CLEAN ENERGY FOR EUROPE:

A REINFORCED EIB CONTRIBUTION

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The Brussels European Council of 8 / 9 March 2007 adopted an Action Plan for energy policy 2007–2009 and committed the EU to achieving at least a 20 % reduction in greenhouse gas emissions by 2020 compared to 1990. The European Council also endorsed a binding target of a 20 % share of renewable energies in overall EU energy consumption by 2020, supplemented by a binding minimum target of 10 % for the share of biofuels in petrol and diesel consumption for transport. Furthermore, the European Council stressed the need to increase energy efficiency in the EU so as to achieve the objective of saving 20 % of energy consumption compared to projections for 2020.

In the light of these new EU energy targets, national energy plans are to be prepared for endorsement at EU level, reflecting the burden sharing which remains to be agreed between Member States.

Against this background, the EIB proposes measures to reinforce its contribution to EU energy and climate change policy. These measures complement the current EIB energy policy adopted as part of the Corporate Operational Plan (COP) 2007-2009, which focuses on five priority lending areas:

- renewable energy (RE),
- energy efficiency (EE),
- research, development and innovation (RDI) in energy,
- security and diversification of internal supply (including TENs-E), and
- external energy security and economic development (Neighbour and Partner Countries).

A facility for energy sustainability and security of supply has been set up. This facility is intended to enhance the EIB's lending capacity by up to EUR 3 billion from own resources in Neighbourhood Countries, ACP, South Africa and ALA until end 2013.

The Bank has established carbon funds with the EBRD, the World Bank and KfW, and it is developing a 2nd generation fund to promote the long-term carbon market post-2012 (after the expiry of the Kyoto Protocol).

1. Renewable energy

The new binding EU target for a 20 % share of renewable energy by 2020 will require a very substantial increase in RE investments.

The COP 2007-2009 has an annual sub-target of EUR 600-800 million for RE projects and a relative target of 50 % of EIB lending to electricity generation associated with RE technologies. These targets are to be interpreted as a minimum, and the amount will be raised in the next COP; a multi-year rolling target could be considered in due course.

As is currently the case for projects financed under the Climate Change Finance Facility as well as RDI projects, it has been decided to increase the possible share of EIB financing to up to 75 % of the cost of RE projects where justified, notably for emerging RE technologies. The Bank will further develop financial instruments specifically for the RE sector, including framework facilities for smaller-scale investments, and increasingly use structured finance and equity funds. Project identification will be reinforced in new markets which are less developed in RE.

When assessing the economic justification of RE projects a distinction must be made between mature technologies (such as hydropower, thermal biomass and onshore windpower) and more expensive emerging technologies, including biofuels.

The economic benefits of *mature* RE technologies in relation to environment and supply security can be given added weight by raising the assumed alternative economic cost of electricity produced by fossil fuel. An increase from the present baseline scenario of EUR 72 / MWh to the order of EUR 80 / MWh (corresponding to a CO_2 price assumption of EUR 50 per ton) is expected to admit a substantial

number of renewable projects considered marginal hitherto. These criteria are to be monitored and updated in the light of developments in EU regulation and carbon price.

For *emerging* RE technologies it is envisaged to split project appraisal into two parts, energy and RDI, and consider the RDI component separately in line with the methods used for other promising RDI projects, while keeping in mind the overall creditworthiness based on feed-in tariffs for the electricity produced or other support mechanisms. For biofuels the focus will be on 2nd-generation technologies. It will be necessary to increase upstream support in order to develop the pipeline for emerging RE technologies.

The EIB approach to renewable energy is the subject of annex 1.

2. Energy efficiency

Increasing energy efficiency (EE) is the first and best way to tackle the key energy objectives of the EU, and it concerns practically all sectors in which the Bank is involved. Therefore energy efficiency considerations are being given top priority and mainstreamed into the preparation of all projects to be financed by the Bank, and EE will be included as a specific item when assessing value added.

In order to qualify for the EE label a project should reduce energy consumption significantly, i.e. by at least 20 % compared to the situation before its implementation.

For projects with such a significant EE contribution it is proposed to increase the possible share of EIB financing up to 75 % of total cost. Dedicated EE credit lines and financing partnerships are to be developed, including for grouped investments in buildings and SMEs. Technical assistance will be involved, e.g. for energy audits, when funds are available. Lending to Combined Heat and Power (CHP) and district heating will be expanded, especially in the new Member States.

The EIB approach to energy efficiency is the subject of annex 2.

3. Research, development and innovation in energy

The EIB is already focusing on renewable energy and energy efficiency in its RDI activities and risk-sharing finance will be deployed in this area. The Bank follows closely the work with energy related European Technology Platforms (e.g. hydrogen and fuel cells, photovoltaics, thermal solar), in order to identify developments relevant for EIB activities.

The Bank is ready to support RDI in carbon capture & storage (CCS) and to part-finance the demonstration plants foreseen, and it is working closely with the Commission for the identification of large European research infrastructures in the energy sector. The ITER project for research in nuclear fusion is part of this, and financing for RDI in nuclear safety and waste management is also envisaged.

4. Security and diversification of internal supply

The Bank will support TENs energy projects, notably those of “European interest” or “priority”. Interconnectors will be financed, also with the aim of increasing competition in the EU energy markets. LNG as well as oil and gas storage projects are given high priority.

The new EU commitment to reduce greenhouse gas emissions by at least 20 % in 2020 compared to 1990 requires the Bank to review its approach and be more selective when financing electricity generation based on fossil fuel, notably coal or lignite, while taking into consideration the security of energy supply.

Once national energy plans have been developed and endorsed at EU level, taking into account the new energy targets and representing an appropriate burden sharing across Member States, the Bank will consider power projects in accordance with these plans. Until these plans are available, the following screening criteria are proposed for possible EIB financing of coal/lignite power stations (cf. annex 3).

New commercial coal/lignite power stations should use best available technology and be "carbon capture ready". They should also be cost-effective taking into account CO_2 externalities, i.e. be able to exploit CCS once that technology becomes commercially available. In order to avoid a shift towards carbon intensive electricity generation, new plants should replace existing coal/lignite power stations while providing a decrease of at least 20 % in the carbon intensity.

The EIB is ready to finance CCS demonstration plants and prototypes for other experimental clean coal technologies as RDI projects.

Retrofitting projects for existing coal/lignite power stations should be relatively small investments, so they do not delay plant replacement in the medium term, and they should aim at substantially reducing pollution, including by increased energy efficiency.

The European Council, in recalling that the Energy Policy for Europe will fully respect Member States' choice of energy mix, noted the Commission's assessment of the contribution of nuclear energy in meeting the growing concerns about safety of energy supply and CO_2 emissions reductions while ensuring that nuclear safety and security are paramount in the decision-making process. The European Council therefore confirmed that it is for each Member State to decide whether or not to rely on nuclear energy and stressed that this has to be done while further improving nuclear safety and the management of radioactive waste. If the Bank is requested to finance a nuclear power plant, the costs of nuclear waste disposal and plant decommissioning will of course be taken into consideration at project appraisal.

5. External energy security and economic development

Energy and the global challenge of climate change will feature prominently in EIB activities outside the EU under the external mandates. In line with the EU priorities the Bank will assist other countries in improving their access to the internal EU energy market through the development of new EU energy import routes.

In developing countries priority is given to support modern and efficient uses of energy and sustainable energy solutions. In order to increase its impact the Bank will put more emphasis on sector and country energy strategies, notably to support reforms of the energy sector, including tariff reforms.

A facility for energy sustainability and security of supply has been agreed by the Board of Governors (cf. annex 4). This facility is intended to enhance the EIB's lending capacity from own resources by up to EUR 3 billion, in addition to the external lending mandates guaranteed by the European Community.

The resources available under this facility will support projects (approved individually by the Board of Directors) that contribute to energy sustainability and security of EU energy supply in Neighbourhood Countries[1], ACP, South Africa and ALA until end-2013.

The proposed facility would thereby help to optimise the use of the relatively scarce resources that benefit from the Community Guarantee while enhancing the profile of the EU action against climate change. A mid-term review of the facility is foreseen by 2010.

[1] Eligible Neighbourhood Countries are Algeria, Armenia, Azerbaijan, Egypt, Georgia, Israel, Jordan, Lebanon, Moldova, Morocco, the Palestinian Authority, Syria, Tunisia and Ukraine.

The EIB approach to Renewable Energy

The recent developments concerning energy policy at the EU level and the increased importance attached to the development of renewable energy require a review of the Bank's traditional way of doing business. This note briefly presents the key issues and proposes possible new approaches to renewable energy.

1. The implications of the new EU policy objectives on renewable energy

The development of renewable energy contributes to the following key objectives of the EU: security of supply, where the focus is on reducing the dependence on imported hydrocarbons (oil and gas) which exposes the Union to both political and economic risks; environment, where the EU wishes to lead the fight against climate change worldwide; and international competitivity, where the development of renewables is intended to put EU industry at the forefront of the rapidly growing low-carbon technology sector.

Since 1997 the EU has been working towards the general target of reaching 12% of renewable energy in overall energy consumption by 2010. While renewable energy has been the fastest growing energy source in recent years[1], the renewable share is unlikely to exceed 10% in 2010. Renewable energy has expanded most rapidly in the field of power generation, thanks to the fast development of wind energy, and some 19% of electricity is expected to be produced by renewables in 2010 (up from 15% in 2004). However, it still falls short of the indicative target of 21% by 2010.

In order to accelerate the development of this sector, the European Council of 8/9 March 2007 endorsed the following significantly more ambitious targets for 2020:

- a binding target of a 20% share of renewable energies in overall EU energy consumption; and,
- a 10% binding minimum target to be achieved by all Member States for the share of biofuels in overall petrol and diesel transport consumption.

To meet these targets will be a major challenge, and the required investment in renewables may be of the order of EUR 600-700 billion. Most of this investment will correspond to renewables used to produce electricity, while the part of renewables used for heating/cooling and biomass will represent a relatively minor part (around 20%). This amount comes on top of the very substantial investments required to meet energy efficiency targets.

The Commission's "Road Map"[2] for significantly increasing the contribution from renewable energy sources gives some indications on the renewable energy sources to be developed. In the electricity market, wind energy is expected to continue to represent the largest share of the expansion, followed by biomass. While biomass[3] represents about 60% of the total renewable energy production of the EU, its main use will continue to be for heat or electricity through combustion in furnaces, and the investments needed to adapt current equipment will be relatively small. However, the fastest expanding biomass sector will be biofuels to replace transport fuels, where completely new installations will be required.

Aside from the investment requirements, having 20% of renewables in the new energy mix will also imply an increase in annual production costs - perhaps in the order of EUR 25-30 billion per annum.

Meeting these targets will require investment decisions that internalise the cost of CO_2 emissions at a relatively high value.

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[1] Renewable energy grew at 3.3.% per year from 1994-2004 for the EU-25, against 1.2% for the total gross energy consumption. It represented 6.3% of total gross energy consumption in 2004.

[2] Commission staff working document Renewable Energy Road Map: Impact assessment. SEC(2006) 1719 of 10.1.2007.

[3] including some municipal waste.

For example, the Bank's current projection of the cost of CO_2 emissions has been derived from the costs of abatement worldwide (yielding a price that rises from EUR 25/t today to EUR 45/t in 2030, in the base case scenario[4]). These abatement costs should define the value of CO_2 credits in an open market trading system. Applying a constraint at the level of the EU may mean that these estimates are no longer adequate to screen renewable energy investments for climate change reasons alone. This is because low cost abatement alternatives outside the EU only become available once the 20% EU target has been reached. As a result, it is likely that the economic incentive provided by the market price of CO_2 will be inadequate to support the required shift to renewables by 2020.

Indeed, analysis by the Commission suggests that a combination of a very high energy price (crude oil of USD 78/bl) and high CO_2 price scenario (some EUR 50/t CO_2) would be needed to generate the required commitment to renewable energy.[5]

While these figures are very uncertain, and more work is needed to forecast the minimum cost curve for the expansion of renewable energy over the next 13 years, renewables will require an additional benefit over that implied by current CO_2 price forecasts if they are to be adopted sufficiently rapidly over the next few years. In the longer term, the relative attractiveness of renewables is likely to increase, as production costs fall and the price of CO_2 increases.

2. Proposed selection criteria for renewable energy

A complication in assessing the support needed to achieve the effective deployment of renewable energy technologies is the fact that many are still in a relatively early development phase. Substantial cost reductions are possible in the future; historically, for example the cost of windmills and of ethanol production has fallen by some 15 percent every time the installed capacity of the technology has been doubled. The similar figure for photovoltaic panels is of the order of 25%.

Thus, an important issue when evaluating renewable energy projects is to recognise the difference between mature and emerging technologies.

Mature technologies are those which are already used commercially. Examples include on-shore wind farms, hydropower, geothermal, and solid biomass. Costs of these mature technologies are expected to decline as productivity gains are made, but the reduction is expected to be modest and – as is the case for conventional power plant - may be more than offset by increases in the price of raw materials (such as steel and copper) or due to production constraints (such as is currently the case in the wind turbine manufacturing industry).

On the other hand, there are a number of technologies that are in an early implementation phase: not only have costs been declining rapidly, but an engineering analysis of the components suggests there is the potential for this to continue. The expected decline might be substantial (say, 30 to 50%). This includes a wide range of options such as grid-connected photovoltaics, solar thermal, and second generation biofuel production technologies. Some technologies such as off-shore wind are approaching "maturity" but can still be considered as "emerging" in the shorter-term.

Each of these groups – mature versus more-experimental technologies – must be considered separately.

Mature renewable energy technology

The Bank's traditional approach to assessing the economic justification of renewable projects is based on the cost of fossil-fuel alternatives, including environmental externalities associated with CO_2 and other pollutants in the calculation. In 2006, an additional benefit related to security of supply (protection against fossil fuel price volatility) was added. Under the Bank's energy and CO_2 base price scenarios (i.e. a price for CO_2 that rises from EUR 25/t today to EUR 45/t in 2030), the cost of electricity of the alternative fossil fuel (Combined Cycle Gas Turbine - CCGT) is some 72 EUR/MWh for a 5% discount rate. This amount is made up of the following components:

[4] Considerable uncertainty is attached to the estimate of marginal abatement costs, with a low value rising from 10 to 20 EUR/tCO_2 over the period 2010 to 2030, and a high value rising from 40 to 80 EUR/tCO_2 over the same period.

[5] However, this still within the Bank's high CO_2 price scenario.

Capital costs	EUR 13
Fuel costs	EUR 34
Security of supply penalty	EUR 10
Environmental externalities	EUR 15

Note that higher energy and CO_2 prices, together with security of supply considerations, have increased the cost of the CGTT benchmark from a figure of EUR 50/MWh used just a couple of years ago.

Further increasing the premium offered to renewable energy to take into account the challenging targets at the EU level (for example, assuming an immediate step increase to a CO_2 price of EUR 50/t, as it is suggested may be necessary according to the Commission's modelling), would mean that the cost of the fossil-fuelled alternative rises to around 80 EUR/MWh for a Combined Cycle Gas Turbine fuelled with natural gas.

An alternative approach to the comparison with carbon-intensive alternatives is to take the 20% target as given, and to consider the cost-minimising strategy of meeting this goal. Since we are not at the point of having optimal capacity expansion plans, the only solution is to benchmark against what might be the marginal renewable technology in 2020. A conservative approach (in the sense of being favourable for renewable energy) is to take this to be current on-shore windmill technology operating at low load factors, as the deployment of wind turbines reaches relatively less windy areas. Under this approach, the cost of electricity would be around 80 EUR/MWh for a wind turbine using current unit cost coefficients and with a capacity factor of only 20%.

Therefore using a more generous benchmark of 80 EUR/MWh to consider commercially mature technologies in the EU seems to be consistent both in terms of natural gas fuelled alternatives (with a high CO_2 price) and exploiting marginal locations for wind power with current technology.[6]

The increase of the current benchmark by some 10% entailed in this proposal (from 72 EUR/MWh to the new level of 80 EUR/MWh) will substantially increase the range of projects that would be considered eligible for EIB finance. Moreover, it should be recognised that the minimum threshold has already been considerably raised through the inclusion of the security of supply premium in 2006 and higher energy and CO_2 prices.

The present discussion has focussed on electricity generation as this is where most investment will take place. A different approach is needed for biofuels. Here the distinction is between first generation biofuel technologies (which might be considered as mature) and second generation or "emerging" technologies. Current (first generation) projects produce fuels that are expensive compared with petroleum fuels.[7] Feedstock costs and the value of by-products have a strong influence on biofuel production costs and these have been subject to some volatility. Due consideration should also be given to the life-cycle CO_2 savings associated with the use of biofuels, which may be modest once emissions related to crop production, harvesting and transport are taken into account. Given the wide range of prices, and the high costs, it makes sense to focus on the more attractive projects (i.e. those with costs lower than the average). The priority should be given, however, to research and development associated with second generation, emerging biofuel technologies where there is greater scope for future production cost reductions.

The benchmark used will have to be monitored and up-dated as additional information is obtained on the premium required by renewables. At some point the costs of renewable technologies will fall so that they become more competitive on their own account. In fact, there will also be additional costs associated with renewables to be considered. For example, as the percentage of renewables in electricity generation increases, there are cost penalties elsewhere in the rest of the grid that should be taken into account.[8] However, in the short-term a simple rule seems appropriate.

[6] In the future Carbon Capture and Storage for Coal is expected to provide a carbon-free alternative to renewables and the acceptable cost of other technologies should not exceed the expected cost of this technology by a significant margin. The cost of coal generation with CCS is expected to be in the EUR 70-80/MWh range in about a decade's time.

[7] In equivalent energy terms, ethanol costs on average almost double the ex-refinery cost of gasoline at USD 60/bbl crude; biodiesel is some 130 % of the cost of the petroleum products replaced under the same crude oil price scenario.

[8] Where renewable energy is not firm (e.g. wind, solar) then back-up capacity will be required, which will entail some additional cost. This is hard to quantify; however, where the penetration of non-firm energy sources in the grid is low then the back-up capacity requirements are relatively small. In any case, renewable energy will at least avoid fuel and variable operating and maintenance costs where the alternative is a fossil fuel-fired plant. Use of a renewable energy source carries some additional benefit due to its contribution to diversifying energy supplies and developing a portfolio of energy sources that is less dependent on the fossil fuel market. Again, this is hard to quantify but may be significant.

Emerging renewable energy technologies

So far, most of the Bank's projects have been with relatively mature technologies and notably with onshore wind and hydropower. However, the costs of some other renewables technologies are on a rapidly declining trajectory. Consider the case of photovoltaics: since early commercial production in the mid 1970s, average PV module costs have decreased from 60 EUR/W_p to around 3 EUR/W_p today. Analysing the various components (and benchmarking with similar production technologies in the computer industry) suggests that prices could fall to around 0.5 W_p in 2020.

Therefore, a starting point is to recognise that projects involving these emerging technologies have a dual purpose – to improve the future design of the technology for the longer-term and to produce electricity in the short-term.

Indeed, it can simplify decision making to address each benefit separately. On the one hand, the value of the electricity generated can be estimated as though it were coming from an alternative mature renewable technology. The figures in the previous section provide a benchmark.[9]

Deducting the value of the electricity produced (including externalities) gives the amount of money being spent to develop the technology. Such investment should be considered in the same way as any RDI project in the Bank's pipeline.

Technologies with significant promise, where the project in question plays an important development role, and where the amount being spent is justified by possible future cost-reduction should receive support from the Bank. This is fully in-line with previous measures to extend the eligibility criteria for innovative renewable energy technologies.

In order to facilitate project identification, a preliminary screening of the technical options is required to indicate in more detail those areas where demonstration projects are likely to be warranted. One can identify three groups:

- In some areas, the key is to expand the production base so that manufacturers can benefit from learning-by-doing. This is the case of photovoltaics where generic support of the technology seems merited.

- Similar issues exist with other technologies, but where the technical solutions to project level risks need to be reviewed. An example here is offshore wind, where future progress in the design of foundations and off-shore interconnection should bring costs down. This will also be the case for many of the biomass projects that will emerge from the EU Biomass Action Plan[10].

- A third group includes newer technologies that are interesting in principle, but where a case-by-case approach is required. This includes solar thermal and wave power.

Financial versus economic profitability

Regardless of the economic interest of a renewable energy project, its financial return will be determined by the support mechanisms provided in each country. These come in the form of capital grants, preferential feed-in tariffs, tax concessions or the distribution of green certificates. While the tariff support in some countries is significantly below the EUR 80/MWh benchmark mentioned above – so that some investment that would be justified will not take place – other countries are more generous in their subsidies. The implication of this analysis is that the higher support mechanisms are likely to face pressures for downward revision as the technologies are increasingly deployed. There is already evidence of this in Germany and Spain, for example, the two EU countries with amongst the greatest penetration of wind power.

[9] With appropriate adjustment for factors such as intermittent supply if these are significant issues.

[10] The Biomass Action Plan was endorsed by the Commission in June 2006. The Council emphasized the need for research, development and demonstration on biomass, regarding new and efficient technologies for generation and use of renewable fuels, including raw materials. This concerns in particular second-generation biofuels, bio-refineries, efficient boiler technologies, the impact of biomass fuel emissions on air pollution and market introduction aspects.

In this context, it should be remembered that support schemes not only contribute to meeting the energy and climate goal, but are also intended to support domestic industries. As discussed above this is legitimate when the RDI expense is merited with innovative technologies, but this would not be so if the outcome is the generation of windfall "rents" for the producers of mature technologies or the selection of sites with poor renewable energy potential.

Many renewable projects are structured via special-purpose vehicles (SPVs) or involve smaller companies, and the financial return of the project is often a key element in its overall creditworthiness. Clearly, the Bank's normal credit policy should apply, and it remains necessary to analyse both the economic and financial justification of the projects in question.

3. New targets/new instruments

The Bank's volume of lending for renewable energy projects has significantly increased in the last 5 years[11]. The current annual COP target of EUR 600-800 million for renewable energy projects, with 50% of EIB lending to electricity generation to be associated with renewable energy technologies, is likely to be met. The Management Committee has already indicated, however, that more should be done.

Therefore, in order to support the ambitious new objectives endorsed by the European Council, and given the substantial R&D and capital investment required, the current targets should be considered as a minimum.

In order to expand lending in this part of the market, the Bank's appraisal procedures will be streamlined and specific financing instruments will be developed, such as the development of framework facilities for small scale renewable energy investments, and the increased use of structured finance.

Rather than limiting its intervention to the usual one-half of the financing required, the Bank funds up to 75% of investment costs in situations where projects are genuinely accelerated and where key policy goals are supported. This is the case for RDI projects under the "Action for Growth" Initiative and for projects that meet the objectives of the Bank's Climate Change Financing Facility (CCFF).

Clearly, investment in renewables is fully consistent with the goals of climate change under the CCFF as they substitute for carbon-intensive alternatives. The development of immature renewable technologies is also fully consistent with the Lisbon Strategy for Growth and Employment through the development of production capacities in competitive low-carbon technologies.

Renewable energy projects also offer substantial opportunities for the Bank to bring greater Financial Value-added whether through structured finance for SPVs producing renewable energy, through lending to the relatively weaker corporates involved in the sector, or through risk-sharing with financial partners. Increasing the contribution of the Bank can certainly accelerate such projects.

Therefore, the Bank has decided to fund up to 75% of project costs for renewable energy where justified and notably for emerging RE technologies (cf. the Action for Growth and CCFF initiatives).

In the future, an increased level of lending is expected to be required for less mature technologies. In order to achieve the planned diversification of the Banks renewable energy portfolio, it will also be necessary to increase upstream support for emerging technologies and to reinforce project identification in new markets.

4. Conclusions

Renewable energy sources have the potential to meet a significant part of the EU's demand for energy, with a reduced impact on the environment and climate change compared with alternatives. They also contribute to diversifying energy supplies and provide additional security through the use of indigenous natural resources. The introduction of renewable energy at the scale envisaged within the EU will, however, require significant public financial support.

Promoting new and innovative renewable energy technologies can contribute to reducing costs to a competitive level, and may also provide opportunities for new industries and employment.

[11] Lending for individual renewable energy projects (excluding credit lines) has increased from an average of 214 M EUR/year during the period 1997-2001 to 442 M EUR/year in the period 2002-2006.

The Bank will continue to support eligible renewable energy schemes, given a favourable assessment of the financial and economic value of the energy produced, including external benefits and the long term potential of any new and innovative technology.

The ambitious new objectives set by the EU are fully recognised and in response the Bank will:

- Aim to increase its annual lending for the renewable energy sector - the current targets will be taken as a minimum for renewable energy operations.

- Finance up to 75% of project costs for renewable energy projects where justified, notably for emerging technologies.

- Develop financial instruments specifically for the renewable energy sector, including framework facilities for smaller-scale investments, and the increased use of structured and risk-sharing finance.

- Update and streamline the selection criteria used: on the one hand the economic benchmark for mature technologies will be modified to be compatible with the goals established for the EU for renewable penetration; and, on the other hand emerging technologies will be presented within a framework of RDI, comparable with other investments that support the Lisbon Strategy.

The EIB approach to energy efficiency

Increasing energy efficiency is the first and best way to tackle the key energy objectives of the EU. It reduces greenhouse gas emissions and import dependence, while enhancing EU competitiveness. During a relatively long period with low energy prices (from the mid-1980s to the early-2000s), policies to increase energy efficiency generated little interest. In the new policy environment, however, the need to revitalise energy efficiency policies in Europe has a top priority.

1. The implications of the new EU objectives on energy efficiency

The EU policy on energy efficiency, presented in the Green Paper on Energy Efficiency of 2005[1], led to the Energy Efficiency Action Plan (adopted by the Commission in October 2006). The March 2007 European Council confirmed the importance of the proposed energy efficiency measures and set the objective to reduce total energy intensity by 20% by 2020. Given modest growth in energy consumption, this implies a reduction in primary energy consumption of the order of 10% with respect to 2004.

Under the energy efficiency action plan, the largest energy efficiency potential is in buildings (residential and commercial), transport, electricity production (mainly CHP) and distribution, as well as in industry. For residential buildings, thermal insulation offers the greatest area of opportunity, while in commercial buildings improved energy management systems are very important. For transport, a significant part of the energy efficiency potential is related to shifting to more energy-efficient modes of traffic. Furthermore, there is still a significant potential to increase energy efficiency in the electricity sector particularly in certain Member States.

The energy efficiency potential varies substantially depending on the country. The energy intensity of the new Member States is significantly higher than that of the EU 15 as a whole, suggesting that there is more potential for savings in these countries; the overall impact on energy efficiency in the EU also depends, however, upon the size of each market.

The impact assessment study for the action plan estimates the savings at EUR 100 bn per year by 2020 in the baseline energy price scenario (USD 48/bl) and around 780 million tons of CO_2. The investment requirements will be substantial – probably even larger than those mentioned earlier for renewable energy – because energy efficiency improvements are often capital-intensive (e.g. in sectors such as in transport, CHP and buildings).

The EU policy on energy efficiency also has an important global dimension. The prime objective is to promote the development of energy efficiency by using bilateral and international trade and development policies.

Achieving greater energy efficiency potential is not easy, however. There are substantial barriers to overcome, including:

- the existence of subsidised energy prices, mainly in developing and transition economies;
- limited information on energy efficiency possibilities;
- limited access to capital;
- hidden costs;
- split incentives, in situations where the equipment purchaser may not be accountable for energy costs (e.g. when buildings are rented).

2. Issues for the Bank

The Bank, has decided to "mainstream" energy efficiency into its operations. In implementing this objective, there are a number of issues to consider.

[1] "Doing more with less", Green Paper on Energy Efficiency, COM (2005) 265 of 22.6.2005.

Firstly, energy efficiency is a multi-faceted concept that covers dedicated investments targeted directly at increased energy efficiency (such as CHP), as well as components of non-dedicated investments. Most projects financed by the Bank result in an increase in energy efficiency in the sense that they normally use the most modern technologies available, which are normally more energy efficient than older ones. The Bank systematically demands that projects submitted for financing respond to this requirement , although it is often difficult to differentiate those project components that lead directly to energy savings from the ones that perform other functions (for instance in the case of a new machine replacing an old, less energy efficient, machine). Improving energy management, including metering, is also an "energy efficient" investment.

Secondly, leaving aside the energy sector itself and some transport and large industrial investments, most energy efficiency investments are small-sized. The Bank can only finance these through appropriate intermediaries. A network of public and private institutions[2] exists in certain countries to support the development of energy efficiency investments and the Bank should further develop partnerships with these organisations as well as with the banking sector. This is particularly relevant for financing energy efficiency improvements in buildings and SMEs.

Thirdly, access to Bank finance is normally not enough in itself to stimulate investment in energy efficiency. It is necessary to address the other barriers generated by a lack of information and possible hidden costs (which may in certain cases justify the use of subsidies). For this reason, it is normally necessary to combine loans with grants and subsidies, particularly in the residential sector and for SMEs. Most Member States have put in place financial support mechanisms for energy efficiency investments that the Bank will support. Energy efficiency is also among the priorities of cohesion policy and Member States are encouraged to promote more investment in energy efficiency. The new joint Commission-EIB mechanisms (JASPERS, JEREMIE and JESSICA) will also be used to further support such initiatives.

3. New approaches

Regarding lending for energy efficiency, the Bank classifies projects under two categories: "energy efficiency", under climate change; and the "management and rational use of energy", under energy. The first group corresponds to projects that contribute significantly to increased energy efficiency, assessed in the light of the energy balance with and without the project being implemented. In order to be eligible under this category the comparison should result in an increase in energy efficiency of at least 20%. Other projects included under the second category and with a smaller relative increase in energy efficiency may still provide significant energy savings, particularly where they involve large-scale power generation or energy consumption.

The energy sector (including CHP and district heating), transport (public transport) and industry are sectors where the Bank has for many years supported investments that contribute directly or indirectly to reduced energy consumption. Additionally, in the energy sector the Bank will continue to play in important role in support of the modernisation of electricity generation and distribution.

The EU energy efficiency objectives will imply an increased focus on buildings, SMEs, CHP and district heating. As many of these investments are rather small the Bank will have to explore the partnerships mentioned before (e.g. with energy efficiency agencies, social housing agencies, energy supply companies, etc.).

The Bank will support the development of national and regional programmes aiming at supporting energy efficiency investments using structural and cohesion funds, particularly in new Member States.

As a logical extension of the Climate Change Financing Facility, the Bank should also be prepared to finance up to 75 percent of "energy efficiency" project costs.

More generally, energy efficiency concerns all of the EIB's operations. In this respect, the Bank will promote the adoption of the most energy efficient solutions in the projects financed, including the introduction of new energy efficiency standards.

Projects will be screened to identify the energy efficiency potential and in selected cases the Bank could propose the realisation of energy audits. The funding of such audits merits further reflection, as they are fully

[2] Such as national or regional energy agencies and energy service companies (ESCOs). These institutions are often supported by the Commission.

justified in the context of improving the rational use of energy, improving access to information and raising awareness of the potential to increase energy efficiency. Energy audits could be included as an obligation under an EIB loan. Alternatively, the Bank could cover the costs of a number of trial audits to test the way in which the information generated on potential energy savings is used by promoters. Based upon this experience, it might be possible to develop alternative funding mechanisms in the future; however, this must be explored in more detail before firm proposals can be made.

4. Conclusions

Energy efficiency is a key priority of the EU due to its contribution to reducing greenhouse gas emissions and enhancing security of supply in a cost effective way. The investments required will be substantial and the Bank can make a significant contribution in this area despite the important obstacles that exist to the development of the energy efficiency potential in many situations.

Most of the Bank's projects result in an improvement in energy efficiency due to the simple fact that they usually incorporate the most modern technologies; however, the Bank should attribute the "energy efficiency" label only when there is a significant contribution to energy savings which results in a reduction in energy consumption of at least 20% compared to the situation before the project was implemented. Other large-scale projects involving smaller relative improvements in energy efficiency may nevertheless make an important contribution to meeting the EU energy efficiency targets and the above criterion will be monitored as experience with energy efficiency is gained.

The Bank will support the ambitious targets set by the European Council in March, 2007, through the following actions:

- Introduction of energy efficiency considerations in all projects financed by the Bank, with the aim of promoting the adoption of the most energy-efficient solutions. Realisation of the energy efficiency potential of selected projects will be supported through energy audits. Energy efficiency aspects will be included in the assessment of value added, in order to clearly identify the contribution of the project to the energy efficiency objective.

- Development of the financing of energy efficiency projects in general - including, where appropriate, grouped investments in buildings and SMEs. The economic test applied to these projects should be consistent with the carbon price scenarios used to assess renewable energy projects. For projects with a significant contribution to energy efficiency, the Bank will propose increasing its customary financing up to 75% of project cost.

- Specific attention will be paid to providing financing for CHP and district heating networks.

- Synergies with JESSICA, JASPERS and JEREMIE will be exploited.

The Bank will continue to support the modernization of existing power generation and transmission networks, together with other investments promoting the rational use of energy and increased energy efficiency in transport and industry.

The EIB approach to coal and lignite fuelled power stations

The new EU commitment to reduce greenhouse gas emissions by at least 20 % in 2020 compared to 1990 requires the Bank to review its approach and be more selective when financing electricity generation based on fossil fuel, notably coal or lignite, while taking into consideration the security of energy supply. The concern arises because of the relatively high carbon intensity of this fuel: modern plants fuelled either by coal or lignite normally produce twice as much CO_2 per kWh as Combined-Cycle Gas Turbines (CCGT) using gas.

This note discusses the issue and presents possible screening criteria for coal/lignite power stations.

1. The implications of the new EU policy objectives on fossil fuel power stations

The European Council of 8/9 March 2007 stressed the need to implement measures to tackle climate change and energy security considerations. It has endorsed a binding target of a 20% share of renewables in overall EU energy consumption, together with the goal of improved energy efficiency (with a target of 20% by 2020). These objectives have substantial implications on the use of fossil fuels for power generation.

The recent scenarios of the Commission[1] for the EU-25 corresponding to these objectives forecast that electricity demand remains almost flat up to 2020 (+ 0.6% per year in 2000-2020). The desired combination of energy efficiency measures and strong penetration of renewable energy in the power generation sector will have a particularly important impact on the future fuel mix:

- The use of coal and lignite is forecast to go down to half of the current levels by 2020 and further decline later. However, power plants using biomass-waste are expected to be equivalent to the decrease of the capacity using solid fuels. This complicates the picture, as with some adaptation, biomass can be used in combination with other solid fuels in coal/lignite power stations.

- The gas-fuelled power generation is expected to increase by only 20% in 2020 (in relation to 2000) but to decline after 2020. In part the increase in gas use for power generation is related to the expansion of CHP, where gas is the preferred fuel.

This scenario shows that the objectives on energy efficiency and renewables will imply a radical change in the energy trends in the EU, with a dramatic impact on the use of fossil fuels for power generation. Most of the investment in power generation in coming years will be related to replacing existing power stations coming to the end of their life, as electricity demand expansion will be very limited.

2. Clean Coal

The Commission's energy policy proposals are supported by various sector-related communications, one of which explicitly presents a policy on fossil fuels[2]. It acknowledges that coal and gas are certain to remain an important part of the energy mix, particularly for power generation. Additionally, fossil fuels can potentially be envisaged for co-production of electricity and hydrogen on a large scale, possibly opening a route to a hydrogen economy.

Coal contributes to security of energy supply as it reduces dependence on imported hydrocarbons (oil and gas). Renewable energy and nuclear options also help diversify energy sources and reduce the consequences of oil and gas price volatility. However, coal and lignite sources are likely to remain an important alternative, especially where local resources are available.

[1] Commission DG TREN, European energy and transport: Scenarios on energy efficiency and renewables. 2006.
[2] Commission communication, Sustainable power generation from fossil fuels: aimed at near-zero emissions by 2020. COM(2006) 843.

The use of coal has a negative implication in relation to climate change objectives due to its higher carbon intensity. A potential technical solution is Carbon Capture and Storage (CCS), which on the face of it makes coal equivalent to renewables in terms CO_2 emissions. With this in mind, the Commission proposes to:

- support the construction and operation by 2015 of up to 12 large-scale demonstration plants of sustainable – in the above sense – fossil fuel technologies in commercial power generation in the EU.

- provide a clear perspective when coal-and gas-fired plants will need to install CO_2 capture and storage. On the basis of existing information, the Commission believes that by 2020 all new coal-fired plants should be fitted with CO_2 capture and storage and existing plants should then progressively follow the same approach.

However, CCS technologies[3], while used today in some industrial applications, are currently not suitable for commercial use at large power plants. As regards the potential technologies, there are different alternatives being studied at present and it is difficult to know what will be the best option in the long run.

Cost estimates for CO_2 capture systems rely mainly on studies of hypothetical plants and are uncertain. The current estimates for the 'cost of CO_2 avoided'[4] are around 25 EUR/t CO_2 for pre-combustion capture (Integrated Gasification Combined Cycle (IGCC) where coal is gasified), around 45 EUR/t CO_2 for a post-combustion capture installed at a clean-coal power plant, and around 60 EUR/t CO_2 for post-combustion capture at a natural gas fired unit (CCGT).

The costs for transport and storage facilities depend on many site-specific factors. Considering a pipeline transport distance of up to 1000 km, the associated costs are around 8-10 EUR/t CO_2. Representative estimates of costs for storage options in saline formations and/or disused oil and gas fields are currently between 0.5 and 6 EUR/t of CO_2 stored.[5]

Thus based upon the above figures (the CCS investment plus transportation plus storage) new technologies based upon pre-combustion separation (IGCC with coal) would be the cheapest option and once available commercially (say around 2020) are likely to be economic with respect to the base scenario for the value of CO_2. Retrofitting existing plant would be economic provided transmission and storage costs are low, while retrofitting of CCGTs using gas would seem uneconomic at this stage. It is interesting to see that coal could become a cleaner fuel than natural gas if these cost differentials were to remain.

However, it is expected that the cost of CCS will fall as experience is gained with the technology. These improvements will be incremental and build up over time, and the mid- to long-term objective of the Commission is to reduce the cost of capture to 20-30 EUR/t CO_2 by 2020 also for post-combustion separation. This implies that CCS would also become competitive for retrofitting a wide range of existing coal plants.

The prospect of future CCS raises the question of whether current investments should be selected on the basis that they are already designed for future retrofitting – i.e. being "carbon capture ready" in some technical sense. In fact, the main constraint implied is that there is sufficient physical space in the vicinity of the power station to install the necessary equipment. While this should certainly be the case, such a requirement will not eliminate very many investment proposals.

As mentioned, EU policy is expected to become tighter in this area. The forced retrofitting of CCS would only pose problems in an economic sense if the cost of the technology remained above the cost of CO_2. Current investments are thus exposed to this future regulatory/technical risk, though the risk is considered to be small given the values of CO_2 used in the analysis. [6]

[3] IPCC, 2005: IPCC Special Report on Carbon Dioxide Capture and Storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change

[4] CO_2 avoidance costs = (discounted production cost,$_{capture\ plant}$ - discounted production cost,$_{reference\ plant}$)/(CO_2 emission rate (g/kWh),$_{reference\ plant}$ - CO_2 emission rate (g/kWh),$_{capture\ plant}$)

[5] If used for enhanced oil recovery, the cost of storage of CO_2 might have a small negative sign – the gas actually has some value in the process.

[6] The current EIB baseline CO_2 price scenario is 25 EUR/t CO_2 in 2010 going up to 45 EUR/t CO_2 in 2030.

Thus, while it is reasonable to expect CCS at some future point of time, it seems prudent to assume that commercial coal powered power stations will not benefit from CSS until 2020 or maybe well beyond. Their medium-term emissions of CO_2 are a reality that must be taken into account in today's investment decisions.

Naturally, the Bank should follow the development of CCS technologies, notably through financing demonstration plants.

3. Coal/lignite versus gas

Under the EIB baseline energy price scenarios, the cost of base load electricity in a new modern coal/lignite power station (clean coal technology) in the EU is generally lower than in new CCGT using gas for a discount rate of 5%[7]: Therefore, if companies do not have to pay the environmental costs of the pollution generated, they will tend to build new coal power stations.

The introduction of environmental externalities, notably the cost of CO_2, into the calculation changes significantly the relative position of these alternatives. Under the EIB baseline CO_2 price scenario and for a 5% discount rate, electricity from a new CCGT using gas is slightly cheaper than from a new modern coal/lignite power station. However, the small difference between gas and coal/lignite options can be easily compensated by adding a small benefit to the coal option in terms of security of energy supply (as gas prices are more volatile than coal/lignite prices).

Note that there also is very little difference between lignite and coal concerning CO_2 emissions. There is only a small difference of efficiency between latest technology coal and lignite generators, and between the carbon intensity of lignite and coal (the "bad name" for lignite comes from other pollutants such as SO_2 or dust particles emitted by old plants). Indeed, some lignites have a lower carbon content than certain types of coal, and the level of CO_2 emissions is usually less than 10% higher for lignite than for coal per kWh. [8]

Thus, coal/lignite electricity generation is cost-effective at the CO_2 price considered. However, to meet EU goals regarding climate change requires that CO_2 externalities are internalised in decision making so that emissions are dealt with somewhere in the economy. Unfortunately, the EU emission-trading scheme might not have the desired effect. For example, there is a risk that companies opt for coal when they get free CO_2 allocations (based upon historical activity) that cover most of their future CO_2 emissions.

The conclusion is that the Bank's economic test is not a sufficient condition given the new EU targets.

4. Screening criteria for coal/lignite power stations

One starting point is to note that the goal is not to eliminate CO_2 emissions but ensure that the use of carbon-intensive fuels is still compatible with the overall targets for emissions. Given its importance as a polluter, the power sector should also make its own contribution, and not overload other sectors of the economy with emission reduction goals.

There is a regional dimension to take into account since the fuel mix is not uniform across Europe and local factors (including the availability of domestic lignite) influence fuel choice. For example, in South East Europe the dilapidated state of most of the existing power stations increases the pressure to complete plans to build replacement capacity. And for security of supply reasons coal and lignite cannot be avoided as fuel for a substantial part of EU power generation.

Therefore, some way of defining the "responsible" use of coal and lignite is required.

This will be clearer once national plans have been developed that take into account the new energy targets, and these plans have been endorsed at the EU-level as representing an appropriate burden-sharing across Member States. However, until such time as these plans are available the Bank will need to exercise careful

[7] Around 47 EUR/MWh for the gas option versus 38 EUR/MWh for the coal option.

[8] Here we only consider CO_2 emissions from combustion. Full energy chain analysis, considering all the steps from cradle-to-grave would increase this figure somewhat (some estimates by the IAEA indicate a further 5 to 10 percent of emissions, including other green house gases such as methane, might take place in the mining phase). In fact, lignite is usually associated with less methane deposits than coal, though it may be possible to capture this in deep mines. Similar figures on non-combustion emissions exist for the production of natural gas. Likewise, some renewables, such as biomass, produce significant levels of greenhouse gases in the wider production chain. These effects are expected to be small, though further analysis on this topic would be merited.

judgement when considering investment proposals based on coal/lignite. It is recalled that one of the Bank's energy objectives is for 50% of EIB lending for electricity generation to be associated with renewable energy technologies, which already requires the Bank to be selective in its approach to fossil fuel.

New coal/lignite power stations

The following conditions could be considered as necessary for EIB financing of new coal/lignite power stations:

- They should use best available technology and be "carbon capture ready".
- They should also be cost-effective taking into account CO_2 externalities, i.e. be able to exploit CCS once that technology becomes commercially available.
- They should replace existing coal/lignite plants and involve a decrease of at least 20% in the carbon intensity of power generation.

The EIB is also ready to finance CCS demonstration plants and other experimental clean coal technologies as RDI projects.

Retrofitting existing coal/lignite power stations

The issues concerning retrofitting of the existing coal/lignite power stations are rather different than for new plants. Without environmental externalities the cost of electricity in an existing coal/lignite power station is normally substantially lower than the cost in a new coal power station, considering the existing investment in the plant as sunk cost. However, if environmental externalities are included in the calculation, the cost of electricity may be just slightly lower than in new power station (gas or coal/lignite) depending upon the case.

The optimal decommissioning strategy for these plants is difficult to define, since it is necessary to ensure adequate capacity while new plants are brought on line. As a consequence, many companies have decided to carry out minor retrofitting investments to continue the operation of some of these plants and to fulfil the stricter pollution emission limits imposed by the Large Combustion Plan Directive. Generally, these investments are small and can be recovered very quickly.

However, the carbon intensity of these old plants is very high. Replacement strategies are needed and such plants should be progressively operated at lower load factors. Therefore, investments in retrofitting should be:

- Small (normally less than 200 EUR/kW) so they do not delay plant replacement strategies over the medium term.
- Pass the Bank's economic test to ensure that the plant should not be shut down in the very short-term.
- Concern investments aiming at substantially reducing pollution, including by increased energy efficiency.

Annex 4

Facility for Energy Sustainability and Security of Supply

1. Policy Background

The European Council adopted a set of guiding principles for an EU external relations policy on energy ("An External Policy to serve Europe's Energy Interests"; Council Document 9971/06). The Decision recommends the EU to "facilitate the maintenance and upgrade of existing energy infrastructure in neighbouring countries of key importance to the EU as well as the development of new infrastructure". EIB loans are explicitly mentioned as one of the instruments to implement this policy.

The Commission communication "An Energy Policy for Europe", issued in January 2007, proposes an ambitious programme to address key challenges in energy in the EU related notably to climate change and security of supply.

Council Decision 2006/1016 of 19 December 2006 (the Council Decision) invites the EIB "to increase its operations outside the Community without recourse to the Community guarantee, particularly in the pre-accession countries and the Mediterranean as well as in investment grade countries in other regions" (Whereas 3). It also stipulates "the protection of the environment and energy security of the member states should form part of EIB's financing objectives in all eligible regions." (Whereas 8). "In Central Asia, the EIB should focus on major energy supply and energy transport projects with cross-border implications" (Whereas 13).

The European Council at its 2007 Spring meeting underlined the leading role of the EU in international climate protection.

2. The Facility

To contribute more effectively to the implementation of key EU policies in the fields of Energy Sustainability and Security of Supply by means of financing projects in Neighbourhood Countries, ACP, South Africa and ALA, and to comply materially and promptly with the Council Decision, the Board of Governors has approved a Global Authorisation for an amount of EUR 3 000 million to be committed during the 7-year period of the current external mandate. The Facility will be reviewed –and adjusted if necessary – in 2010, at the scheduled mid-term review of the external lending mandates.

The following eligibility criteria will apply:

- Renewable energy, notably based on wind, biomass, solar (thermal and photovoltaic), geothermal and small/medium sized hydro, including directly related electricity transmission lines;
- Energy Efficiency investments;
- Carbon Capture, transportation or storage projects and other projects aiming specifically to reduce greenhouse gas emissions not indicated before;
- Projects contributing substantially to Security of EU energy supply (those parts of Energy TENs located in Neighbouring countries; extension of energy transportation infrastructure in producer and transit countries or enhancing physical and environmental security; upstream oil and gas developments directly related to EU supply).

The Facility is available for projects located in Neighbourhood Countries[1], ACP, South Africa and ALA. Borrowers would be selected on the basis of the Bank's normal criteria.

[1] Eligible Neighbourhood Countries are Algeria, Armenia, Azerbaijan, Egypt, Georgia, Israel, Jordan, Lebanon, Moldova, Morocco, the Palestinian Authority, Syria, Tunisia and Ukraine.