applications (e.g. electricity, heat). As already was identified in the RECIPES project [30], being able to make a thorough analysis and give clear recommendations one needs to look at specific renewable energy *market-technology-equipment combinations*. In the RECIPES project the market-technology-equipment combinations under study have been defined. The market-technology-equipment combinations, taken into account in the RECIPES project, are presented in Table 1. These market-technology-equipment combinations will also be subject of study for the current 'RTD4EDC' project. The combinations are grouped on basis of the renewable energy source. The following table presents an overview of the market-technology-equipment combinations based on energy source and end-use.

RE technology	RE market-technology-equipment combinations
Solar thermal	▪ Hot water for residential, commercial and public use in all areas ▪ Solar thermal processes for industrial use
Photovoltaic	▪ Electricity for grid connected single users and large fields ▪ Electricity for rural areas as stand alone or for local grid
Wind	▪ Grid connected electricity from on shore and off-shore wind parks ▪ Electricity from single turbines, grid connected ▪ Electricity for rural residential and public services as stand alone or local grid ▪ Mechanical power (water pumping, milling)
Geothermal	▪ Electricity grid connected ▪ Heat for local industry or public services
Small and medium size hydro power	▪ Grid connected electricity (medium size) ▪ Stand alone or local grid electricity for rural residential and public services ▪ Mechanical power for milling (small)
Bio-energy	▪ Cooking and heat for rural residential ▪ Bio gas for cooking and heating for rural residential

RE technology	RE market-technology-equipment combinations
	▪ Stand alone wood and agro waste combustion/waste digestion for cogeneration ▪ Grid connected electricity with wood combustion and gasification ▪ Grid connected electricity with agro digesters or incineration of city waste ▪ Bio fuels from energy crops

Table 1 Market-technology-equipment combinations

EDCs: Countries under study

In work packages 1, 2 and 3 information is gathered from emerging and developing countries. As the European Commission INCO list consists of 115 countries for practical reasons a selection of countries is made. To provide an understanding of the role of RTD&D and an overview of best practices in EDCs, it is not deemed necessary to use information from all these 115 countries – the project team has attempted to base the conclusions on a representative sample of countries. The countries that where studied in depth are given in the next table.

Africa	Latin America / Caribbean	Asia and Pacific
1. South-Africa	6. Argentina	11. China
2. Ghana	7. Brazil	12. India
3. Cameroon	8. Mexico	13. Indonesia
4. Uganda	9. Colombia	14. Philippines
5. Niger	10. Peru	15. Thailand

Table 2 Selection of countries for identification of best practices and evaluation of market potentials

The selection of the countries is based on achieving a well-balanced spread with regard to geographic, climate and socio-economic characteristics. These countries were also studied in the preceding RECIPES project, during which relations with local experts were established in each country. [30]

It should be noted that when is spoken in this report about Africa (African countries), Latin-America (Latin-American countries) and Asia (Asian countries) we usually mean only the Emerging and Developing countries in these regions.

Research Technological Development & Demonstration

When we speak about RTD&D (Research Technological Development & Demonstration) policies we do not only address technological issues but look at it in a broader context. Policy and socio-economic research, investigating effective business models and financing schemes and looking at issues like market access, capacities of people (business, industry and government) and industry potential are also looked at.

RTD4EDC validation activities

Within the RTD4EDC project a number of activities have been executed to integrate other persons (outside the project team) opinions and to validate the results. In Annex E all validation activities have been described in more detail. In Annex F all actors involved have been mentioned.

First of all an Advisory Board has been established at the start of the project. Role of the Advisory Board was: “To steer the project by giving recommendations, both on the chosen approach and on critical issues occurring during the study”. The Advisory Board was consulted three times during the project.

Secondly 38 people have been interviewed including: EC policy makers, policy makers in EDCs, program managers involved in RE projects in EDCs and EU RE industry representatives. Thirdly 53 EU RE industry representatives have answered a survey going into detail about the current market potential for RE in EDCs.

Fourthly the draft results of the RTD4EDC project where presented at the Tenth World Renewable Energy Congress and Exhibition, 22-23 July 2008 in Glasgow, Scotland, United Kingdom. Project team member Siem Haffmans presented the draft results at the European Workshop: "Success factors for International Cooperation on Research, Technological Development and Demonstration in the Area of Renewable Energy".

Finally a validation workshop was organised by the project team on 29 September 2008 in Brussels. At this meeting, with 12 persons representing the EC and EU RE industry, the draft results where presented and the recommendations discussed. The results of this validation workshop have been incorporated in this final report.

Relevant EU policy areas

When looking at EU policy areas that are (partly) dealing with RTD&D and/or Renewable Energy in EDCs, a wide range of policies has relevance to the subject of this study. The Desk Research was the starting point of the RTD4EDC project. It included the following domains and communities of overlapping activities and sources of information:

1. (EU) Policy for the global development; for supporting emerging and developing countries;
2. (EU) Policy on climate change;
3. (EU) RTD Policy in the field of energy and renewable energy sources;
4. (EU) Policy on innovation, dissemination and the role of the European industry in global markets.

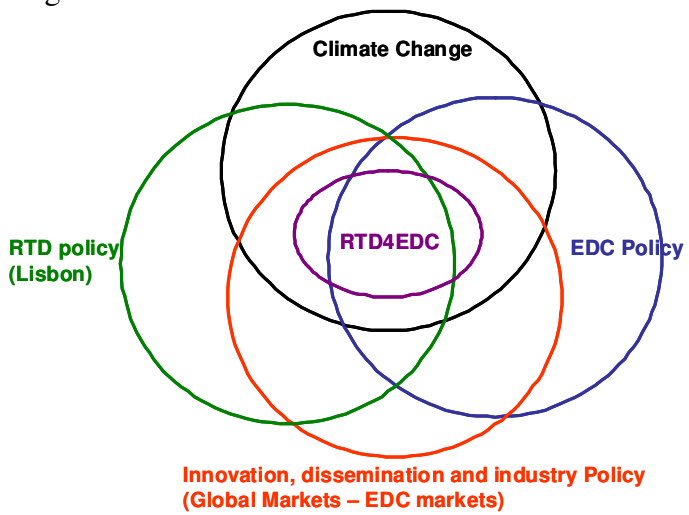

Figure 1 Illustration of the complexity of the scoping of RTD4EDC

Climate Change

Global emissions must be cut to at least half of 1990 levels by 2050 if we are to have a chance of limiting global warming to no more than 2°C above the pre-industrial level.[3] Combined emissions

[3] The EU is ready to cut its emissions to 30% below 1990 levels by 2020 if other industrialised countries agree to do likewise under a new agreement (in any case by at least 20%).

of developing countries are projected to overtake those of the current industrialised world by around 2020. Climate change cannot be controlled without efforts by EDCs, especially the emerging economies. Combating climate change includes the implementation of intelligent and efficient energy systems in the growing economies of EDCs.

RTD policy - EU Research area (ERA)

The RET innovation model of Europe is increasingly opening up towards the world. Both for contributing to abating climate change – but also for reasons of remaining economic competitive, responding to global demographic, human resource and educational challenges, and for fighting poverty, creating stability and promoting political co-operation, dialogue and trust.
Today, Europe has a strong technological leading positions in many RET-domains such as solar technologies (PV, CSP, passive solar), wind energy, geothermal, biofuels and CHP technologies. In general in the field of RET and the underlying disciplines, Europe has a lot to offer to EDCs – e.g. a strong Science &Technology (S&T) base in fundamental sciences, energy technologies and environmental and sustainability disciplines.

S&T co-operation is much more needed than in the past – as all regions are seeking technological excellence in their scientific working relationships in the field of RET. There is a global competition for technological leadership in RET (strategic energy markets for the future) and emerging blocks such as Brazil, Russia, India and China (BRIC) show increasing interest and are moving towards top S&T positions themselves. Therefore co-operation of the EU with EDCs should be attractive and can create 'win-win' situations. In order to progress, ERA has to successfully interact with other parts of the world. Knowledge generated in Europe is, in many situations, exploited and disseminated worldwide and will benefit from developments occurring elsewhere.

EDC / Development Policy

As the world's largest donor of development assistance, the EU is strongly committed to supporting developing countries in their fight against poverty, the achievement of the UN Millennium Development Goals and the promotion of sustainable development. These strategies need to be owned and driven by developing countries themselves.

The EU recognises that the most effective way to promote adaptation to and mitigation of climate change is to 'mainstream' these objectives into strategies for poverty reduction and/or sustainable development. A number of earlier dedicated instruments for RTD&D for RET have been ended (such as Coopener) and have been replaced by instruments that consider the 'science and society' issues in the broader context of the EDC society. Combating climate change is integral to the EU's commitment to help developing countries meet the Millennium Development Goals.

PART II: General conclusions

1. The potential for renewable energy in emerging and developing countries is high.

2. RTD&D is an enabling factor in furthering the implementation of renewable energy in emerging and developing countries.

3. RTD&D plays an important role in facilitating the EU industry to access these high potential markets.

4. These impacts of renewable energy RTD&D should be improved.

1. The potential for renewable energy in emerging and developing countries is high

Emerging and developing countries have 80% of the world's population but consume only 30% of global commercial energy. As energy consumption rises with increases in population and living standards, the need to expand access to energy in new ways is growing as well as the awareness of the environmental costs. Increased recognition of the contribution that renewable energy (RE) can make towards energy independence, climate change mitigation, rural development, improved health and lower health costs (linked to air pollution), is shifting RE from the fringe to the mainstream of sustainable development.

1.1 Market growth (up to 2020) of Renewable Energy in EDCs is the same size as in developed countries

Desk research shows that the realistic market potential for renewables in EDCs in 2020 is of the same size as in developed countries. The basis for this conclusion was the RECIPES project [30], an EU funded project investigating in great detail the market potential of different market-technology-combinations in emerging and developing countries. Besides RECIPES also the following important studies have been taken into account:

- World Energy Outlook 2007 / China and India Insights, International Energy Agency
- Energy and Climate Change, World Energy Council, 2007
- US DoE Energy Information Administration – EIA scenarios
- Energy Policy Scenarios 2050, World Energy Council, 2007
- Shell scenarios to 2050
- EREC scenarios to 2040
- Wind Force12 - Greenpeace and EWEA
- EWEA 2006, Annual Report
- Renewables, Global Status Report, REN 21, 2007
- 2007 Global Energy Survey, World Energy Council, Korn/Ferry International, 2007

RE in 114 INCO countries

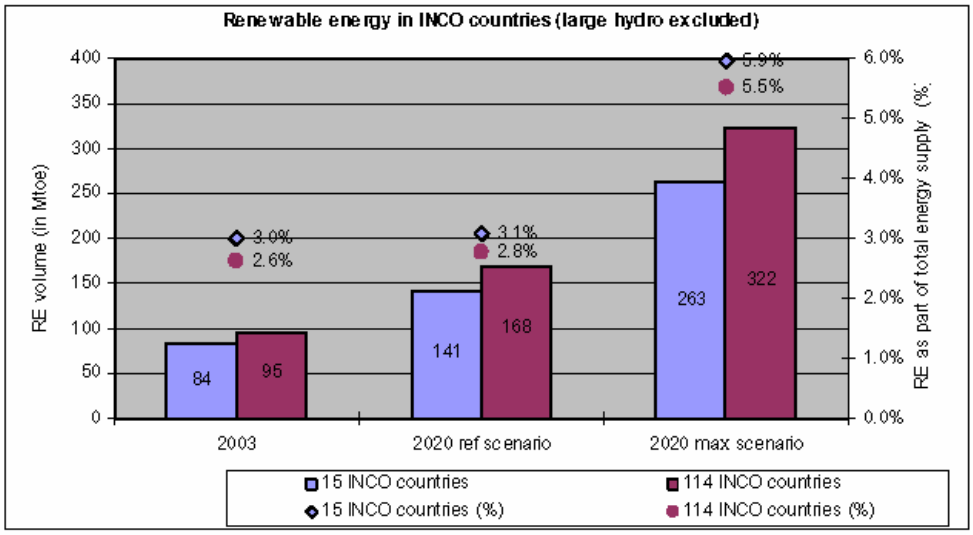

Figure 2 RECIPES Results; Renewable Energy in 114 INCO countries

The RECIPES results are in general still valid, but the results sometimes can be updated on specific technologies and countries.

In some EDCs, especially China and India, renewable energy is outpacing the expectations of a few years ago.

China and India are developing RE capacity faster than expected, specifically for Wind energy, Solar thermal and Photovoltaic. African and Latin American EDCs are not implementing RE as fast as expected. But these renewable energy markets still have a significant potential for European Industry. The following table presents the most remarkable changes in expectations (compared to RECIPES results [30]) of installed renewable energy capacity in EDCs.

RECIPES Market potential 2020 – Maximum scenario (update 2008)
Wind energy - China; The Market potential for Wind energy in China is raised under the maximum scenario from 30.000 MW to 45.000 MW in 2020. - India; The Market potential for Wind energy in India is raised under the maximum scenario from 20.000 MW to 25.000 MW in 2020. - Other Asian, Latin American and African EDCs: The market potential for Wind energy is not growing as fast as expected, but the potential is still there.
Small and Medium Hydro - China; The Market potential for Small and Medium Hydro is raised under the maximum scenario from 46.000 MW to 80.000 MW in 2020. - India; The Market potential for Small and Medium Hydro in India is raised under the maximum scenario from 13.500 MW to 15.000 MW in 2020. - Other Asian, Latin American and African EDCs: Markets for Small and Medium Hydro are not growing as fast as expected, but they have great untapped potential. Especially for the European industry the market potential is still there.
Solar Thermal - China; The Market potential for Solar Thermal is raised under the maximum scenario from 110.000.000 to 150.000.000 Installed Systems in 2020(Government Target). - India; The Market potential for Solar Thermal in India is raised under the maximum scenario from 2.000.000 to 5.000.000 Installed Systems in 2020 (Supportive Government Policy). - For other Asian, Latin American and African EDCs the potential market expectation for Solar Thermal is not changed.
Photovoltaic - China; The Market potential for Photovoltaic is raised under the maximum scenario from 930 MW to 1.800 MW Installed Capacity in 2020 (Government target). - India; The Market potential for Solar Thermal in India is raised under the maximum scenario from 145 to 3.500 MW Installed Capacity in 2020 (Government target = 10 GW). - For other Asian, Latin American and African countries the potential market expectation is not changed.
Solid Biomass and Biogas - China; The Chinese Government target calls for 5,5 GW of biomass-fired generating capacity by 2010 and 30 GW by 2020. - India; The use of biomass in power generation and biofuel production is projected to increase more quickly. Current installed capacity for biomass power generation is 0,3 GW and it is expected to reach 4,5 GW in 2020. - Among developing countries, small-scale power and heat production from agricultural waste is common. The use of biomass for power and heat production is significant in countries with large sugar industry, including Brazil, China, Colombia, Cuba, India, the Philippines and Thailand.
Biofuels for transport

- Emerging and Developing Countries are very interesting for the production of second generation biofuels. For EDCs there is a large potential with high revenues per hectare. Export of EU technology is interesting, because not every country has the technology to build their own plants for the processing from biomass to ethanol (fermentation).
Geothermal energy - Geothermal provides almost 10 GW of power capacity, growing roughly 2-3 percent per year. Most of this is in Italy, Iceland, Indonesia, Japan, Mexico, New Zealand the Philippines and United States.
Other renewable energy technologies - Concentrated Solar Power is becoming a very interesting RE technology and the first projects are planned in EDCs, mainly in North Africa. - Ocean and tidal energy is still in the demonstration phase, although there are possibilities in many EDCs, such as: Chilli, Mexico, etc.

1.2 EU RE Industry representatives perceives EDCs as (highly) attractive markets but there are big differences between different regions and RE technologies.

In general EU RE Industry representatives see Asian/Pacific countries and Latin American countries as (highly) attractive markets. African countries are also perceived as attractive, however less than Latin American and Asian / Pacific countries, due to (perceived) difficult market conditions and high barriers.

It should be noted that when is spoken in this report about Africa (African countries), Latin-America (Latin-American countries) and Asia (Asian countries) we usually mean only the Emerging and developing countries in these regions.

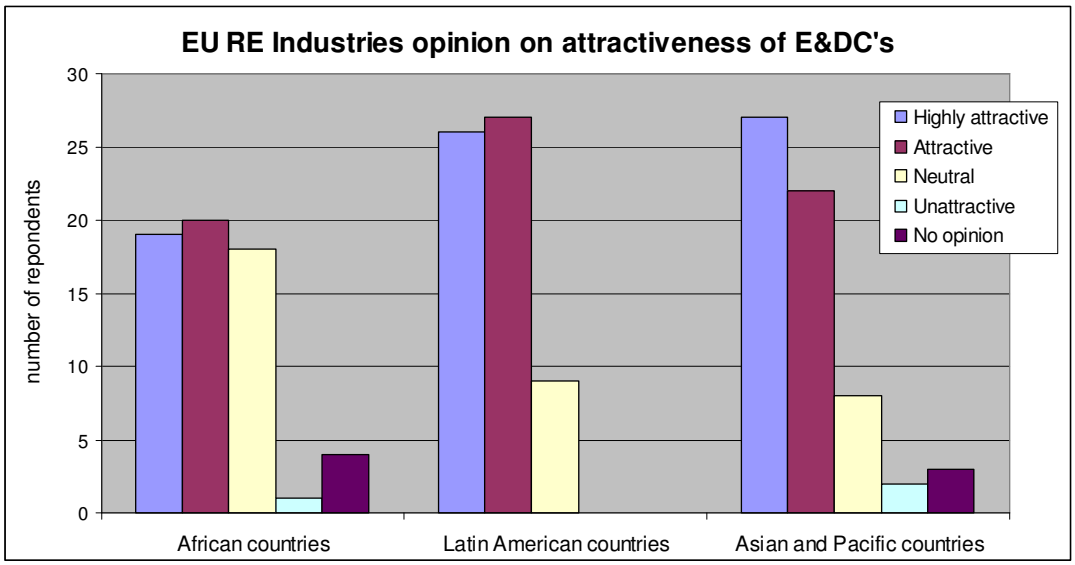

Figure 3 Market attractiveness of EDCs (RE Industry survey)

There are big differences between different RE technologies and different regions

Overall conclusions on the attractiveness of EDC markets for EU Industry are:

- Wind energy is considered most attractive in Asian and Pacific countries, followed by Latin American countries. African countries are perceived as less attractive.
- Small and medium hydro is considered highly attractive in Latin American countries and Asian countries. African countries are perceived as less attractive.

- Solar thermal is considered most attractive in Africa and Latin America The market in Asia is considered less attractive.
- Photovoltaic is considered most attractive in Asia, followed by African and Latin American countries.
- Geothermal is considered most attractive in Latin-America, followed by Africa.
- Solid biomass / biogas and bio fuels are considered most attractive in Latin-America, followed by Asian and African countries.

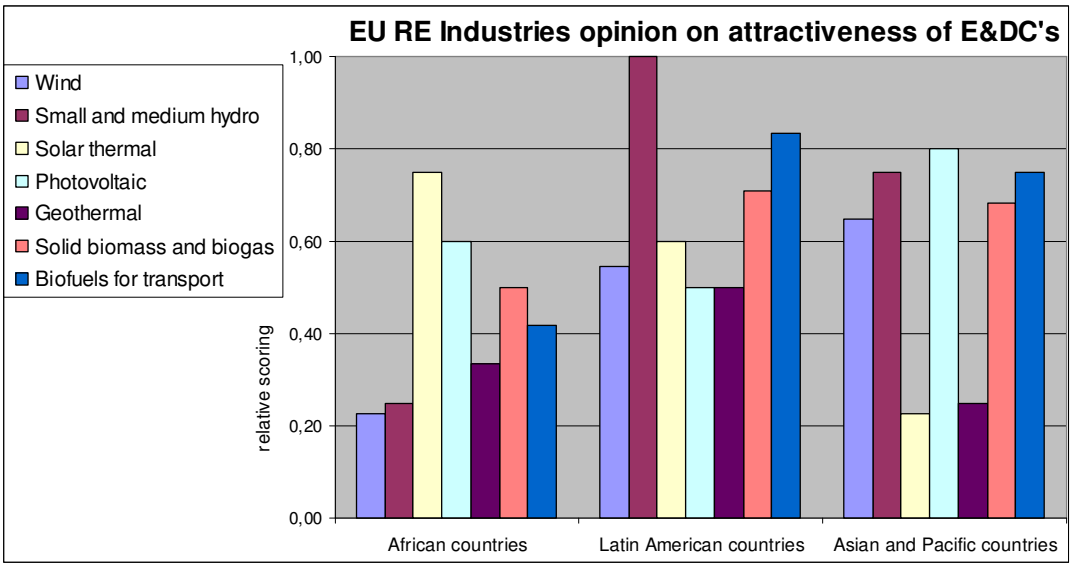

Figure 4 Market attractiveness per RE technology of EDCs (RE Industry survey)

A growing number of European RE Industry companies is exporting to EDCs

Most of the respondents of European RE Industry are already exporting to EDCs (39%) or they are planning to do so (21%).

Are you exporting Renewable Energy technologies, equipment or related services to Emerging & Developing Countries?		
Answer Options	**Response Percent**	**Response Count**
Yes, currently	39%	20
In the future (planned)	21%	11
No	31%	16
Not anymore	0%	0
Not relevant	14%	7
Answered question	**100%**	**54**

Table 3 Export of RE technologies to EDCs (RE Industry survey)

EDC markets are complex and competition is getting more intense

The markets in EDCs are perceived by EU RE Industry as more complex than the home market. Although there are big differences between Emerging Countries and Developing countries, market accessibility and market conditions are seen as the main barriers in most markets.
In Emerging Countries, such as: China and India, the competition with local manufacturers is getting more and more intense.

2 RTD&D is an enabling factor in furthering the implementation of renewable energy in emerging and developing countries

Research, Technological Development and Demonstration has direct and indirect linkages with the implementation of renewable energy systems in emerging and developing countries. It should be noted however that the importance of RTD&D is different for each specific technology.

Based on desk research, information from other studies (WP 1) and analysis of the best-and-worst practices (WP 3) it is concluded that RTD&D is an enabling factor in furthering the implementation of renewable energy systems in emerging and developing countries.

2.1 Research and demonstration activities in the area of (renewable) energy are crucial in international cooperation

Following the outcome of the public consultation on the communication "Towards a European Strategic Energy Technology Plan" [10], for energy technologies in general, the most important issues for international cooperation are considered to be:

- Applied research and demonstration (73% of respondents);
- Know-how exchange (59% of respondents);
- Technology transfer (58% of respondents);
- Basic research is seen as the next priority (54% of respondents), followed by market and regulatory issues (ca. 45% of respondents).

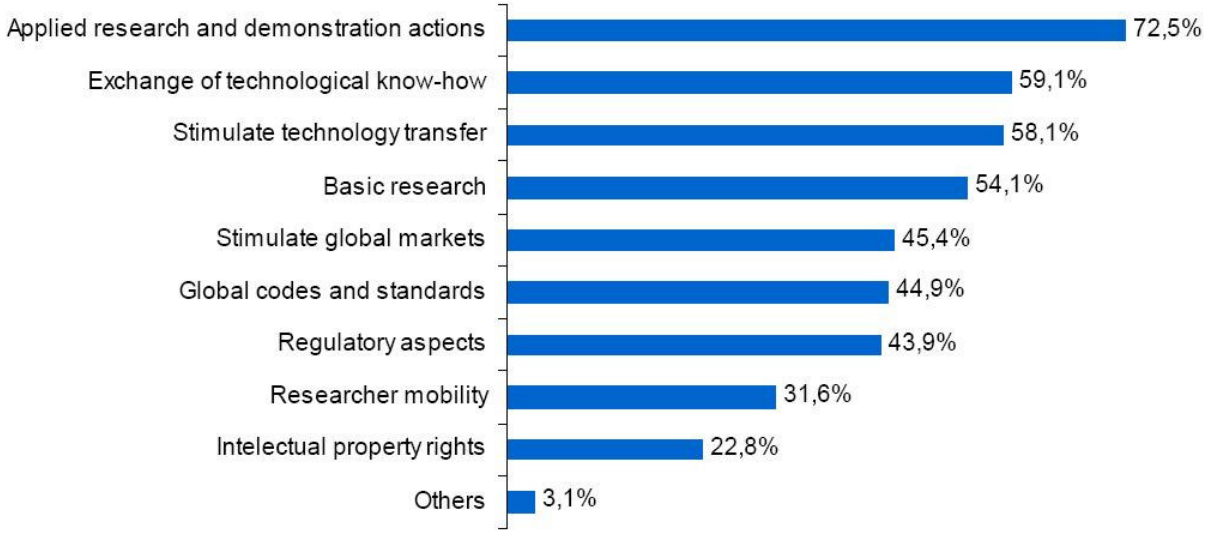

Figure 5 Most important issues for international cooperation

The preferred technologies for international cooperation are renewables, energy efficiency and bio fuels. Preferences vary somewhat per region. An important notion is that for all EDC regions renewable energy is one of the most important issues. For Africa it is the most important issue. For Asian countries, especially China and to a lesser extent India, energy efficiency is also important. In Latin-America, bio fuels are also an important issue.

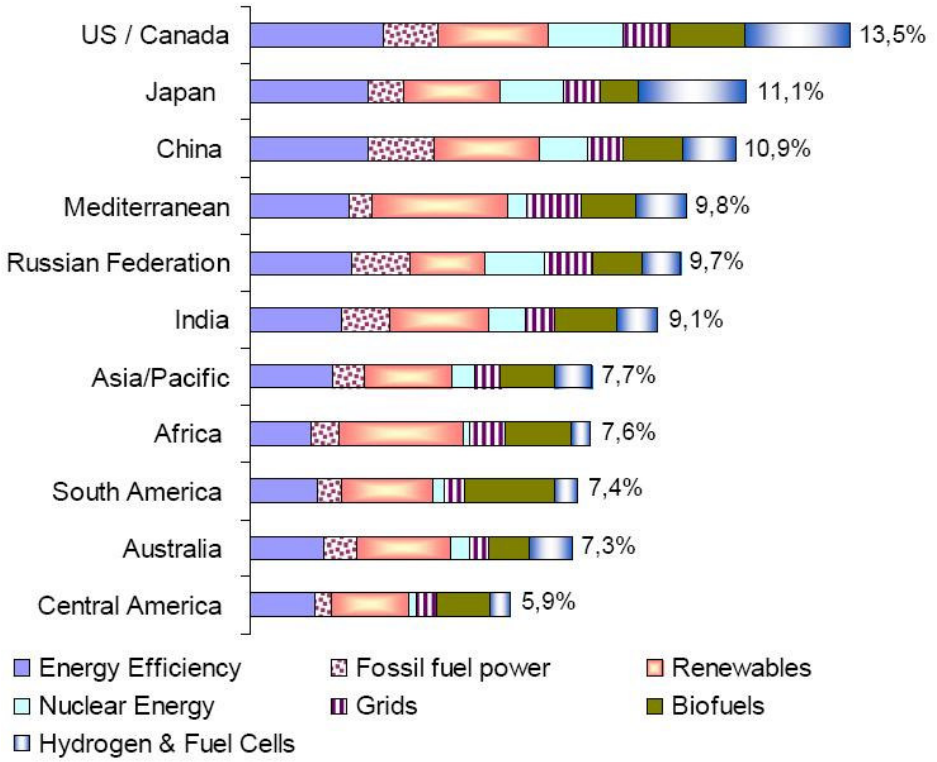

Figure 6 Most important energy technologies per region

2.2 Research and technological development furthers the implementation of renewable energy technologies

2.2.1 For successful and sustainable introduction of existing renewable energy technology in emerging and developing countries, mainly non-technological research and development is needed

Existing renewable energy technologies that are well utilised in developed countries usually do not require extensive technical research and development to enable their implementation in emerging and developing countries. Exceptions are research and development aimed at increasing the energy efficiency; however this research is often even more beneficial for developed countries, and research aimed at adapting the technology to the local (geographical) circumstances (e.g. climate, water and soil surface). The latter is usually needed in all new areas where a technology is introduced.

Much more important for the successful introduction of new renewable energy technologies in emerging and developing countries is the way the implementation process is organised.

Consider implementation activities as part of the job. It is important to integrate implementation activities and costs in the project set-up (training, setting-up, integration in local social context, financing structure). Failure of RE projects is in most cases linked to inadequate implementation and not meeting user needs. Failure damages the image of RE and labels it as second best.

Recommendation of the RECIPES project, "Renewable energy in emerging and developing countries: An increase by a factor of 3 can be achieved by 2020", Brussels, January 2007

This requires non-technical research and development e.g.:
- Socio-economic research aimed at understanding the implications of introducing a new technology in a society.
- Socio-economic research aimed at understanding the pre-conditions for introducing a new technology in a society.
- Research aimed at developing successful business models.

On basis of the 'best and worst practice' case studies (WP 2) regional analyses were conducted for Africa, Asia and Latin America. The following statements regarding socio-economic research results from these analyses:

Africa	▪ A major identified barrier (for an increased implementation of renewables) is the adaptation of RETs to the local needs and circumstances. ▪ Research should be aimed at a better comprehension of the local situation – focussed on socio-economic development and policy research. ▪ There is a perceived lack of scope for local innovation and customisation. ▪ Local 'ownership' of projects and programmes is a prerequisite to avoiding the notion that donor funded projects operate disconnected from local needs and without due consideration for local contexts.
Asia	▪ Socio-political problems (e.g. employment demands and public procurement of land) frustrate large scale RE projects. ▪ Local community often does not support and cooperate to implement RE project in their place. ▪ Lack of successful (and profitable) business models for PV enterprises discourages investors and financing institutions from providing commercial financing for companies engaged in PV businesses.
Latin-America	▪ Active involvement of local communities is a pre-requisite for a successful demonstration project. ▪ Consideration of the cultural identity and attitudes of the communities and technology users is crucial for the successful implementation and operation of the project. ▪ Sound socio-economic research should be a pre-requisite to establish appropriate project objectives.

Table 4 Socio-economic research needs (result from WP 2)

2.2.2 Additional RTD is needed to be able to introduce (new) renewable energy technologies adapted to the specific needs of emerging and developing countries

When developing new or improved renewable energy systems the starting point is research, followed by technological development and demonstration and finally market introduction. Starting from the specific needs in emerging and developing countries, currently available renewable energy systems often do not suffice. Many renewable energy systems are developed for utilisation in industrialised countries. So far, introduction of RETs from the EU in emerging and developing countries has pre-dominantly been tried with minor or no modifications.

However – as illustrated in the table above – utilisation in emerging and developing countries often brings about specific needs that require new ways of developing renewable energy technologies. Depending on the situation, country and technology, these needs can be very different. For example, for many renewable energy systems simplicity of use, robustness, easy maintenance and use of locally available materials (possibly locally manufactured) is much more important than increased energy yield / efficiency with sophisticated techniques. Also the required size of a system

can be totally different in emerging and developing than developed countries, due to differences in intended use and energy demand.

Therefore additional research and development efforts are needed to:
- Understand the specific needs of emerging and developing countries in relation to renewable energy systems. These needs can even differ per country.
- Develop (new) renewable energy technologies that address these needs.

2.2.3 Socio-economic research and research for policy support in emerging and developing countries will help to develop a supportive local policy framework

Energy sovereignty and energy security
Renewable energy technologies have the ability to give self reliance to local communities, where they can utilise the excellent renewable energy resources available for their own good. It will allow local people to have control over their energy resources and determine the type of energy to use for their daily needs. In Africa, this issue of energy sovereignty needs to be scaled up and this can only be possible by the use of renewable energy. Renewable energy can also help to limit the insecurity in terms of supply of energy and promote access to more vulnerable populations. We therefore advocate that renewable energy should be integrated into local development plan while focusing action on the development of rural enterprises (including local production). [31]

Inadequate policy and lack of implementation of existing policy
In African countries, policy formulation is usually left in the hands of government officials and consultants without consultation with the civil society. In other instances, policies are not given adequate publicity and thus rot away on the shelves of government officials. Such policies do not adequately reflect the needs of civil society. One key area of improvement would be to have more transparency on energy policy, and to engage civil society in the planning process. The African continent should adopt policies that encourage greater efficiency in energy use across all users; policies that encourage the development of local manufacturing capacity of renewable energy technologies; policy that encourages the prioritization of bringing modern energy services to those now without any access; policies that encourage the improvement of public utilities; policies that integrate climate change and energy programmes and policies that mainstream energy in other sectors of the economy. [31]

Lack of awareness of renewable energy technology's advances
Renewable energy technologies have not been given adequate publicity in Africa especially among policy makers, business community and the civil society. If potential end-users do not know what energy systems are available and what they are capable of doing, there will be no demand and therefore no market for the energy system. Without adequate exposure to renewable energy and energy efficiency technologies and the services they can provide, policy makers, the business community and civil society will have limited bases upon which to make decisions and will be apprehensive to commit resources to the technology. [31]

Climate change is typically not on the top of the environment or sustainable development agenda in Latin America. Raising awareness of climate change at a national level therefore requires connecting climate change related issues (energy, transport, industry, agriculture, land use change, coastal adaptation, etc.) to sustainable development priorities. It is therefore all the more important to help countries assess technologies needs that match their development or local environmental agenda. Agendas differ widely from country to country. Also critical are the differences in a country's capacity to adapt and absorb technology, infrastructure, human and natural resource availability, culture, policy and economic environment etc. These differences make technology assessment by region, country or sector key in the technology transfer process. Technology

assessment is only useful if it includes an assessment on how to effectively attract and apply these technologies. [32]

A major barrier for the development and introduction of renewable energy technologies in many of the emerging and developing countries is lack of supportive policies for renewables. Also in many policy fields like economic development, environment, energy security, health, gender issues and poverty alleviation the potential contribution of renewable energy is not (fully) identified. However many signs are pointing in the same direction; "***Renewable Energy Technologies have a higher relative contribution to socio-economic and environmental development in emerging and developing countries than non RET's.***"[4]
The benefits of renewable energy technologies for other policy areas should however be made more evident (quantitative) and country specific in order to be taken into account.

Socio-economic research on the benefits of renewables versus non-renewable energy options in terms of environment, health, economic development, poverty alleviation, security of supply, dependence on imported fuels and vulnerability to price increases will help to stimulate the development of supportive policies for renewables in other policy areas.

Another barrier in many of the emerging and developing countries is lack of knowledge needed to develop a strong renewable energy policy framework. Depending on the country, research and development on market potential, technical energy potential and specific maps (e.g. wind, solar, geothermal) will help to identify the best renewable energy options, thereby stimulating the introduction of these technologies.

The analyses of the best and worst practice case studies in the three regions conclude the following regarding the necessity to develop a strong policy framework:

Africa	▪ In many countries the policy measure - market information feedback loop is not in place. ▪ Market orientated research makes definition of policy measures based on their anticipated impact on the market which the RTD&D seeks to develop or grow possible.
Asia	▪ The main policy barriers that are identified are the lack of appropriate policies / incentives / mechanisms for RE projects, the lack of appropriate legal/regulatory framework to enable investment in renewable energy especially for grid connected RE projects, and the lack of appropriate interconnection tariff and cost sharing mechanisms at the utility level. ▪ Absence of a legal framework for establishment of RET capacity leads to lengthy and complex negotiations with local and national level agencies. ▪ The lack of a comprehensive policy and suitable financing schemes are affecting private investors' interest in renewable energy programs.
Latin-America	▪ The Brazilian model of public funded research centres and R&D projects could be a model for other countries in the region. This requires in the first place active R&D policies and substantial public funding.

Table 5 Necessity for developing a strong policy framework (result from WP 2)

[4] RECIPES project (final report), "Renewable energy in emerging and developing countries: An increase by a factor of 3 can be achieved by 2020", Brussels, January 2007

2.3 Renewable energy demonstration projects with high visibility and long-term sustainability enhance the implementation of renewables

Renewable energy demonstration projects are directly linked to the implementation of a renewable energy system and therefore directly contribute to increased implementation of renewables. But renewable energy demonstration projects further the implementation of renewables in an even broader context.
Visibility and long term sustainability of a demonstration project are pre-requisites. Visibility is essential to achieve that the stakeholders can learn from the demonstration project – which is usually one of the main aims of these projects. Long term sustainability (security of energy supply) is needed to prevent reputation damage for the specific technology and renewables in general`.

2.3.1 Successful and sustainable demonstration projects can remove barriers and take away or prevent preconceptions

It is generally known that demonstrating a new (or unknown in the given situation) renewable energy system can help further the penetration or market introduction (depending on the way a technology is introduced) of such a system.

In 91% of the analysed best-and-worst practices, demonstration was a pre-requisite for comparable sequel implementation projects.

Analysis of the best-and-worst practices (WP 2) showed that demonstration projects are crucial in overcoming (or showing how they can be overcome) the following barriers: market accessibility, market conditions, cultural aspects and educational aspects.

Even technologically fully developed renewable energy systems can benefit from demonstration projects as often proof is required for further implementation of socio-economic integration, overcoming juridical hurdles and availability of financing. A demonstration project can take away any preconception actors might have.

2.3.2 Demonstration projects can stimulate other actors to take action

There is a general support for the idea that RTD&D activities are an important means to stimulate renewable energy technologies. Especially in a context of international cooperation, research and demonstration activities are very much valued. Research and demonstration activities are less threatening, from a competitive point of view, than market oriented activities.

The extend to which developing country parties will effectively implement their commitments under the United Nations Framework Convention on Climate Change, will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology.
National governments are often reluctant to adopt binding quantitative commitments on their emissions that may be felt unduly “restrictive” in terms of economic development, lead to unknown costs and raise concerns from various stakeholders might find in technology cooperation a more “positive” way of introducing – at least in part – the same kind of changing patterns. Technology co-operation may ease some of the barriers anticipated by different actors and stimulate them to take action. [1]

3 RTD&D plays an important role in facilitating the EU industry to access these high potential markets

One aspect of particular interest is globalisation of innovation, and several indicators illustrate this trend. Following Archibugi & Iammarino (1999), globalisation of innovation consists of three different categories: the international exploitation of technology produced on a national basis; the global generation of innovation; and the global technological collaboration. Representative of the first category is perhaps the annual average growth of 13% of international patents in the decade 1985-1995. The second category includes notably patents generated in foreign subsidies of large firms – a real but still limited phenomenon that is slowly growing. The third category is international techno-scientific collaboration between firms. The number of international technology agreements between firms has doubled in the 1980s, representing 60% of all inter-firms (national and international) technology agreements.

Developing countries may not be left out of the internationalisation of private RTD. For example, China not only attracts significant Foreign Direct Investment (FDI) but also RTD investments from foreign own companies operating on its territory. Over 50 multinational enterprises, including Intel and Microsoft, have established R&D centres in China to tap the local pool of technical personal. They are not only doing locally-oriented R&D (obviously an important part of technology transfer), but also act as nodes in these enterprises global R&D activities (Liu & White, 2001). [1]

3.1 RTD&D can help to solve the barriers obstructing large-scale deployment of renewables

3.1.1 Barriers obstructing deployment of renewables

The following table provides an overview of the main barriers per region, based on an analysis of the best-and-worst practices from WP 2.

Barrier type	Africa	Asia	Latin America
Market and information	▪ policy measure - market information feedback loop is not in place. ▪ Poor overall data / information availability.	▪ Lack of adequate data in terms of assessment of solar / wind resources, sites and equipment performance. ▪ Lack of information on previous experiences.	
Cultural / socio-economic	▪ Lack of local 'ownership' causes low involvement of local actors which is a significant risk for the success of a project.		▪ Active participation requires consideration of the cultural identity. ▪ Socio-economic issues not a focus of international donors.
Capacity / education		▪ Managerial and technical skills limited resulting in inadequate business planning. ▪ Inadequate technical skills and local competence for installation and maintenance.	
Technology	▪ Adaptation of RETs to the local needs.	▪ Lack of domestic manufacturing capability weak manufacturing and service industry. ▪ Lack of standardisation / design and installation guidelines.	
Financial barrier			▪ Major focus of projects, renewable energies are either not competitive, or not affordable for users.

Barrier type	Africa	Asia	Latin America
			▪ Research in most Latin American countries notoriously under-funded.

Table 6 Main barriers identified per continent (best-and-worst practices, WP 2)

The markets in EDCs are perceived by EU RE Industry as more complex than the home market. Although there are big differences between Emerging and Developing countries, market accessibility and market conditions are seen as the main barriers in most markets.

3.1.2 Barriers perceived by EU RE Industry in EDCs are relative high, especially in Africa

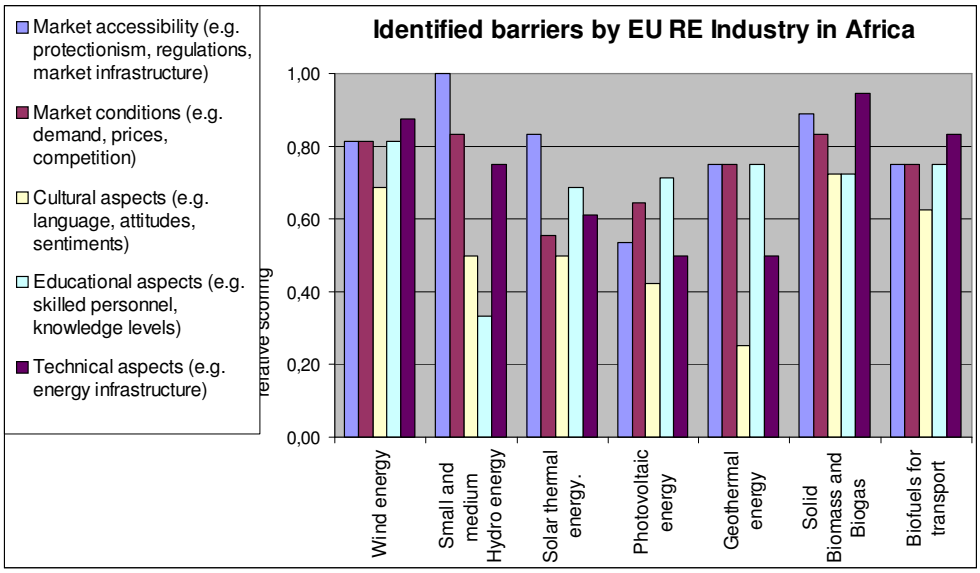

Figure 7 Identified barriers per RE Technology in Africa (RE Industry survey)

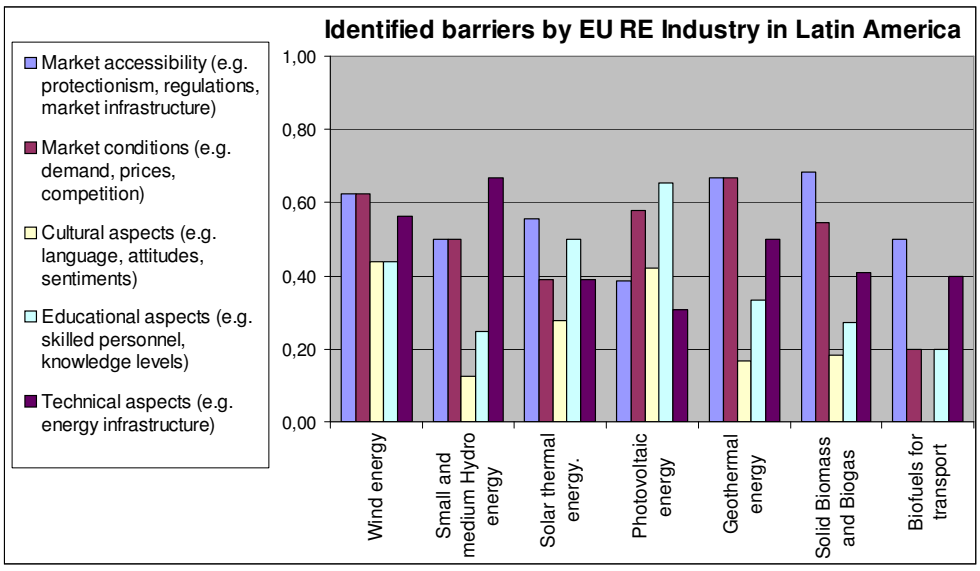

Figure 8 Identified barriers per RE Technology in Africa (RE Industry survey)

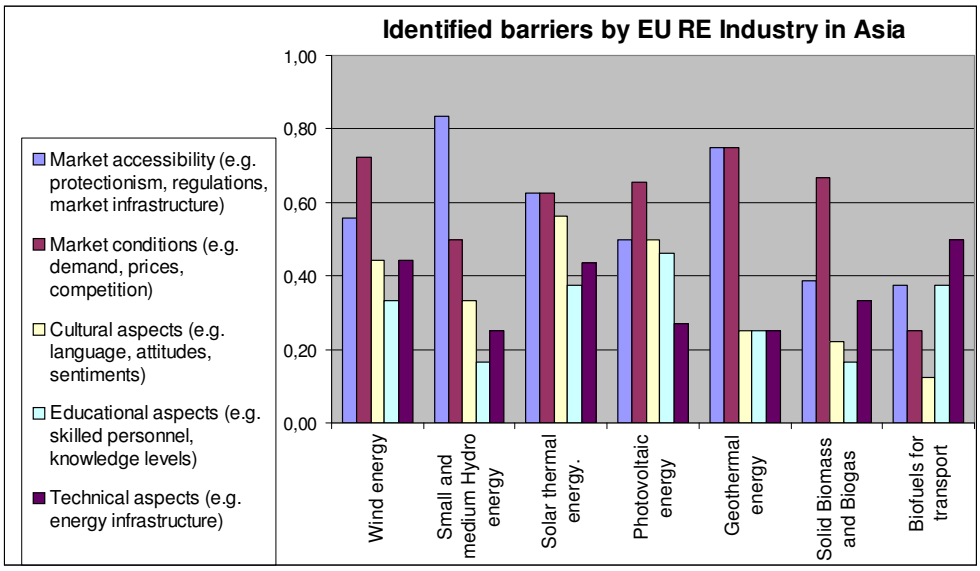

Figure 9 Identified barriers per RE Technology in Africa (RE Industry survey)

In Africa all barriers are perceived relatively high with some differences per RE technology.
In Latin America barriers are perceived medium, with main barriers in market accessibility and market conditions, followed by technical and educational aspects.
In Asian Countries barriers are perceived medium high, with main barriers in market accessibility and market conditions.

3.1.3 RE RTD&D in EDCs: take into account local circumstances

Currently, in many developing countries, especially Africa, there is minimal governmental support for infrastructure for energy systems, including businesses that manufacture components and whole equipment, others that stock and sell the supplies and materials, others that maintain systems in operation and businesses that provide appropriate financing. [31]
To be successful in emerging countries requires technological excellence, in order to be able to compete with low cost technologies from home countries. In Developing Countries market conditions have to be developed together with capacities of local business partners and policy frameworks. Table 6 presents the main barriers per continent. A more detailed analysis is given in the WP 2 final report.

3.2 Advantages of RTD&D cooperation for EU industry:

Several reports conclude that the European Union will not manage to become the most dynamic and competitive knowledge economy in the world unless it also manages to be the most open knowledge economy of the world.

1. S&T international cooperation can be further enhanced by open collaborative projects for the participation in R&D; joint undertakings for large facilities; open access and special support actions to benefit from shared facilities; the stronger participation of industry; and the establishment of more Technology Platforms. [11]
2. Enhancing technological cooperation at all levels (from R&D to diffusion) can lead to benefits in terms of technological cost reductions as well as accelerated market penetration. It also seems that there is scope for improving technology collaboration in the area of climate change. [1]

There is no shortage of arguments to justify the need to open up the ERA to third countries. The report of the ERA Expert Group 6 ('Opening to the world: International cooperation in Science and Technology') [17], mentions the following four rationales: Economic competitiveness, Responding to global challenges, Meeting the demographic and educational challenge of human resources and Promoting political cooperation, dialogue and trust.

More or less the same rationales can be applied to individual companies:

1. Opening up to the world / global innovation
2. Local researchers have knowledge about local problems and social contexts
3. Availability of researcher capital
4. Low cost research

Knowledge from non-EU countries can be an important driver for innovation and a crucial way of adapting to local needs and circumstances. European companies already perform a substantial amount of R&D and other knowledge-based activities in other continents. This is a vital component for their own competitiveness, since it provides an open window towards technological opportunities generated elsewhere as well as the timely and efficient generation and development of products found on these local markets.
International S&T cooperation can also play a role in an adequate participation in the expanding market for disembodied technology and the importance of emerging economies, like South Korea and China as buyers in this market.
Public sector cooperation can play a role in technology transfer and trade with these economies by making them better aware of Europe's possibilities as a technology supplier. Equally, Europe has much to gain by encouraging the growth of such trade within Europe.
The European demographic decline will affect the possibility of recruiting scientists and engineers in the future. Cooperating with the research sector in EDCs will open up it's research potential for EU industry and will enhance the temporary transfer of young scientists and engineers from these countries to Europe and vice versa. With an additional advantage of usually lower labour costs. This opens up the possibility for EU industry to innovate at much lower costs.

3.3 RTD&D can help market access?

The markets in EDCs are perceived by EU RE Industry as more complex than the home market. Although there are big differences between different EDCs, market accessibility and market conditions are seen as main barriers in most markets. Main success factors are: the right local partners and governmental assistance in the target market.
In Emerging Countries, such as: China and India, the competition with local manufacturers is getting more and more intense.

During the interviews with EU RE representatives the importance of co-operation with local partners was highlighted:

- Involvement of local SMEs is needed for the implementation. There should be a reliable partner in these countries, to install and to serve spare parts. Joint ventures are important.
- It could be useful to co-operate with local Research Institutes and Universities.

There is a general agreement that international cooperation is very important in the field of energy technology [20]. Enhancing technological cooperation at all levels can lead to benefits in terms of technological cost reductions as well as accelerated market penetration. [1]

Also the leaders of the G8 understand the importance of cooperating with EDCs on the subjects of renewable energy and sustainability. During their annual meeting they have drafted a declaration stimulating renewable energy and sustainable development.

4 These impacts of renewable energy RTD&D should be improved

4.1 Public and private budgets for Energy research and technological development have declined in the last 25 years

Becoming the worlds most sustainable economy, requires a deep change in the European energy technology innovation process. Taking into account the urgency of technological innovation, the decline in European public and private expenditure on (renewable)energy related research and the ambitious (CO2 emission reduction and renewable energy) targets we have set, it is clear that we are falling short on the current Renewable Energy RTD&D expenditures.

In the SET plan [6] ('European Strategic Energy Technology Plan - Towards a low carbon future'), the issue is described as follows:

"This is a vision of a European Union with a thriving and sustainable economy, with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies as a motor for prosperity and a key contributor to growth and jobs. A European Union that has grasped the opportunities lying behind the threats of climate change and globalisation and that it is ready to contribute to the global energy challenge, including increasing access to modern energy services in the developing world. 'Business as usual' is not an option. The current trends and their projections into the future demonstrate that we are simply not doing enough.[…]

This is compounded by the disappointing progress towards a European Research and Innovation Area and historically declining research budgets in the energy sector. For reasons mainly related to the specificities of the sector, energy research budgets (public and private) in OECD countries have halved in real terms since the 1980s and it is paramount that this trend be decisively reversed, certainly in the European Union. Given the uncertainties and risks inherent in low-carbon technology innovation, increased public investment and a stable, predictable policy framework will play a vital role in leveraging increased private investment, which should be the main driver of change."

4.2 The EU RE sector still has a prominent role but is under pressure

Although the EU renewable energy industry is prominent in most markets and in some technologies still leading, emerging countries are becoming fierce competitors. Several emerging economies are set to become major players in technologies for sustainable development.

In **China**, there is an increased awareness of the environmental costs of rapid economic growth and the risks of fossil fuel dependency. Targets have been set to reduce energy consumption and to increase the share of energy supplied from renewable sources. The national R&D programme focuses on technology related to urban environmental protection, water resource use, clean energy and regional ecological development. There are R&D efforts in wind power, photovoltaic and biomass.

India is building up a large programme for renewable energy focusing on biogas, biomass, solar energy, wind energy and small hydropower. While it earlier focused on domestic consumption, India is increasingly targeting export markets with renewable energy products.

Brazil already has close to half of its energy needs supplied by renewable sources. It has developed particular strengths in biofuels for transport, e.g. biodiesel and ethanol. In 2007, 86 percent of new cars sold in Brazil were biofuel or flex-fuel cars.

4.3 Current EU policy framework provides many possibilities for Renewable Energy RTD&D related to EDCs but actual activities are still limited

4.3.1 EU RTD Framework Programmes do not attract substantial EDC participation

The participation by researchers, research organisations and industry from EDCs in the Framework Programmes for RTD has so far been limited. With the current 7th Framework Programme, improvement is expected as the approach towards international cooperation is different from FP6 and the preceding FPs. In FP7, the rules for participation allow parties from third countries to be involved in all four specific FP7 programmes; Cooperation', 'Ideas', 'People' and 'Capacities'. The 'Cooperation' programme is generally open for participation of third countries and has specific key actions focused on international cooperation ('SICA': Specific International Cooperation Actions). [17]

The following graph shows the number of applications (proposals submitted) from selected third countries in the first FP7 (2007) Energy call. [Cordis]

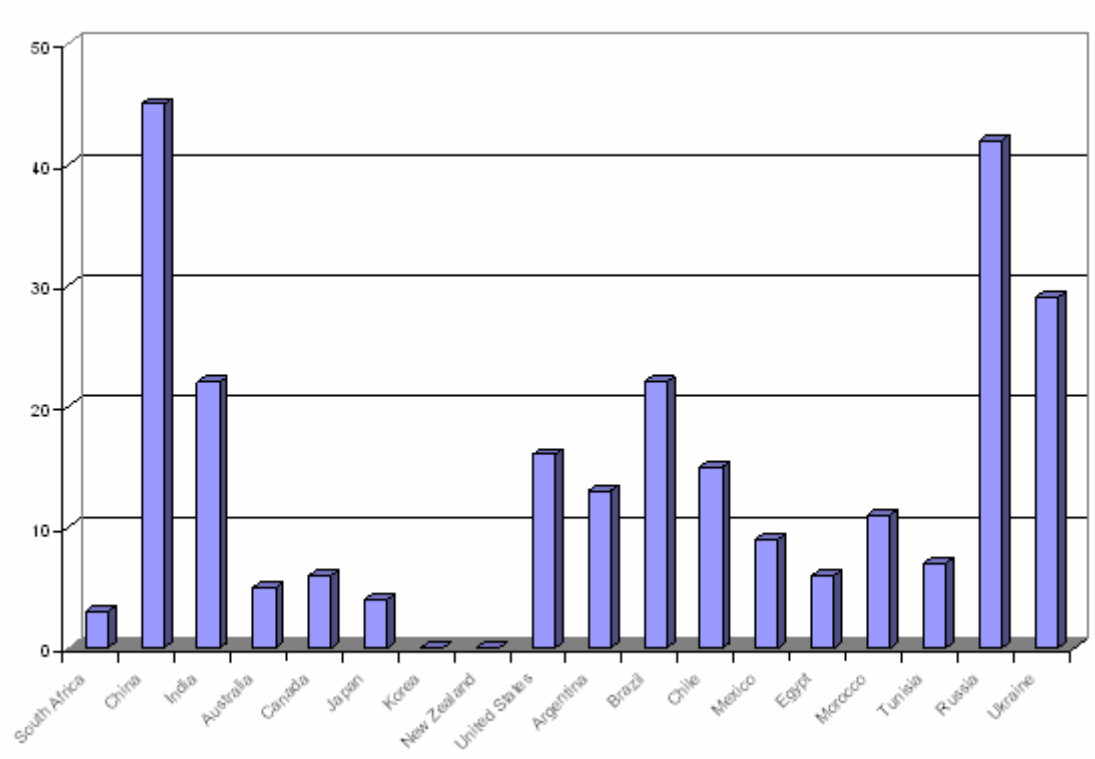

Figure 10 Participation of third countries in the first FP7 Energy call [Cordis]

In total, 6.5% of the proposals (equalling a total of 345 proposals) submitted under the first energy call in FP7 contained a third country participant. As shown in the graph, the highest numbers of proposals from EDCs within this total of 345 are from China, Brazil and India – which gives the impression that participation by emerging countries is better evolved than participation from developing countries.
It should be noted that FP7 does indeed appear to show improvement when compared to FP6 [17]. However, participation from third countries and particularly from developing countries in the first energy call can still be regarded as modest to say the least.

4.3.2 RTD&D programmes and instruments are perceived as complex by SMEs active in renewable energy in Member States

The EU renewable energy industry survey that was carried out as part of the RTD4EDC project (see also WP3 report) shows that most of the respondents are aware of the possibilities offered by the RTD Framework Programme (53% of the respondents indicated that they know the programme very well, and another 32% indicated that they know the programme to some extent – see also paragraph 4.3.5). There where however also some comments on the attractiveness of the programme, e.g. several respondents indicated that the (application) procedures are too complex and the administrative burden is too high, especially for SMEs.

4.3.3 FP7 projects are initiated by European participants and focus on the EU perspective

Although the openness of the framework programmes for third countries has been improved, the initiative for a project proposal is still taken by the European participants. Therefore, the topic addressed and research questions that are formulated are usually approached from the perspective of the EU partners, which may negatively influence the usefulness of the results for the third country participants. An increased focus on the perspective of developing countries would therefore be welcomed, in order to ensure that research results are equally beneficial for participants from emerging and developing countries as they are for EU participants.

4.3.4 EU RTD&D instruments related to EDCs fail to articulate relevant EDC issues

International public sector cooperation has grown in volume and in the diversity of instruments used for this type of cooperation. However, it has largely remained confined towards the large science and technology producing regions of the EU, Japan and North America. A major challenge for public sector cooperation is thus to widen the scope of international cooperation activities and to devise instruments capable of including non-OECD countries as partners.[17]

Besides these EU policies and instruments several other initiatives and activities are developed, for instance the IEA Implementing Agreements. EDCs can make use of the mechanism of joining specific tasks in new and ongoing implementing agreements, which could be a good route to connecting them to state of the art knowledge and research networks. Unfortunately EDCs are currently not well represented in the IEA IAs.

The possibilities for Europe for enforcing and enhancing RTD&D related to EDCs are numerous. Following and under scribing the conclusions from the “Report of the ERA Expert Group” [17], several improvements can be made to increase their effectiveness.

FP7 foresees the possibility that in a very limited number of cases, where it is justified in terms of the scope of an RTD objective and the scale of resources involved, long-term public private partnerships may be set up in the form of Joint Technology Initiatives (JTIs) (European Parliament and Council, 2006a: 9). These initiatives are mainly resulting from initiatives of industry in the context of the European Technology Platforms (ETPs).

4.3.5 EU RE industry is not very familiar with all EU instruments (WP3)

The EU has many different policies, programmes, initiatives and activities with a relation to Renewable Energy in EDCs.
EU RE Industry is generally familiar with the Framework Programmes, EU Energy Facility and European Technology Platforms, but most of the other instruments are not very well known.
EU CDM / JI projects and EU Emission Trading Scheme are seen as quite effective and they give good business opportunities for EU RE Industry.

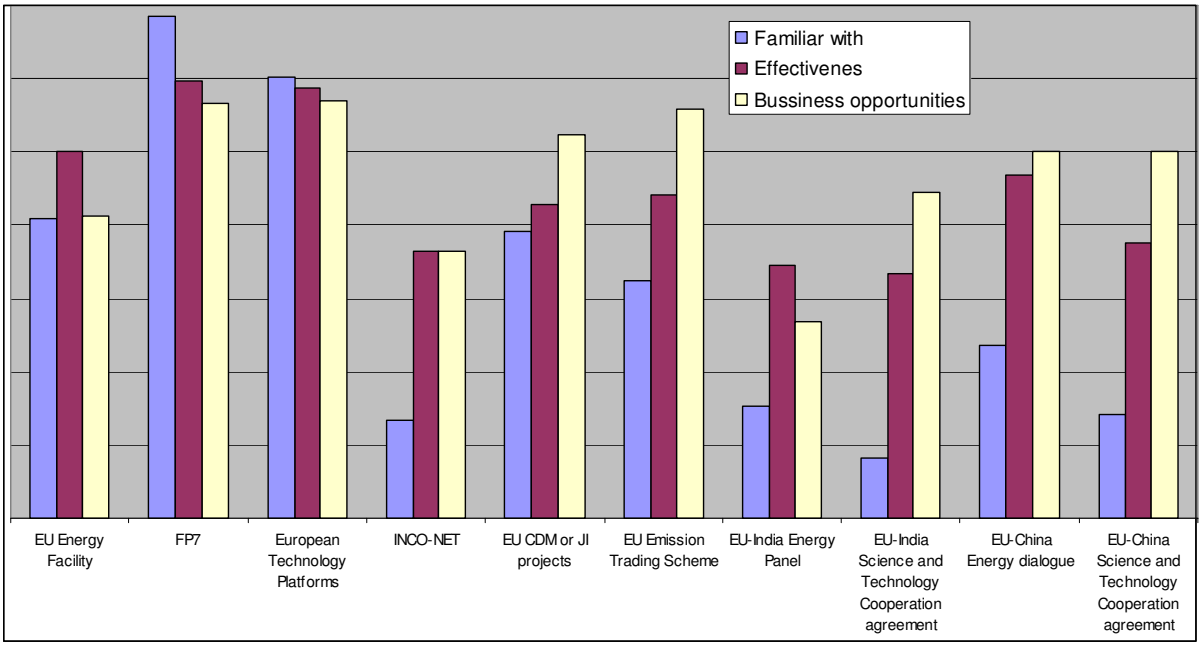

Figure 11 EU Policies, programmes, initiatives and activities (RE Industry survey)

Bilateral programmes, focussed on Emerging Countries (China and India) are not very well known, but they are nonetheless – from the (scarce) information provided through the survey - seen as effective and they give business opportunities for EU RE Industry.

4.4 EU RTD&D instruments and activities related to EDCs lack focus on Renewable Energy

Although not fully covering all policies and instruments, several assessments suggest that there is a lack of focus on renewable energy and EDCs within the broad pallet of policies and instruments available.

Within the dedicated International Cooperation activities for 2007-2008 in the cooperation specific programme of FP7, only 2% of the entire budget (164 Million €) is available for energy projects. In 2006 there where no INCO projects on renewable energy with EDCs. [18]

During FP6, ETPs were established bringing together industrial and other stakeholders to define and implement strategic research agendas in specific technological fields. From the start, ETPs did not systematically consider international cooperation to any particular extent. [17]

There are three ETPs on renewable energy: European Biofuels Technology Platform, European Technology Platform for Wind Energy and Photovoltaic Technology Platform. The biofuels and wind energy ETPs do not mention any RTD&D activities specifically aimed at EDCs. The Photovoltaic platform however mentions two priorities that are related to EDCs (socio-economic research and research related to island and hybrid systems), and has established a working group on developing countries [27]

PART III: Recommendations

The impact of renewable energy RTD&D on implementing renewables in emerging and developing countries and facilitating the EU industry to access these high potential markets can be improved by:

5. Building strong, durable partnerships between EU and EDC research communities

6. Building strategic partnerships between EU industry and local stakeholders

7. RTD&D efforts should be focussed on specific local needs and socio-economic circumstances

8. Improving the learning curve by ensuring previously acquired knowledge is available and accessible

5 Building strong, durable partnerships between EU and EDC research communities

5.1 Europe needs to become the most open knowledge economy of the world: "Open up the ERA to third countries!"

5.1.1 Four strong rationales for international S&T cooperation

Several reports ([1] Philibert C, "International energy technology collaboration and climate change mitigation", OECD/IEA, 2004 and [11] EC JRC, "Report on the Workshop, June 5, 2007, on International Cooperation", Brussels, July 2007) conclude that the European Union will not manage to become the most dynamic and competitive knowledge economy in the world unless it also manages to be the most open knowledge economy of the world.

There is no shortage of arguments to justify the need to open up the ERA to third countries. The report of the ERA Expert Group 6 ('Opening to the world: International cooperation in Science and Technology') [17], mentions the following four rationales:

1. Economic competitiveness;
2. Responding to global challenges;
3. Meeting the demographic and educational challenge of human resources;
4. Promoting political cooperation, dialogue and trust.

In this report it was stressed that the EU **economy** should also rely on sources of knowledge from non-EU countries. European companies already perform a substantial amount of R&D and other knowledge-based activities in other continents. This is a vital component for their own competitiveness, since it provides an open window towards technological opportunities generated elsewhere as well as the timely and efficient generation and development of products. A more direct involvement of the business sector in steering international cooperation is therefore welcome. The ERA should facilitate this access to external sources of knowledge.

Also international S&T cooperation can play a role in an adequate participation in the expanding market for disembodied technology and the importance of emerging economies, like South Korea and China as buyers in this market. Currently Europe fails to do so. Public sector cooperation can play a role in technology transfer and trade with these **economies** by making them better aware of Europe's possibilities as a technology supplier. Equally, Europe has much to gain by encouraging the growth of such trade within Europe.

The ERA should also make more visible its contribution to the generation of knowledge beneficial to everybody. A wider analysis of societal requests that can be addressed by available scientific and technological knowledge would certainly be beneficial in responding to the **global challenges** we are currently facing..

The European **demographic decline** will affect the possibility of recruiting scientists and engineers of the future. Opening up the ERA will enhance the temporary transfer of young scientists and engineers, born outside Europe, the US and Japan to Europe.

EU S&T cooperation has wider political implications and is a tool of the overall **EU external policy**. The ERA expert group believed that a closer exchange of communication with the representatives of EU foreign policy could be beneficial to maximize the effectiveness of S&T policies towards third countries.

Across the four main rationales that justify S&T collaboration, it has forcefully emerged that what the EU can provide and receive from the various countries is often profoundly different. Obviously, countries are different in terms of size, level of S&T infrastructures, willingness to engage in long term cooperation, fields of scientific and technological excellence and geographical proximity. All these factors substantially shape the nature of collaborations and they require adequate fine-tuning of the aims and instruments to be used.

5.1.2 General agreement on the importance of international cooperation in the field of energy technology

There is a general agreement that international cooperation is very important in the field of technology, especially energy technology [20].

The importance of international cooperation in technology is also acknowledged by most respondents. For energy technologies, the most important issues for international cooperation are considered to be:

- Applied research and demonstration (73% of respondents);
- Know-how exchange (59% of respondents);
- Technology transfer (58% of respondents).

Basic research is seen as the next priority (54% of respondents), followed by market and regulatory issues (ca. 45% of respondents).

Source: Report of the Public Consultation on the European SET-Plan

The core of collaborations occurs among similar institutional subjects. Public players such as universities and other publicly funded research centres are more likely to engage in collaborations with similar entities. Likewise, companies are often engaging in collaborations with other companies. But collaborations in science, technology and innovation are not only public-to-public or business-to-business. On the contrary, it has emerged more and more that the collaborations among public and business players are of fundamental importance for successful innovation and economic growth [33]. In emerging scientific and technological areas, firms manage to innovate successfully when they can interact with high quality university labs and can easily recruit trained and qualified young researchers and engineers. At the national level, it is widely recognized that a successful innovation strategy requires collaboration and integration among business and public institutions.

These collaborations will be equally valuable if they occur among business and public institutions based in different countries. In fact, the EU, through the various framework programmes, has already facilitated and promoted pan-European collaborations among networks of innovators operating in the public and the business sectors. This, however, does not exclude wider forms of collaborations. In fact European and other public research centres can be an important asset to allow firms to explore, identify and select scientific and technological opportunities at the world level that they can exploit for their innovations.
The need to engage in international S&T co-operation in the field of renewable energy has also been concluded from the side of the emerging and developing countries. In the analysis of the best and worst practices (see also the WP2 report of this study), the following is concluded regarding co-operation with the EU.

Africa	EU areas of involvement need to be early stage high risk investment such as replicating / demonstration technology, feasibility study funding, data collection and capacity building for stakeholders both private and public. The role of the European Commission could be the export of expertise in the field of policy and technology - knowledge networks therefore need to be further developed / strengthened and co-operation between research institutes in EU and EDCs should be improved.
Asia	EU actors, research institutes as well as companies should join hands with domestic Asian institutes and companies. EU partners can provide more advanced skills and technologies, which will directly help expanding the market of the local partners, and may be beneficial in reducing the costs of local manufacturing. The role of the EU should be country/region and technology specific. For example, biomass based micro CHP technology could be promoted in regions where biomass is grown substantially and promotion of Solar thermal application for industrial use in India.
Latin-America	The EU should encourage a participative approach, involving local partners and beneficiaries. Within this context financial facilities can be provided to support joint projects between EU and local research institutes and SMEs. These cooperation's with local research institutes and manufacturers could lead to the development of low-cost, appropriate technologies and systems, with benefits for both sides. Research and production capacities should be developed in those countries that offer major market potentials for the respective technology (like e.g. Argentina, Chile, Colombia, Peru in the case of wind energy).

Table 7 Suggestions for EU S&T cooperation (result from WP 2 regional analysis)

5.2 International S&T cooperation is currently confined to OECD countries

International public sector cooperation has grown in volume and the diversity of instruments used for such cooperation. However, it has largely remained confined towards the large science and technology producing regions of the EU, Japan and North America. A major challenge for public sector cooperation is thus to widen the scope of international cooperation activities and to devise instruments capable of including non-OECD countries as partners.

A challenge for international cooperation polices thus lies in devising a strategy that will successfully go against the grain of the historical trends in the globalization of public knowledge without losing the partners in the OECD area that the EU has successfully gained from cooperating with in the past.

5.3 Recommendations

5.3.1 Increase participation of EDC partners in Framework Programmes

- The possibility of participating in the European Framework Programmes for RTD should be actively promoted in EDCs.
- A (geographically and technically) balanced co-operation between actors should be one of the main criterion for the selection of projects, however with regard to the initiation of projects, the focus should be broadened to include a reasonable share of projects that are driven by a demand from EDC partners.
- The possibility of involving EDC partners should be actively promoted among European actors active in RTD. The possibility to involve these partners is insufficiently known. Promotion through national contact points could be an effective means to shape this

promotion – a large share of proposers is in contact with one of the national contact points while formulating their proposals. The NCPs could actively look for possibilities / benefits of co-operation with EDCs in the proposals and suggest these to the proposers where relevant. The NCPs could furthermore facilitate the partner search – many NCPs currently already have such a facility to assist proposers in finding partners in Europe – this could fairly easily be expanded to EDC partners.

5.3.2 Bring together leading European and EDC partners

A second instrument that is deemed to be very interesting in furthering the co-operation between EU and EDC partners in renewable energy technology development is the initiation of a technology platform on this subject. European Technology Platforms 'provide a framework for stakeholders, led by industry, to define research and development priorities, timeframes and action plans on a number of strategically important issues where achieving Europe's future growth, competitiveness and sustainability objectives is dependent upon major research and technological advances in the medium to long term' [Cordis]. ETPs are usually focused on a specific technology; there is for instance a European Biofuels Technology Platform and a European Technology Platform for Wind Energy. An EU – EDC renewable energy technology platform would have a broader technological perspective, but would be much better equipped to tackle the specific co-operation issues brought about by this type of international co-operations. Given the importance of scientific and technological co-operation, for EDCs but certainly also for European competitiveness in the long run – it would be certainly worthwhile to look into possibilities of forming an ETP dedicated to this subject. Ideally this would in time lead to the forming of a Joint Technology Initiative.

6 Building strategic partnerships between EU industry and local stakeholders

Several reports, as well as the regional analyses (WP 2), show there is a need for improved collaboration between EU industry and local stakeholders from EDCs in the area of renewable energy. This cooperation should be accomplished at various levels (policy, research, business) and by different types of actors (research community, governmental organisations and policy makers, NGOs and renewable energy industry). Cooperation between actors from EU and EDCs can be mutually beneficial from an economic, social and environmental perspective.

Improved collaboration of the EU renewables industry with stakeholders in EDCs can:

- Speed up innovation as there is an interesting research base in EDCs, both in terms of availability of people and capacities and in low costs.
- Take away the barriers that currently obstruct the large-scale deployment of renewables.
- Be a crucial factor for being able to successfully access and maintain a position on these high potential markets.

Developing concrete partnerships requires an individual and (technology /country) specific approach, looking at barriers and opportunities, market conditions and roles of local actors. What should these partnerships look like, both in terms of stakeholders involved, subjects and conditions for collaboration? The following paragraphs are aimed to provide guidance into these questions.

6.1 Main success factors are: the right local partners and governmental assistance in the target market.

In the following table the main success factors are summarised, based on the results from the RE Industry survey (WP 3). From this summary it is clear that establishing the right local partnerships and governmental assistance are crucial, according to the EU industry respondents.

Success factors for doing business in EDCs	Most important	Second important
Africa	The right local partners Governmental assistance	Assistance from international organisations
Latin America	The right local partners Governmental assistance	Local presence Home market governmental assistance
Asia	The right local partners	Local presence Governmental assistance

Table 8 Summary of results from RE industry survey (WP 3)

6.2 Partnerships with the aim to increase large-scale deployment of renewables

From an industry point of view the partnerships should be targeted at large-scale deployment of renewables. For industry, expansion is important and should be done “the sooner, the better”. However in practice, industry should take into account long lead times.

The following table gives an overview of the possible partners that should be taken into account in renewable energy implementation projects. The actual choice for partnering strongly depends on the country and technology at hand and on the specific barriers obstructing large-scale implementation.

Possible partners
Governments: governments play a crucial role in the facilitation of the deployment of renewables. Their policies and interventions can either help or obstruct the deployment of renewables. The capacities of governments in EDCs, both in quantity (number of people and budgets) and quality, often is much lower than in developed countries. Therefore necessary policies and interventions are not in place or enforced. A partnership can help to take away some of these problems.
Research community: local researchers are best positioned to identify and solve local barriers preventing deployment of renewables. As the identified barriers are often linked to specific local socio-economic contexts (see paragraph 3.1), this is even more the case. Current research infrastructures in many developing countries are however weak in terms of budget. Partnerships can have multiple advantages for both parties.
Market actors: to be able to produce and market a technology a certain level of cooperation with market actors is needed. Often this is not the case in developing countries, especially in many African countries. To decrease costs for production, transportation, marketing, installation and maintenance, a certain level of local presence from EU industry can be required. Partnerships with local market actors will stimulate capacity building and can help EU industries to establish a stable local presence.
Finance sector: financing is a crucial factor for the deployment of renewables, especially for large scale applications. The financing sector in many developing countries is lacking the knowledge of and experience with large-scale renewable energy projects.
NGOs: NGOs in developing countries act at many different levels having a relation with deployment of renewables: access to energy, health, gender, learning and education or development in a more general sense. NGOs can be important partners when implementing renewables. The can act as provider of knowledge on the local circumstances or partner for the actual implementation process.

6.3 RTD&D can help to take away barriers that currently obstruct large-scale deployment of renewables

Although more efforts are probably needed, Research, Technological Development and Demonstration activities can help to take away barriers that currently obstruct large-scale deployment of renewables. The following table identifies the main RTD&D subjects per type of partner. These RTD&D activities are based on barriers as identified in the case studies, industry survey, interviews and literature study.

RTD&D activities identified for partnerships with EDC stakeholders	Government	Research community	Market actors	Finance sector	NGOs
Technical research and Development:					
- Adaptation of existing technologies to local geographical and climate circumstances	X	X			
- Development of specific technologies addressing the local (energy) needs	X	X			
- Technical potential and site studies	X	X	X		
- Identifying maintenance issues	X	X	X		X
Social-cultural research:					
- Identification of (energy) needs	X	X			X
- Social-cultural advantages and disadvantages of (new) renewable energy systems		X			X
- Ownership and payment models	X	X	X	X	X
- Awareness on renewables of local communities	X	X			X
Economic research:					
- Solutions for financing capital intensive projects	X	X	X	X	
- Economic advantages of renewables versus other energy	X	X		X	

RTD&D activities identified for partnerships with EDC stakeholders	Government	Research community	Market actors	Finance sector	NGOs
alternatives: energy infrastructure and industrial activities					
- Life-cycle costing of renewables versus non-renewable alternatives	X	X		X	
- Research on developing local industry and businesses	X	X	X		X
Development and Implementation activities:					
- Large scale demonstration projects both centralised, grid connected as well as small-scale decentralised (home) renewable energy systems	X		X	X	X
- Demonstration of local business development	X		X		
Policy supportive research:					
- Implications of deployment of renewables for other policy areas like health and safety, access to energy (rural electrification), security of supply and energy security, environment, climate change, local industry and employment, gender, innovation and research	X	X			
- Developing a supportive policy and legislative framework for support of renewables	X	X			
- Research on successful supportive (financial) instruments	X	X		X	
Market research:					
- Market potentials for renewables	X	X	X		
- Research on successful business and payment models	X	X	X	X	X

Table 9 RTD&D activities identified for partnerships with EDC stakeholders

6.4 Recommendations

Currently, in many developing countries, especially in Africa, there is minimal governmental support for infrastructure for energy systems, including businesses that manufacture components and whole equipment, others that stock and sell the supplies and materials, others that maintain systems in operation and businesses that provide appropriate financing. [31]
Enhancing technological cooperation at all levels (from R&D to diffusion) can lead to benefits in terms of technological cost reductions as well as accelerated market penetration. [1]

6.4.1 Stimulate the creation of strategic partnerships between EU RE industry and local stakeholders in EDCs

Co-operation of EU RE Industry with local government, private sector and RTD partners in EDCs is crucial for long term market success.

- Stimulate the creation of Technology Platforms in EDCs (see also paragraph 5.3)
- Organize partnership events with EU Renewable Energy and local EDC stakeholders in different regions and countries.
- RTD and Demonstration projects can be helpful to enter markets in EDCs and to raise awareness and trust, but follow-up is needed not achieve multiplication.
- Support the implementation of financial policies & instruments, such as Feed-in Tariff and Investment Funds. These are very effective ways to get RE to EDCs.

7 RTD&D efforts should be focussed on specific local needs and socio-economic circumstances

Throughout the study, from various sources of input (interviews, literature, survey and case studies) a main conclusion is that one of the main factors for the success of a renewable energy implementation process is the alignment with the local context. Projects need to be well adapted to local needs, and need to be well adapted to local possibilities – e.g. in terms of financial possibilities of the end users and in terms of their capacity to (organise) the maintenance of the respective systems. This chapter summarises a number of specific local context aspects that need to be taken into account. The input for this chapter mainly originates from the Work Package 2 report in which the 'best and worst practices' are analysed.

7.1 Barriers for implementing RE in Africa

The main RTD&D related barriers for Africa that have been identified in the case studies and interviews that were carried are:

1. Technology barrier;
2. Market information barrier;
3. Socio-economic barrier.

The following paragraphs describe in more detail these barriers.

7.1.1 Technology barrier

In the case studies, a major identified technology barrier is the adaptation of RETs to the local needs and circumstances. There is a perceived lack of scope for local innovation and customisation. One of the causes of this barrier is that African countries are predominantly RE technology importers (although not exclusively). Better customisation of technologies to local needs is likely to imply increased export of EU goods and services. Apart from pure technical research, this would also require research aimed at a better comprehension (and where necessary improvement) of the local situation – the research focus should therefore be on socio-economic development and policy research.

7.1.2 Market information barrier

In many countries the policy measure - market information feedback loop is not in place. Energy, renewable energy and climate change issues are long, multi decade issues, as is generally the temporal scope of the policy process. Data availability, data temporal and statistical resolutions are poor, which makes planning difficult – in particular where sophisticated markets for energy are not in place.

7.1.3 Socio-economic barrier

Linking energy access to productive and social uses of energy is a prerequisite to ensure that energy has a true impact on the socio-economic development of developing countries and really contributes to the achievement of the MDGs. For decentralised energy systems, a minimum load has to be ensured in order to guaranty proper use and maintenance of the system. Residential use alone is usually not enough to ensure this minimum load is achieved. [31]

Local 'ownership' of projects and programmes is a prerequisite to avoiding the notion that donor funded projects (multilateral or bilateral donor funded projects in general, including EU projects) operate disconnected from local needs and without due consideration for local contexts. Apart from

the aforementioned technology barrier that is often a consequence of this notion, it is also a barrier in itself. Without local ownership the level of involvement of the local actors (project participants – e.g. involved in implementation and maintenance of RETs, and end-users) is lower, which is a significant risk for the success of a project.

7.2 Barriers for implementing RE in Asia

The main RTD&D related barriers for Asia that have been identified in the case studies and interviews that were carried are:

1. Technology barrier;
2. Lack of standardisation;
3. Capacity barrier;
4. Information barrier.

Most of the above issues are very similar in all the five Asian countries that have been studied. All the countries have similar barriers in project implementation and require RTD&D support in broad sense. However, while implementing the RTD&D support, a pre-requisite is to be site and project specific – in most cases even within a country (e.g. India and China are very large countries with diverse geo-climatic and social conditions). The success of a RE project is highly dependent on:
(1) Local capacities / resource availability
(2) Geo climatic conditions
(3) Social acceptability / adaptability / demand
(4) Regional/provincial policy

The following paragraphs describe in more detail these barriers.

7.2.1 Technology barrier

In most of the countries, the main technical barriers identified are a lack of domestic manufacturing capability for renewable energy systems, and in general a weak manufacturing and service industry.

7.2.2 Lack of standardisation

Standards, certification, and accepted general system design and installation guidelines are not yet sufficiently developed and are (where guidelines exist) erratically applied in many Asian countries, with a detrimental effect on system performance and quality.

7.2.3 Capacity barrier

Managerial and technical skills remain limited among many companies selling and installing RE systems, resulting in inadequate business planning and poor cost and quality control. Inadequate technical skills and local competence for installation and maintenance of RE systems, inadequate knowledge of system developers and end users about RE market conditions and availability of RE systems, poor availability of spare parts for operation and maintenance of renewable energy systems are considered to be critical barriers for successful implementation of RE projects in developing countries. Most of the RE projects are implemented in remote and rural areas, lack of trained manpower is more prominent in those areas and there is always insufficient local capacity for O&M and repair.

7.2.4 Information Barrier:

Most of the developing countries do not have proper RE resource data at national and provincial levels. Lack of adequate data in terms of assessment of solar/wind resources, sites and equipment

performance are is a problem faced by many project developers. Even when data is available, it is often not easily accessible or expensive to buy. At a more general level, there is a lack of information on experiences with projects that have been carried out in the past – no 'knowledge base' is being built up on the successful implementation of RE projects.

7.2.5 Other barriers indirectly related to RTD&D

Furthermore the following barriers have been identified that are less or indirectly related to RTD&D:

- ***Policy barrier:*** All Asian countries under study require to adopt more supportive and strong national policy, regulatory (e.g. interconnection tariff and cost sharing mechanisms at the utility level) and incentive mechanisms to promote and adopt RE technology, especially for grid connected projects..
- ***Economic and financial barrier:*** The high initial investment costs for renewable energy systems, lack of funds for renewable energy technology R&D and lack of incentives and institutional support for distributed generation systems are considered to be one of the major barrier to promote RE technology in developing countries – as these lead to a situation in which RE is not capable of competing with conventional power technologies.
- ***Infrastructure and network:*** Most of the project sites in developing countries are located in remote areas, which are very difficult to access, have no road or bad road and communication network. Implementation of projects in such remote areas and operation and maintenance afterwards became prohibitively expensive due to high cost of transport and conveyance.

7.3 Barriers for implementing RE in Latin-America

The main RTD&D related barriers for Latin-America that have been identified in the case studies and interviews that were carried are:

1. Socio-economic / cultural barrier;
2. Financial barrier – lack of funding for RTD&D.

The main and most relevant difference between the Latin American countries that have been studied is the outstanding position of Brazil with regard to genuine R&D activities that are carried out by qualified academic and other research centres and receive funding from public research funds. All other countries (probably except Chile and Mexico) lag far behind compared to Brazil, both in terms of the number of research centres and researchers and - most notably - in funding of R&D activities. This leads to the situation that R&D activities either have to be carried out with very limited funding or depend on foreign funding and therefore implicitly on the policies and preferences of international donors.

Among the other countries of the region (except Brazil), some encouraging examples exist, how RTD&D activities can be realized with (limited) local funds and focussed (limited) international cooperation, in particular:

- Peru: the development and market introduction of locally produced, low-cost solar heaters, solar dryers and micro hydroelectric turbines.
- Regional: the demonstration projects for the electrification of rural community centres and isolated communities with productive aims in Argentina, Paraguay, Peru and Uruguay, coordinated by INTN Paraguay and co-financed by OAS.

The following paragraphs describe in more detail these barriers.

7.3.1 Socio-economic / cultural barrier

In many demonstration projects it is necessary to achieve the active participation or involvement of local communities. In this respect the consideration of the cultural identity and attitudes of the communities and technology users (which is especially of importance as many regions that still lack modern energy services are populated by indigenous communities and nations) is crucial for the successful implementation and operation of the project. Judging from the experiences gathered in the best and worst practices, fundamental socio-economic research has apparently so far not been a focus of international operating donors (neither of the EC in the case of the SILAE and CCE projects). Sound socio-economic research should be a pre-requisite to establish appropriate project objectives.
Lack of understanding of the cultural identity and attitudes of intended users is a major barrier to the successful implementation of projects.

7.3.2 Financial barrier – lack of funding for RTD

Financing instruments are a major focus of internationally funded projects, as most renewable energy options are currently either not competitive, or not affordable for end-users. Concerning RTD, it should furthermore be recognized that research projects and research in most Latin American countries are notoriously under-funded. For many research centres, to attract international cooperation funds or technical cooperation has proven to be of vital importance and frequently has a catalyzing effect (see e.g. the early involvement of GTZ in the development of solar thermal technologies in Peru).

7.4 Recommendations for Africa

7.4.1 Stimulate market orientated and policy research

The policy environment is complex and again country political and socio-economic specific. Research is required to define policy measures based on their anticipated impact on the market which the RTD&D seeks to develop. This should address the risk of unintended market distortions through such technological development and demonstration. In terms of technology transfer the global benefits of the transfer must be considered both in the pricing of such transfer and in the ability of the technology recipient to innovate rapidly further, thereby allowing for final step tailoring to the local specifics of market demand. From there, the market can take over - both global and thriving local markets support and drive further technological development through competition.

7.4.2 Other major RTD&D issues to address

- Further develop local manufacturing ability (capacity and technology);
- Focus on non-technical issues – ‘techno-social interface’;
- Improve the policy monitoring (feedback loop);
- Facilitation of support mechanisms for market creation is a main requirement (e.g. certificates, permits, feed in tariff, obligations).

7.4.3 Improve the information basis and its accessibility

- Information linkages – stimulation of information dissemination such as wind resources from Eastern Cape economic stimulation;
- Improve energy data collection (biomass, technologies and applications) especially in Sub Saharan Africa.

In terms of RE being primarily driven through a development agenda in EDCs, it should be noted that the local benefits of technological research, development and demonstration, including optimising local resource (natural and energy resource) utilisation must be proven, documented and publicised – this is currently not always the case.

7.4.4 Increase local ownership

For a project to be successful it needs a local champion (entrepreneur) therefore the proposed project should be driven locally be that person in government or the private sector. This person should be able to identify needs of the market or department, write the proposal indicating the associated budgets, secure the necessary support from the appropriate stakeholders and have a basic technical proficiency to provide the funding actor (e.g. the EU) with the necessary confidence of a positive outcome and the commitment to see the project through. The funding actors should be ready to respond to the champions needs be they financial, technical or capacity building, without trying to modify the champions' proposal to meet their agenda.

7.4.5 EU should stimulate the demonstration of best practices

These best practices should be focussed on:

- Technical and training certification and promotion of (EU) standards;
- Expertise on renewable energy policy and capacity building at government level, thereby stimulating the preparation of policies;
- Industry-technology life cycle studies (country and market specific and focus on local market needs);
- Expertise on renewable energy technologies and capacity building for private stakeholders (industry, finance and NGOs);
- Sustainable, large scale demonstrations of technologies, for technologies that have not yet been implemented successfully.

➢ Create and develop knowledge networks on the above issues and promote co-operation between the different actors in EU and EDCs.

7.5 Recommendations for Asia

7.5.1 Support EU companies in entering the Asian market

EU companies can be supported through the development of high density demonstration projects – these should be market driven, and support industry to invest in EDCs to produce quality products (including support for technology improvement to reduce the costs of local manufacturing.

7.5.2 Improve capacity development

Improve development of standardised training programmes at different levels (institutional development, managerial training, research / technical, design and engineering). These programmes should include the development of marketing skills and involvement of investors / finance institutes.

7.5.3 Strengthen the awareness and knowledge levels of policy makers

Support the development of policies and regulatory/contractual models for independent power producers that give renewable energy an equal footing with conventional generation and facilitate transparent third-party grid access.

7.6 Recommendations for Latin-America

The focus of EU intervention should not be on an increasing number of projects but on the sustained support to few programmatic projects with a high probability of success, acknowledging the timeframe required to achieve sustainable results. Objectives and work plans of projects should take into consideration the local realities.

7.6.1 Improve involvement of local RTD stakeholders

Genuine R&D projects are usually undertaken by Research Centres of the respective country, who are often connected to universities. Local Research Centres are aware of the local circumstances and barriers and therefore in a position to direct R&D to solving both technical and socio-economic barriers. The EC could play an important role in supporting these efforts, fostering communication and interaction between local and international experts in order to develop shared understanding of the specific circumstances of rural electrification.

7.6.2 Stimulate policy and funding for public R&D by S&T cooperation dialogues

The Brazilian model of publicly funded research centres and R&D projects could be a model for other countries in the region. Nevertheless, it requires in the first place active R&D policies and substantial public funding, i.e. sovereign policy decisions of national governments and parliaments that cannot be directly influenced by international donors, such as the EU or foreign aid agencies. Indirectly the EU can influence this by starting dialogues with the respective countries and governments on S&T cooperation.

7.6.3 Encourage and support EU – local research co-operations

There is a general lack of international cooperation in renewable energy RTD&D. EU research institutes should be encouraged and financially supported to develop partnerships and joint R&D projects with their counterparts in Latin American countries, both in the fields of technological R&D and in the socio-economic research (i.e. on the application of RE technologies and systems). Joint R&D activities could include the realization of demonstration projects involving Latin American and European SMEs (see also below).

7.6.4 Encourage and support EU – local industry co-operations

EU suppliers of RE technologies and systems should be encouraged and financially supported to cooperate with local research institutes and SMEs when adapting their technologies to local conditions. Special emphasis should be given to the experience of EU countries with decentralized energy systems. Other interesting issues for EU - Latin American cooperation could be the transfer of experiences of European SMEs specializing in the assembly and system engineering of small RE systems.

7.6.5 Major RTD&D subjects to address

Cooperation projects in the field of renewable energy RTD&D should foster / focus on:

- Socio-economic research, either as integral component of rural electrification projects or as fundamental research;
- Developing and implementing appropriate finance mechanisms for RE projects and RE RTD activities;
- Application of RE technologies in rural and remote areas and in specific cultural environments.
- The support of local capacities and finance mechanisms for RTD&D projects in energy.

8 Improving the learning curve by ensuring previously acquired knowledge is available and accessible

As indicated in the previous chapters (see e.g. Table 6, on page 24), the availability of knowledge or information - especially market information and knowledge of socio-economic/cultural circumstances and effects - is seen as one of the main barriers for the successful uptake of renewable energy technologies in developing countries, especially in Asia and Africa. In Latin-America the issue appears to be less prominent, however also in this region lack of information / available knowledge is identified as a problematic issue in several case studies. Furthermore, the issue is mentioned in the paper 'Key challenges in stimulating diffusion of clean technologies in Latin-America' [32]

Also, the issue is noted in several publications, such as the 'Pre Dakar Position Paper - Strategies to Scale-up Renewable Energy Market in Africa' that was formulated by NGOs and other stakeholders for the International Conference on Renewable Energy in Africa, 16-18 April 2008. In this paper, inter alia the following is noted regarding information related obstacles to renewable development in Africa:

- *"Lack of exchange of information and experience on what works and what does not within and between countries, given differences in cultural and marketing contexts.*
- *Lack of awareness of renewable energy technologies has caused major setbacks to development in Africa. Until recently, most of our policy makers and government officials were not knowledgeable on these technologies and policies could not be formulated in favour of the technology. On the side of the potential end users, creating awareness will go a long way to help Africans start to integrate the technology into their thinking and acting. Without adequate exposure to renewable energy and energy efficiency technologies and the services they can provide, policy makers, the business community and civil society will have limited bases upon which to make decisions and will be apprehensive to commit resources to the technology."* [31]

Summarising, it can be stated that the issue of knowledge / information gaps refers to the following three problematic issues:

1. **Insufficient knowledge is available on previous experiences** with the implementation of a certain technology. As a consequence project developers / initiators have to reinvent the wheel for problems that are likely also encountered – and perhaps solved – by other projects.
2. **Closing the 'policy feedback loop'** – policy makers in EDCs tend to have insufficient information on the possibilities and specifications of renewable energy technologies which hampers adequate policy making as a founded, balanced comparison between energy options (including renewables) can not be made.
3. **Information related to renewable energy markets /** renewable energy potential (including technical information on geo climatic conditions) **is insufficiently available**, although this is crucial for investors and for the purpose of policy monitoring and policy development.

In the following paragraphs these three types of information gaps are discussed and starting points are provided for the possible role of the EU and other actors. As the latter two issues show overlap in the type of information that is required and in target audience, these are discussed together in paragraph 8.2.

8.1 Gathering, and learning from knowledge on previous experiences

Although there are several collections of case studies available, and programmes managed by national governments and international donor organisations evidently have information on projects that were funded by them, thorough evaluations of these programmes and projects are scarce.

Furthermore, there are little overarching initiatives to bring together experiences from different sources and make them available for project developers from industry and the public sector and policymakers. As a consequence, the 'learning curve' for the implementation of renewable energy in EDCs is developing insufficiently – no overall knowledge base is being built up and project developers (either from governmental organisations, (other) donor organisations or industry) are dependent on the knowledge that is being built up internally in knowledge sharing systems (where available) and in the experiences of their staff. With regard to the latter, there is a high risk of knowledge being lost – either through natural staff mobility or through organisational developments (e.g. reorganisation of departments, programmes ending or being transferred to a different (part of the) organisation).

In Europe, several instruments have already been launched to provide access to information on previous (demonstration) projects; however these are focused pre-dominantly on Europe. In the Caddet database ((http://www.caddet.org) information is available on almost 600 projects, however only 6 of these projects are located in countries studied in the RTD4EDC project.

8.2 Availability of information on market potential / closing the policy feedback loop

As concluded in the regional analysis of the best and worst practices, especially for Africa (see also the separate WP 2 best and worst practices analysis report), there is a lack of information which is necessary for effective policy making. This concerns information on technologies (i.e. sufficient information to be able to compare different energy options and their consequences, from different perspectives – e.g. socio-economic, costs and benefits, environmental impacts; this issue will be discussed later on in this paragraph), but also information on overall market potential and potential in specific local circumstances. The latter information issue is not only hampering the development of effective renewable energy policies – it is also a main barrier for project developers.

8.2.1 Information on renewable energy market potential

Organisations like REN21 provide valuable information on developments in the markets for renewable energy technologies; however this information is pre-dominantly at macro-scale. From other sources, more detailed information is available on renewable energy potential at country level. For instance, in the RECIPES project [30], detailed assessments have been made of (country and market-technology) specific renewable energy market potentials in the 15 emerging and developing countries and ('country briefs') were made highlighting the main aspects determining the renewable energy potential in 99 other EDCs.
The 15 detailed country studies give a good impression of the renewable energy potential – technical potential as well as realistic potential, also taking into account market conditions such as perceived risks. This information is deemed to be useful for project developers to get a good impression of the markets for renewable energy, and for policy makers to be able to determine what the main factors are, that determine the market potential, and what the barriers are for the realisation of this potential.

However, this information is still at a too high level to incorporate all local specificities that are required both for sound policy making and for the strategy for project development. In the analysis

of the best and worst practice case studies, it is concluded that the success of a renewable energy implementation project is highly dependent on:

- Local resource availability;
- Local geo-climatic conditions;
- Social acceptability / adaptability and demand;
- Regional / provincial policy.

This type of detailed, local-specific information is usually not sufficiently available to policy makers and project developers (or at all). One of the recommendations from the analysis of the best and worst practice is therefore that a study is conducted addressing the subject within each of the designated countries. These studies would be aimed at identifying where best to intervene to ensure maximum impact – they should be country and market specific and focus on local market needs.

8.2.2 Need for policy monitoring and support for policy making – cost benefit analysis

Policy makers in EDCs, at the national and local levels, do often not only lack information on actual local market potentials for renewable energy options, there is also a lack of knowledge on social, economic and environmental assessment of renewable energy technologies. As this assessment is required to make a well-founded decision on a specific technology or other policy intervention, this knowledge gap is directly affecting the quality of the policies that are being developed (and in some cases even prevents that policy is developed). The existence of a sound stimulating policy is in turn seen as a pre-requisite for the successful implementation of renewable energy projects. In the opinion of the project team there is an urgent need to address this knowledge gap.

The two main issues to be addressed are:

1 Capacity building and awareness - improvement of the knowledge levels of local policy makers on renewable energy options;
2 Implementation of a policy monitoring and evaluation 'system'.

In the past (but also currently), a number of projects have been carried out with the aim to improve the knowledge levels of local policy makers. Furthermore, a number of tools have been developed that aim to assist policy makers in making well-founded decisions on for instance technology options. These where focussed on the assessment of costs and benefits of different renewable energy technologies (compared to currently used technology and other alternatives based on fossil sources).
However, also other assessments should be made for sound policy making on renewable energy options. For instance, the importance of infrastructure / grid development is often underestimated – in some cases the bottleneck is not the availability of the energy source, but the transport of the energy to the demand. This often will also involve the choice between a grid extension, the development of a local grid or local / stand alone systems. Several studies and tools exist that can assist or facilitate in making this decision (e.g. the Homer programme, developed by NREL (https://analysis.nrel.gov/homer/ can calculate in which circumstances grid extension is economically more viable than a stand-alone system).

On the whole policy makers in EDCs do not have sufficient information to make well founded policy decisions. The existing tools and executed capacity development projects are there but its information is not widely disseminated and not sufficient to cover all aspects of local policy making.

Another problem is that policymakers in EDCs often miss the tools and or the experience/capacity to implement a policy monitoring and evaluation system. Such a system is very important to monitor progress and to be able to find out what is working and why.

8.3 Recommendations

8.3.1 Improving availability of knowledge on previous experiences

To improve the availability of knowledge on previous experiences with the implementation of renewable energy in developing countries, a two step approach is recommended:

(1) organisations at which the information on previous experiences is (or should be) available (mainly the donor organisations) should adapt (and if necessary improve) their knowledge systems in order to make available their experiences for future project developers;
(2) A single point of access (portal) should be created to allow easy access

Both initiatives could be initiated in parallel, the portal could be built up with links to existing information sources and expanded constantly when more dedicated information comes available from donor organisations. Both actions are described in more detail in the following paragraphs:

Improvement of knowledge management within the donor organisations

Improvement of this situation has to be organised both at the level of the organisation and at an overarching level:
Improvement of knowledge management within the donor organisations (including national governments): donor organisations build up knowledge by keeping files of projects that were previously carried out, however this knowledge is in most cases rather static. Usually, periodic evaluations are carried out at project and at programme level, mainly aimed at improving the programmes and the management. These are however not in all cases made public and are in many cases specifically targeted at improvement of the specific programme, which limits their use as input for renewable energy implementation projects in general. It would therefore be recommendable that donor organisations, as part of their knowledge management strategies, develop means to make the lessons learnt from their experiences available for other parties active in the implementation of renewable energy in EDCs.

Portal: bringing together experiences from different sources

Initiative to bring together experiences from different sources: as a second step, a point of access should be created that provides access to the experiences of the different organisations active in the implementation of renewable energy projects. In many cases, if it does exist, this information is dispersed (e.g. spread over different Directorates-General and information services of the European Commission, different units / departments within international organisations, different ministries at the national level) and not easily accessible. Bringing this information together by means of for instance a portal website could be a good means to improve this situation, provided that this website is well-structured, user-friendly (i.e. searchable in different ways, e.g. by country, technology, application) and kept up-to-date continuously. Ideally the portal website should already contain sufficient information for a project developer to be able to assess whether it is interesting to study the detailed information. Therefore short project descriptions could be included, that could for instance be based on the formats and database developed for this project (available for registered users at the project website: www.developingrenewables.org).

8.3.2 Closing the policy feedback loop: create a toolbox and knowledge network for local policymakers

An initiative that would bring together tools, policy examples, documentation, course materials and other means to assist local policy makers in acquiring knowledge and develop strong policies in support of renewable energy implementation could therefore be a welcome additional information source. Ideally this would be an initiative that can be filled and updated by the policy makers themselves. The IEA / JREC / EC initiative Global Renewable Energy Policy Measures database (http://www.iea.org/textbase/pm/grindex.aspx) could (partly) fulfil this task – the database contains an extensive selection of examples of policy measures and can be updated by users. However, in addition to the policy measures there should be room for more 'policy capacity building' oriented documentation – in the opinion of the project team this could be done as part of the same database, e.g. by adding separate database sections in which tools and supporting documentation can be stored and retrieved.

8.3.3 Improving the availability of market related information

For the improvement of market related information, the aforementioned facility providing access to information on previous experiences is not adequate. This type of information, aimed to support the decision process of project developers should be to a high extent dynamic and up-to-date. It is therefore recommended to create a facility that constantly gathers and distributes information on renewable energy markets in developing countries. This could for instance consist of a website that provides up-to-date information on market potentials for renewable energy in developing countries, structured by country and technology; combined with a monthly market information update that is sent to interested parties.

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B Annex: Management summary WP1 report

The European Union is one of the frontrunners in developing pro-active policies in the field of energy security and climate change and in supporting the development of new clean technologies that can cut global emissions of greenhouse gases. Clean energy production and consumption technologies – and especially Renewable Energy Technology (RET) – play a crucial role in this transition towards a global 'low carbon' economy. RTD&D addresses the earlier phases in the innovation processes that can pave the way towards large-scale implementation of new technological products and systems.

The RTD4EDC project is focussed on the role of Research, Technological Development and Demonstration (RTD&D) in the implementation of renewable energy technologies in Emerging and Developing Countries (EDCs). This report presents the results of the general information gathering and desk study (work package 1 of the RTD4EDC project). Work package 1 concentrates on: Fact finding and summarising the relevant developments, policies and (program) activities related to the subject of the RTD4EDC study.

PART 1: Global developments & EU Policies and strategies

In this part of the report some key overall developments are identified in the field of RE technologies related to Emerging and Developing Countries.

Global developments

- **A paradigm shift** (new industrial revolution) is needed before low-carbon energy markets can be brought to maturity. The European Union is one of the frontrunners in developing pro-active policies in the field of energy security and climate change and in supporting the development of new clean technologies that can cut global emissions of greenhouse gases.
- Climate change cannot be controlled without efforts by **Emerging and Developing Countries.** Combined emissions of developing countries are projected to overtake those of the current industrialised world by around 2020. Combating climate change includes the implementation of intelligent and efficient energy systems in the growing economies of EDCs.
- There is general understanding that significant technology breakthroughs on a global scale will be needed to solve the problem, with a key role for **Renewable Energy Technologies** (RETs) in this transition towards a global 'low carbon' economy. RTD&D addresses the earlier phases in the innovation processes that can pave the way towards large-scale implementation of new technological products and systems.
- There is a strong need for making progress in the field of **global renewable energy policies** tangible. Global Renewable Energy Policies and Measures Database is in this respect a step forward. The Global Renewable Energy Review Arrangement as proposed could be an even more valuable instrument.
- **The role of the market** is crucial for successful implementation of RET in EDCs. Mobilization of private investment is important – and therefore an important the role of governments is to remove the obstacles for private investment.

EU Policies and strategies

The scope of this study is a complex mixture of different interrelated EU policy areas, such as: Energy Policy, Development Policy, Environment Policy and Research Policy. Some of the main developments in EU policy and strategies in this area are:

- **Sustainable Development;** The EU recognises that the most effective way to promote adaptation to and mitigation of climate change is to 'mainstream' these objectives into

strategies for poverty reduction and/or sustainable development. Combating climate change is integral to the EU's commitment to help developing countries meet the Millennium Development Goals.

- **Strategic Energy Technology Plan;** The SET-Plan calls for reinforcement of international cooperation and for implementing a coherent and differentiated open innovation strategy in relation to developed, developing and emerging economies. Options for further engaging and cooperating with EDCs include:
  - Networking energy technology centres; Cooperation with developed countries will involve public interest research and long-term exploratory research.
  - Setting up large-scale demonstration projects on technologies with the highest potential in the local context;
  - Increasing the use of innovative financing mechanisms, such as the Global Energy Efficiency and Renewable Energy Fund;
  - Reinforcing the use of the Kyoto Protocol mechanisms, notably the Clean Development Mechanism for investments in emissions reduction projects, if the post-2012 international agreement on further CO2 reductions is reached.
- **Emission Trading System;** ETS and CDM are helping developing countries to move towards sustainability through the promotion of projects that reduce greenhouse gas emissions. CDM projects contribute to transfer of clean energy technology to EDCs.
- **Research Framework Programmes;** Today, Europe has strong technological leading positions in many RET-domains such as solar technologies, wind energy, geothermal, biofuels and small hydro technologies. Successive EU Research Framework Programmes have helped to provide this foundation.
- **S&T cooperation;** The EU RTD programmes are open to cooperation with research institutions in EDCs. However the actual participation by EDCs in these programmes is currently at a very low level.

PART 2: EU Programmes

There are a number of different EU Programmes related to RTD&D, RE technologies and EDCs

- **Intelligent Energy Europe** (IEE) - Access to IEE-2 for EDCs is urgently needed and will be mutually beneficial for EDCs and EU. In a global energy market – international partnerships are key for the build-up of strong strategic research and market positions. Organisations from EDCs can open local markets and can act as technology partner or supplier (e.g. solid biomass, biofuel).
- **COOPENER** projects involved a well-balanced participatory approach, most of them featuring in addition a south-south transfer of experience. From experience it became clear participation of local state or public bodies (e.g. energy agencies) is needed to create buy-in and local ownership of concepts and practices.
- **EuropeAid** - Since the transfer of 'energy' from DG TREN to EuropeAid and EC decision not to continue COOPENER as part of IEE-2, the role of energy has changed. Priority will primarily be given to the important role of energy in poverty alleviation.
- **ENRTP**, executed by AIDCO, is the successor of COOPENER. The ENRTP has earmarked an amount of €804 million for the seven years between 2007 and 2013. Thus, through the ENRTP, the EU will have a large amount of dedicated resources for RET in EDCs. A clear disadvantage is the relative distance between AIDCO-F3 and the IEE-2 Programme. Building strong linkage between both programmes on the subject of RET is needed and essential for good imbedding of ENRTP in the EU energy S&T framework.

- **PRO€INVEST** is an EU-ACP programme that provides technical and financial support to organisations representing the ACP private sector in their mission of sustainable investment promotion.
- **Framework Programmes** - The EU Research Framework Programmes can be seen as the cornerstones of technology development at a European scale. The Seventh Framework Programme (FP7) supports RTD on technical, socio-economic and policy research both on individual technologies and on a system change towards a 'low carbon' economy. FP7 is open to any entity including those located in EDCs. Therefore it contributes to knowledge exchange and potentially stimulates the use of RE in EDCs indirectly.

PART 3: EU-EDC Partnerships

Bilateral agreements are successful as they can create critical mass, mobilise political forces and build local support structures, such as the set-up of the matching programmes by the EDC governments. Bilateral agreements can also play an important role in RTD&D cooperation. They create leverage and stimulate universities, research institutions and industry in to participate in the EU Framework Programme. This way they have access to allowing them to benefit from the results of co-operation with European institutions and industry.

- **EU Energy Initiative (EUEI)** for Poverty Eradication and Sustainable Development was launched at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. EUEI is an umbrella organisation that aims to ensure that people in developing countries obtain access to modern and affordable energy services as prerequisite for achieving the Millennium Development Goals.
- **ACP-EC Energy Facility** - The Energy Facility is a co-funding instrument through a "call for proposal" system and is demand driven. Projects that take place in ACP countries (Sub-Sahara Africa, Caribbean and Pacific) that are energy-related and could contribute to poverty alleviation are eligible.
- The **EU-China Partnership on Climate Change** provides a high-level political framework that will further strengthen cooperation and which sets out concrete new actions in the field of climate change.
- **EU-China S&T cooperation** has largely taken place through the Framework Programmes (FP). In FP5 and FP6 Chinese entities were already eligible for particular calls. FP7 in principle is open to any entity, whether located in the EU or third countries including China.

EU-India S&T cooperation - An extended and dedicated institutional bilateral framework is in place with regard to cooperation in the fields of renewable energy, clean development and climate change considering the **EU-India Initiative on clean development and climate change** and the **EU-India Energy panel**.

C Annex: Management summary WP2 report

Implementing renewable energy technologies in a sustainable and socio-economically acceptable way in emerging and developing countries (EDCs) takes more efforts than in industrialised countries. Already a lot of experience has been gained with such projects but the lessons learned are not very well disseminated.
In this report 74 case studies (we have called them 'best and worst practices') have been gathered and analysed. Focus of the analysis was on the question: "which lessons can be learned for the implementation of renewables in EDCs, with an emphasis on Research, Technological Development and Demonstration (RTD&D) aspects". Within the scope of RTD&D also socio-economic and financial issues have been looked at.

The countries for which best and worst practices were studied are: China, India, Indonesia, the Philippines and Thailand for Asia; Brazil, Bolivia, Peru, Argentina and Colombia for Latin America; and South Africa, Ghana, Cameroon, Uganda and Niger for Africa. In total, 74 best and worst practices were collected of which 43% were from Asia; 23% from Latin America, of which two regional; and 35% from Africa.

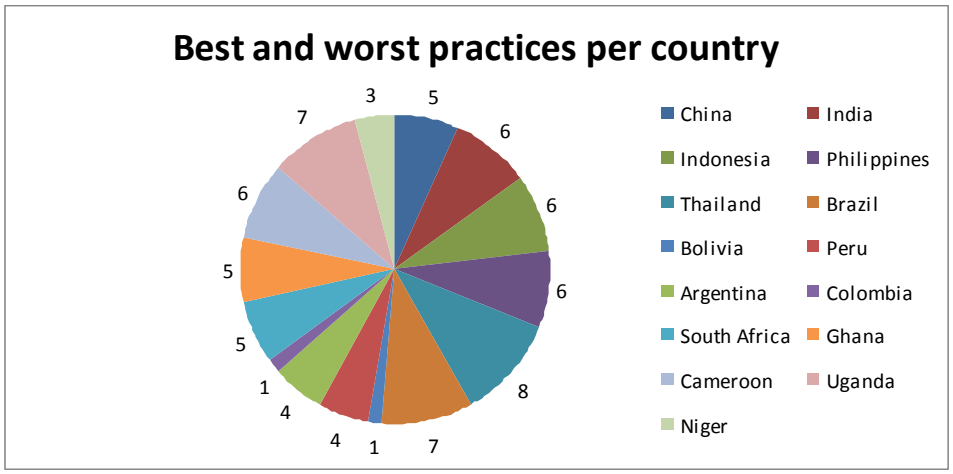

Figure 12 Division of best and worst practices by country

Most best and worst practices (63) are related to electricity production, some on heat or hot water (13) and a few on transport fuels (5) or mechanical power (3).
The renewable energy technologies (RETs) covered in the case studies represent all mainstream (such as wind and solar), but also include RETs that are in an earlier development stage (for example tidal energy). The technologies that are addressed most in the best and worst practices are as follows: photo voltaic (addressed in 47% of the case studies); biomass / gas (39%); wind (32%); hydro (26%); and solar thermal (23%) – note: in most cases more than one technology is addressed in a project. The majority of the technologies are non-grid connected (57), followed by local grid (32) and grid connected (27).

In the opinion of the project team the collection of described best and worst practices is a fair representation of the type of renewable energy projects that are carried out in emerging and developing countries.

Although the division between RTD and demonstration projects can not always be made accurately (as quite a number of projects include elements of both), it can be concluded that most projects included in the study are focusing on demonstration rather than on RTD (Figure 13).

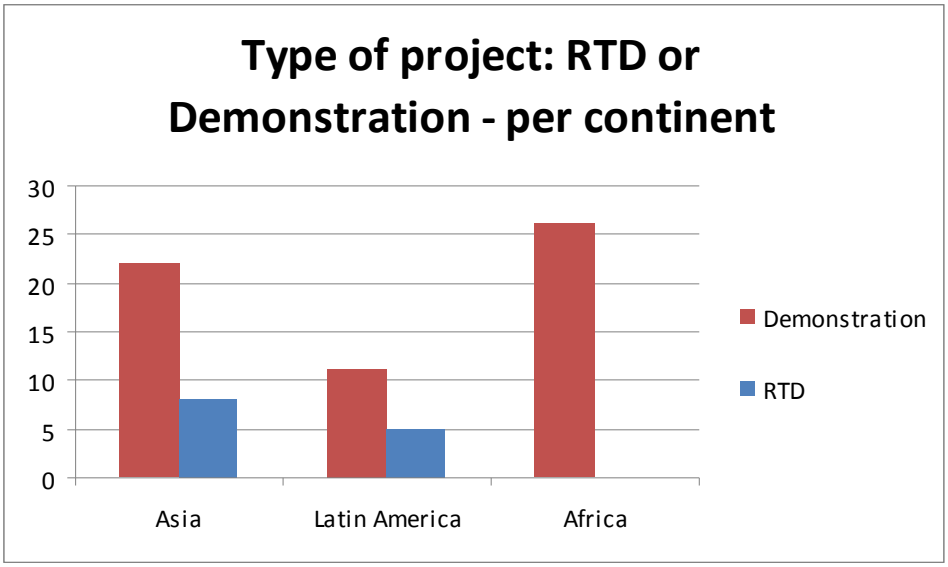

Figure 13 Division between RTD and demonstration projects per continent

The barriers encountered in the case studies differ per continent (Figure 14). A few items that stand out are mentioned below:

- Adverse market conditions (demand, prices, competition) were the most prevalent barrier in all best and worst practices;
- Technical barriers appear to be the least prominent barrier in all three continents.

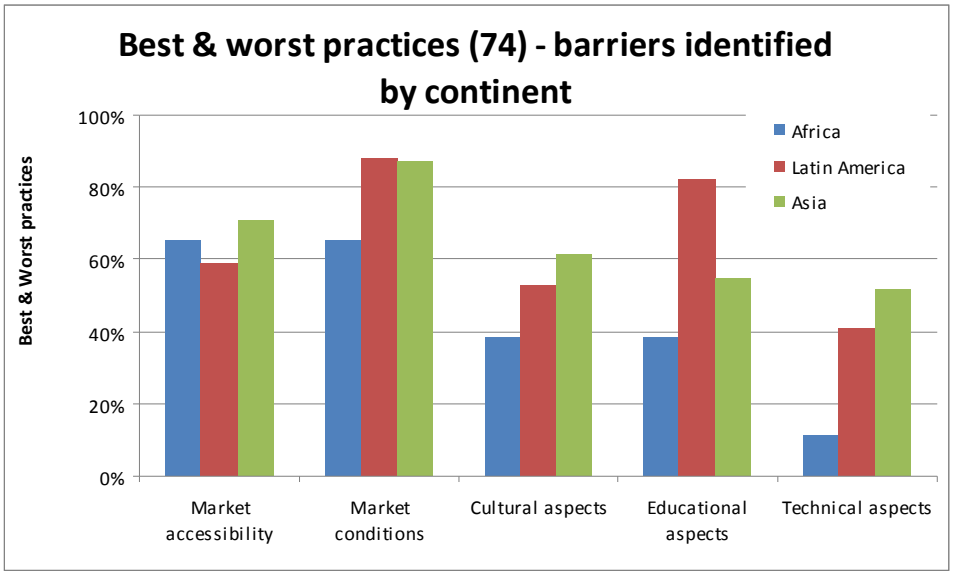

Figure 14 Barriers identified in the case studies - by continent

Generally speaking, demonstration projects are more commonly targeted to overcoming the first four barriers mentioned in the graph (market accessibility, market conditions, cultural aspects and

education aspects), whereas RTD projects are mostly addressing technical aspects. It can therefore be noted that the type of project (RTD or demonstration) typically chosen is generally in line with the types of barriers that are prevailing in the respective continent (i.e. the vast majority of projects from Africa that are included in the study are demonstration projects – the barriers encountered in these projects are typically non-technical). In Asia and Latin America, a larger share of the projects studied has an RTD-focus and focuses on technical barriers. Although it should be noted that only a limited number of case studies could be carried out in the framework of the study, according to the project team these general findings of the best and worst practices is reflecting an actual difference between the three continents that is related to the maturity of the (internal) markets for RETs. Once markets have been developed up to a certain level (i.e. the technology has been demonstrated to function in principle), technological aspects become more important as these to a large extent determine the longer term durability and viability of a project.

A main conclusion from the analysis of the described best and worst practices is that one of the main factors for the success of a renewable energy implementation process is the alignment with the local context. Projects need to be well adapted to local needs, and need to be well adapted to local possibilities – e.g. in terms of financial possibilities of the end users and in terms of their capacity to (organise) the maintenance of the respective systems.

The following table provides an overview summary of the main barriers per region as they have been identified in the case studies.

Barrier type	Africa	Asia	Latin America
Market and information	▪ Market information barrier: policy measure - market information feedback loop is not in place. ▪ Poor overall data / information availability.	▪ Information Barrier: lack of adequate data in terms of assessment of solar / wind resources, sites and equipment performance. ▪ Lack of information on previous experiences.	
Cultural / socio-economic	▪ Socio-economic barrier: lack of local 'ownership' causes low involvement of local actors which is a significant risk for the success of a project.		▪ Socio-economic / cultural barrier: active participation requires consideration of the cultural identity. ▪ Socio-economic issues not a focus of international donors.
Capacity / education		▪ Capacity barrier: managerial and technical skills limited resulting in inadequate business planning. ▪ Inadequate technical skills and local competence for installation and maintenance.	
Technology	▪ Technology barrier: adaptation of RETs to the local needs.	▪ Technology barrier: lack of domestic manufacturing capability and weak service industry. ▪ Lack of standard design and installation guidelines.	
Financial barrier			▪ Financing instruments: major focus of projects, renewable energies are either not competitive, or not affordable for users. ▪ Research in most Latin American countries notoriously under-funded.

D Annex: Management summary WP3 report

The RTD4EDC project is focused on the implementation of renewable energy technologies in Emerging and Developing Countries (EDCs). The project is executed by a consortium of four partners based in Europe (Belgium/The Netherlands), and in Emerging and Developing Countries (Paraguay, South Africa and India).

RTD4EDC will deliver one "overall final report" and three underlying reports:

- WP 1: The role of EU RTD&D policy to increase implementation of renewables in EDCs
- WP 2: The role of EU RTD&D in best and worst practices from EDCs
- WP 3: Evaluation of export potential for EU RE industry and identification of effective RTD&D policies

This is the report of Work Package 3 in which the following activities were carried out in view of the evaluation of export potential and identification of effective RTD&D policies:

1. Desk Research > Updating of EU RE industry export potential in EDCs; The RECIPES project (http://www.energyrecipes.org) included an analysis of market size and market trends for RE in all developing countries and providing detailed information on a selection 15 countries. The RECIPES results are updated with data from recent market studies on EU RE exports.
2. Survey amongst EU Industry representatives; A survey has been conducted amongst EU Industry representatives, in which 53 respondents participated. The survey included a validation of the qualitative EU RE market potential in the EDCs but also contained questions on perceived market barriers and opportunities and on the role of (EU RTD&D) policy in improving the implementation / market conditions.
3. Interviews with EU Industry representatives; From the survey a representative sample of 20 well-informed people were asked for a further in depth interview. Interviews elaborate barriers and policy shortcomings for individual market-technology-equipment combinations. Other questions focus on the way policy can provide practical solutions to realise the EU RE market potential. In Annex C a list with all the interviewed persons is presented.
4. Analysis and reporting; Analysis of the information gathered from the above mentioned sources resulted in the underlying report. Initially a separate report on the current export potential of EU RE to EDCs and a report on possible effective and practical solutions to realise this potential through RTD&D and/or alternative policy instruments were planned, however both subjects are integrated in this report.

EU renewable energy export potential [1]

RECIPES: "Tripling the volume of renewable energy in emerging and developing countries in 2020 is possible in a maximum scenario, with a positive socio-economic impact and continued opportunities for EU RE industry".

The general conclusion of the RECIPES project is still valid, but the results can be updated on several specific technologies and countries.

- Desk Research shows that it is very likely that the maximum scenario is realised: "Tripling the volume of renewable energy in emerging and developing countries in 2020".
- China and India are developing RE capacity faster than expected, specifically for Wind Energy, Solar Thermal and Photovoltaic. Other Asian, African and Latin American EDCs are not implementing RE as fast as expected. But these renewable energy markets still have a significant potential for European Industry.

In general EU RE Industry representatives perceive EDCs as (highly) attractive markets.

- Asian/Pacific countries and Latin American countries are perceived a little more attractive markets then African countries.
- There are great differences in market attractiveness between the different RE technologies under study (see also chapter 4).

Barriers and success factors

- In Africa the highest barriers are perceived by EU RE Industry, followed by Latin American countries and Asian and Pacific countries, although there are some differences for different RE technologies.
- The main success factors perceived by EU RE Industry in all markets are: The right local partners and Governmental assistance in the target market.

EU Policies, programmes, initiatives and activities

- EU RE Industry is generally familiar with the Framework Programmes, EU Energy Facility and European Technology Platforms, but most of the other instruments are not very well known.
- EU CDM / JI projects and EU Emission Trading Scheme are seen as quite effective and they give good business opportunities for EU RE Industry.
- Bilateral programmes, focussed on Emerging Countries (China and India) are not very well known, but they are nonetheless – from the (scarce) information provided through the survey - seen as effective and they give business opportunities for EU RE Industry.

Suggestions for future programmes and initiatives

- Co-operation EU RE Industry with local private sector and RTD partners in EDCs is crucial for long term market success.
- A (online) database with local information of EDCs and best practices can be very useful, so that not everyone makes the same mistakes.
- Knowledge transfer is a good way to accelerate RE in EDCs.
- Demonstration projects can be helpful to enter markets in EDCs and to raise awareness and trust, but follow-up is needed not achieve multiplication.
- EU program for Policy support to EDCs can improve the conditions for EU Industry to enter the markets in EDCs.

E Annex: RTD4EDC Validation activities

During project execution the following specific (besides the interviews and regular contacts we had with policy makers, EU RE industry representatives and researchers) validation activities has been undertaken:

- Advisory Board
- Presentation of draft results at WREC, Glasgow, 23 July 2008
- Validation workshop 29 September 2008

Advisory Board

The Advisory Board has been established at the start of the project (in Annex F a list with all members is included). Role of the Advisory Board was: "To steer the project by giving recommendations, both on the chosen approach and on critical issues occurring during the study". The Advisory Board was consulted three times during the project:

- On June 20 2007, we have set-up an e-mail consultation with the Advisory Board. Four of the members have responded and have provided valuable input for the directions to take in the project. Their comments have been taken into account in the further set-up and execution of the project.
- On 7 March 2008 we have organised an Advisory Board meeting that was attended by all project partners and by three advisory board members: Dr. Linkohr, Mr. Farinelli and Mr. Schneider. The meeting has resulted in valuable input for the analysis of the information that was gathered in the study. Furthermore, a discussion was held on possible recommendations to be made on basis of the preliminary results of the project.
- The draft final reports (overall report and reports of WP 1, 2 and 3) were sent to the Advisory Board for comments on 25 September 2008.

Presentation of draft results at WREC, Glasgow, 23 July 2008

Fourthly the draft results of the RTD4EDC project where presented at the Tenth World Renewable Energy Congress and Exhibition, 22-23 July 2008 in Glasgow, Scotland, United Kingdom. Project team member Siem Haffmans presented the draft results at the European Workshop: "Success factors for International Cooperation on Research, Technological Development and Demonstration in the Area of Renewable Energy".

Validation workshop 29 September 2008

A validation workshop was organised by the project team on 29 September 2008 in Brussels. At this meeting, with 12 persons representing the EC and EU RE industry, the draft results where presented and the recommendations discussed. The results of this validation workshop have been incorporated in this final report.

The project validation workshop was organised on 29 September 2008 at the Fondation Universitaire in Brussels. The workshop was attended by 17 persons, including representatives of the EC (DG Research, DG Environment, DG Relex, DG Enterprise, and DG Tren), renewable energy industry (ARE, EREF) and a development cooperation agency (GTZ). Presentations and discussions were held on the main conclusions of the study, the regional analyses and the tentative recommendations of the study. The project team has incorporated the results of the discussions in the final version of the final project reports (overall report, WP1, 2 and 3 report), that are enclosed with this activity report.

F Annex: Actors involved in the project

This annex presents all actors involved during the project. This involves:

- Project partners;
- Advisory Board;
- Persons interviewed;
- Persons involved in the survey;
- Persons involved in the validation workshop, 29 September 2008

Project partners

Emiel Hanekamp	Partners for innovation BV	Netherlands
Peter Karsch	Partners for innovation BV	Netherlands
Siem Haffmans	Partners for innovation BV	Netherlands
Cees van Halen	Partners for innovation BV	Netherlands
Peter Vissers	Partners for innovation BV	Belgium
Carolien van Merksteijn	Partners for innovation BV	Netherlands
Frens Daamen	Partners for innovation BV	Netherlands
Wolfgang Lutz	Esenerg	Netherlands
Victorio Oxilia	Esenerg	Paraguay
Dwipen Boruah	IT Power India Ltd	India
Hari Natarjan	IT Power India Ltd	India
Rituraj Borah	IT Power India Ltd	India
Markku Toryalai Hart	IT Power India Ltd	India
M. Prasath	IT Power India Ltd	India
Jason Schäffler	Nano Energy Ltd	South-Africa

Advisory board

Prof. Eberhard Jochem	Senior executive, Energy Policy and Energy Systems Department, Fraunhofer Institute Systems and Innovation Research	Germany
Mrs. Mechtild Rothe	Vice-President of the European Parliament / EUFORES	Belgium
Mr. Michel Raquet	European Parliament, Greens / EFA adviser on energy	Belgium
Dr. Rolf Linkohr	director of the Centre for European Energy Strategy	Germany
Mr. Ugo Farinelli	Secretary General, Associazione Italiana Economisti dell'Energia	Italy
Mr Hans Schneider	Senior advisor Builddesk	Netherlands

Interviews carried in work package 1

Hugo Altomonte	United Nations
Oliver Page	UNDP/GEF Regional Coordination Unit, Latin America and the Caribbean
Sergio von Horoch	Consejo Nacional de Ciencia y Tecnología (CONACYT)
Bernhard Zymla	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
Ray Holland	GTZ, EUEI PDF Manager
Iñigo Sabater	DG TREN, Unit B2 - TEN Policy, Technology Dev. & Diss. of results
William Gillett	DG Energy and Transport

Ian Clark	(ETAP)
Gilles Lequeux	DG Research
Jean-Marie Bemtgen	DG Energy and Transport
Sheppard Lynn	DG Environment
Gert-Jan Koopman	DG Enterprise and Industry
Samantha Őlz	IEA
J. Gururaja	Renewable Energy Advocacy Forum
Debasish Majumdar	Indian Renewable Energy Development Agency Ltd.
Binu Parthan	REEEP
Carmen Armstrong	REEEP Southern Africa, AGAMA Energy (Pty) Ltd
Dieter Holm	ISES Africa

Interviews carried in work package 3

Paula Llamas	ARE - Alliance for Rural Electrification	Belgium
Philippe Dumas	EGEC – European Geothermal Energy Council	Belgium
Lauha Fried	ESHA – European Small Hydropower Association	Belgium
Uwe Trenkner	ESTIF – European Solar Thermal Industry Federation	Belgium
Mariangeles Perez Latorre	ESTELA – European Solar Thermal Electricity Association	Belgium
Pierre Ungemach	GPC IP / EGEC - Geothermal	France
Nicolas Fichaux	EWEA – European wind Energy Association	Belgium
Robert Vierhout	EBio – European Bioethanol Fuel Associations	Belgium
Dorte Fouquet	EREF – European Renewable Energies Federation	Belgium
Eleni Despotou	EPIA – European Photovoltaic Industry Association	Belgium
Jan Erik Nielsen	PlanEnergi – Solar Thermal consultancy	Denmark
Steve Sawyer	GWEC – Global Wind Energy Council	Belgium
John Neeft	SenterNovem – Biofuels programme manager	Netherlands
Jean-Marc Jossart *	AEBIOM – European Biomass Association	France
Hubert Zimmer *	Renewables for Development	Germany
Michael Geyer *	Abengoa Solar SA	Spain
Paulo Mendonca *	IT Power	UK
Alla Weinstein *	EU-OEA Ocean Energy Association	Belgium
Carlos Velasques *	CELAPEH	Colombia
Gilles Lequeux *	EU DG Research	Belgium

**) Interview at WREC 2008 in Glasgow*

Persons involved in the survey

Alexander Zachariou	Energy Solutions	Bulgaria
Paul van Aalst	E+Co	Netherlands
Katharina Krell	EUREC Agency EEIG	Belgium
Stefan Dietrich	Q-Cells AG	Germany
Bernard Weber	MAXWATT SAS	France
António Sá da Costa	APREN - Portuguese Renewable Energy Association	Portugal
Arthur de Vries	Celstar BV	Netherlands
Rainer Hinrichs-Rahlwes	BEE - German Renewable Energy Federation	Germany
Geiss	EUFORES	Belgium

Philippe Dumas	EGEC	Belgium
Yves Schenkel	CRA-W	Belgium
Alexander Zachariou	Solar Cells Hellas	Greece
NIJS Johan	PHOTOVOLTECH	Belgium
Dr Doerte Fouquet	EREF asbl / Kuhbier sprl	Belgium
Christine Lins	EREC	Belgium
M. Boogert	Scheuten Solar	Netherlands
DUVAL Jacques	Saft power systems	France
PESNEL Pierre	VERGNET	France
GRASSI Giuliano	EUBIA	Belgium
Stephane Senechal	EUBIA	Belgium
I. Samak	Engcotec gmbh	Germany
Albert K. Plessing	Isovolta AG	Austria
Gerhard Kleiss	SolarWorld AG	Germany
Michael Payne	Shell WindEnergy	NL
David Erhart	First Solar, Inc.	United States
Conall Bolger	Airtricity	Ireland
Mike Meinhardt	SMA Technologie AG	Germany
Peter Brun	Vestas Wind Systems	Denmark
Edita Vagonyte	European Biomass Association	Belgium
Ernesto Macias	Isofoton	Spain
Jeremy Stokes	Suntech	China
Jaap-Jan Ferweda	WindVision	Belgium
Count Jacques de Lalaing	Solar Power Group	Germany
Marco Poliafico	greenfuel4u	England
Frank Suhadolnik	Bowcliffe Partners	United Kingdom
Jose Ospina	Organic Power Ltd	Ireland
Stefan Dietrich	Q-Cells AG	Germany
Joseph Deignan	Optienergy	Bulgaria
Juquois	ADEME	France
Marc de Boer	BioFuel Projects International B.V.	Netherlands
Alfred Hardne	sunrj.com	Sweden
Adam Kupczyk	Agricultural Univer. of Warsaw	Poland
Sauro Pasini	Enel	Italy
Simon Sharp	Sunwoven	Portugal
Reinhard Caliebe	MARC Power GmbH	Germany
Debeaumont J-L	beaumont consult	Belgium
John Mustarde	Solarcentury	UK
Pedro Trentin	greenVenture partners	Brazil
Gerhard Stryi-Hipp	German Solar Industry Association	Germany
Jesús Alonso	Isofotón	Spain
G.J. Jongerden	Nuon Helianthos	Netherlands
Christoph Panhuber	Fronius International	Austria
Thomas Keil	Erdstrom AG	Germany

Persons involved in the validation workshop, 29 September 2008

Mr. Bruno Schmitz	DG RES Head of Unit
Mr. José Ruiz Espí	DG RES
Mr. Sven Schade	DG Enterprise, innovation

Ms. Katharina Krell	Greenovate Europe
Mr. George Strongylis	DG ENV international relations -
Mr. Ray Holland	GTZ
Mr. Guido Glania	ARE
Mr. Aurelio Politano	DG ENV G.3 sustainable development
Mr. Robert Reid	DG external relations, Unit L.3
Mr. José Fluxa	DG TREN, international cooperation
Ms. Doerte Fouquet	EREF
Mr. Bernardo Abelló	DG Research Unit K.1 (international cooperation in energy)
Mr. Dwipen Boruah	IT Power India (RTD4EDC project team)
Mr. Wolfgang Lutz	Esenerg (RTD4EDC project team)