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Sustainable Energy Supply –
RWE's Activities

Ladies and Gentlemen,

Chart 1 I am pleased to be able to give this presentation at the 8th International Congress on Sustainable Energy Technologies, taking place in Aachen this year. In line with the general motto of sustainable energy technologies, I would like to take this opportunity to give a basic overview of the sustainability requirements to be met by large utilities in supplying energy.

Chart 2 RWE itself is one of the five largest European utilities. The main focus of our business activities is on Germany, the UK, NL and Central and Eastern Europe. In the upstream area, the oil and gas production activities comprise both Europe and North Africa as important regions. After the successful integration of Dutch company Essent, the RWE Group is able to bridge the gap between the British Isles and Continental Europe as far as the geographical alignment of our business areas is concerned.

Chart 3 What are the key factors for sustainable energy supply in Europe from our point of view? As a listed company that operates profitably and assumes responsibility for both its shareholders and stakeholders we have identified four elements:

Competitiveness
Environmental compatibility
Security of supply
Acceptance

We took the well-known triangle of sustainable energy supply, as a basis and added acceptance. From our perspective it is vital that we cannot push through strategies or technologies against the resistance of the population, regardless of how good they may be; that is, we strive to win the necessary acceptance. This means that we want to ensure that resistance – no matter by that it is caused – is not passively taken as a given, but that the introduction and continuation of successful climate-protection strategies is instead actively promoted by providing information and fact-based arguments. Hence, we have to take on a proactive role in promoting acceptance.

Chart 4 The focus of our sustainable energy supply strategy is, of course, on the reduction of the energy-related carbon emissions of our entire portfolio. This is the success factor of our entire corporate strategy. At present, RWE as a company is the largest CO_2 emitter of the European Union with 172 mill. t of CO_2 in 2008. Our short-term goal is to reduce carbon emissions by 33% or some 56 mill. t by 2015. This chart shows which measures we will take to achieve this goal. On the conversion side, three groups of activities to be carried out in the short term over the next six years should be mentioned:

- The construction of new, efficient fossil-fired power plants as replacement for old plants to be decommissioned

- The continued operation of the two Biblis A and B nuclear power plant units with a total of 2,400 MW.

- Investments in renewable energy-based plants throughout Europe

Chart 5 Assuming the total generation capacity in the RWE Group increases, the share of renewables in electricity production is to be virtually doubled to 30% by 2020, as is the share of natural gas-fired power plants, so that coal will play a minor role in relative terms, but in the overall generation portfolio will remain as important as it is today in absolute terms. This outlook until 2020 also assumes the continued operation of the nuclear power plants in Germany and the construction of new nuclear power plants in the UK in conjunction with E.ON and the erection of nuclear power plants in Eastern and South-Eastern Europe, in which RWE would like to participate.

Chart 6 So what measures with regard to technology development have we taken and do we intend to push ahead with? As a whole, all measures aimed at increasing energy efficiency are considered – both with respect to conversion technology on the supply side and with respect to consumption. In parallel, CCS technology will be developed to commercial availability. Securing the option of nuclear power generation will, as mentioned, play an essential role. The increase in the share of renewables will be promoted with some 1 billion euros annually in the next years. And in order to guarantee a secure energy supply and improve the integration of fluctuating renewable energy feed-in, we are working on developing adequate energy storage technologies for the electricity market and, additionally, the heat market.

This brings us to the issue of increasing energy efficiency:

Chart 7 The quickest way to reduce carbon emissions related to electricity generation is to replace old, low-efficiency power plants by plants with state-of-the-art efficiency. A prominent RWE example is the lignite-fired unit with optimized plant technology at Niederaußem, which has a net efficiency of more than 43%, based on the LHV value of the fuel. This plant has been in operation since 2002. Another two plants with 1,100 MW_{net} each are currently under construction at the Neurath location. Once these plants have been commissioned, all fifteen 150-MW plants still in operation will be decommissioned, so that – at the same electricity production - 9 mill. t less CO_2 will be emitted per year. We are pressing ahead with this so-called no-regret measure, which we regard as a top priority, because in the medium term we will still need lignite to maintain the security of supply in the electricity market and to secure the market for our lignite. But hard coal also plays an important role. We are currently erecting two twin unit plants with 2 x 800 MW equipped with the same boiler technology as cutting-edge lignite-fired power plants both at the Westfalen location and in the Dutch town of Eemshaven.

Chart 8 But we are not satisfied with a net efficiency of 43% in the case of lignite-based boiler plants. In the medium term – i.e. as of 2018/2020 – hard coal- and lignite-based power plants with a net efficiency of 50% should be available. This is why we are working on the development of a lignite drying technology that permits run-of-mine lignite to be predried from today's moisture content of 55 – 60% to a moisture content of about 10 – 12%. The required drying energy will then be reused in the power plant process, allowing the efficiency-related disadvantage of lignite compared to hard coal to be offset. To this end, RWE developed the so-called fluidized-bed drying process with internal waste heat utilization, WTA in short. This process is currently being tested on a commercial-scale plant at the Niederaußem power plant. The plant being tested in Niederaußem has the right capacity for future commercial use.

In parallel, the steam parameters of the boiler plants have to be increased further: from 600 or 620°C and 275 bar today to 700°C and 350 bar. To achieve this, new nickel-based materials have to be developed and tested. In a joint project with other power companies and the manufacturing industry, we are conducting long-term tests with these materials and new techniques for processing them. An initial design study on a so-called 700°C power plant is almost completed. The first demonstration plant could be constructed some time during the next decade, so that these ultra-supercritical steam generator technologies based on nickel materials may be proven by the end of the next decade.

Taking lignite predrying into consideration, a net efficiency of 50% would then be state of the art for both hard coal and lignite. This increase in efficiency is also an essential prerequisite for the introduction of the so-called Carbon Capture and Storage technology (CCS in short), which I would like to come back to later.

Chart 9 Increasing energy efficiency on the demand side has a long tradition at RWE. Within the scope of the realignment and structuring of activities this is an important business area. Thus, we founded a new company called RWE Effizienz GmbH as a legal entity for the German market.

All demands side related efficiency improvement activities are now pooled in this company. The focus is on private customers, small and medium-sized enterprises, municipalities, craftsmen and architects. Key topics and products are geared towards increasing efficiency in the use of energy in the municipal area and in households.

Municipalities, both as customers and as shareholders of RWE, play a special role. The energy-related advisory service is to create a win-win situation at the contracting level that will also be a profitable business for RWE.

In addition to further energy-saving advice, smart metering will initially be to the fore as far as private customers are concerned. Smart meters make the structure of the customers' electricity consumption more transparent, permitting them to positively influence their own consumption behaviour .

Chart 10 Electromobility in the transport sector cannot be developed and introduced without the assistance of the automotive industry. All major automotive manufacturers are cooperating with power companies. For instance, RWE and Daimler have formed an alliance. As a utility, we believe our job is to develop the required infrastructure, including the necessary technical standards, in conjunction with the grid operators. The integration of electric vehicles and their batteries into the supply and demand structure has to be taken into account as well. We believe that in the medium term electromobility will have a great future in Europe due to the increase in low-CO_2 electricity production and, as a result, virtually zero-CO_2 driving power in automobiles.

Without e-mobility, the EU will not be able to reach its target of reducing CO_2 emissions per km to 95 g by 2020 (today: well-to-wheel ≈ 199).

Chart 11 CCS technology is uncharted territory. It allows fossil energy sources to be used while producing as few CO_2 emissions as possible. RWE dealt with this technology at an early stage and now intends to demonstrate the industrial-scale viability of carbon capture, transport and storage in the IGCC-CCS flagship project in Hürth.

The lignite gasification process in the IGCC plant permits the use of lignite from the Rhenish mining area not only to generate electricity but also to produce other products, e.g. synthetic natural gas, methanol and fuel for the transport sector. In addition, it can simply be used as feedstock and thus as a substitute for oil and gas in the chemical industry. CCS technology included, the CtL and CtG technologies also enable low-CO_2 conversion processes. The captured CO_2 is to be stored in saline formations, found mostly in the subsoil of north Germany. The required transport pipeline leading from the Rhenish lignite mining area to north Germany would be the first stage of a carbon infrastructure connecting the Rhenish-Westphalian industrial region, with the storage region.

Chart 12 In parallel, we are working on another carbon capture technology, the so-called CO_2 flue gas scrubbing technology. It is suitable for retrofitting commercial boiler plants as well. We are pleased to see that there is a global technology development competition going on. In two of these technology lines we are involved either as senior or as junior partner, namely the

amine-based technology that we are developing in collaboration with Linde and BASF, and Alstom's chilled ammonia technology.

Chart 13 However, we still have to put a great deal of work into gaining acceptance of carbon storage. The sudden resistance against exploration activities required for the possible storage of CO_2 in Schleswig-Holstein in north Germany shows us that it is crucial that we inform and convince everyone involved. One-sided emotional mobilization in particular during election campaigns in conjunction with the stoking of fears sometimes seems impossible to overcome. The picture on the left illustrates that. The picture on the right demonstrates how natural phenomena caused by the release of CO_2 are dealt with in a natural way. The picture shows children enjoying the periodic eruptions of the Crystal Geyer in the US, which are caused by a natural CO_2 deposit.

Chart 14 Though in quantitative terms this won't be the solution for carbon capture technologies, let's not forget that CO_2 can also be used. Be it to increase the growth rate of biomass, like here in our algae test plant, or as a feedstock for the chemical industry. And how about artificial or technical photosynthesis with the aid of solar energy? Here, the basic research is just getting started. Even though we don't have the answers to the open questions yet, we know that CO_2 can be a substitute for certain products produced from oil, coal or natural gas. We just have to look at things realistically and press ahead with our work.

Chart 15 At the beginning, I mentioned RWE's goal of doubling the share of renewables-based electricity generation to 30% by 2020. To achieve this goal, we founded our own company – RWE Innogy. Having started with an installed capacity of some 1,500 MW and a project pipeline of 9,000 MW, the first target is to have 4,500 MW in renewables-based capacity implemented by 2012 and more than 10,000 – 12,000 MW by 2020. To this end, we have lined up 1 billion euros for annual investments over the next few years.

Chart 16 Most of the money will be invested in onshore and offshore wind power and biomass. But we will also participate in the development of new technologies in the field of renewable energy. These include the use of ocean energy in two projects in the UK and the development of small-scale wind power plants especially for the UK market. In addition, we are interested in further developing biomass preparation processes to permit biomass to be used in large thermal power plants. The youngest child in the family of technologies is the further development of solar thermal power plant technology, including a participation in the Spanish Andasol 3 power plant together with other partners.

Chart 17 The integration of wind power plants into our electricity supply systems is another important field of development. Among other things, additional energy storage systems will be of help here. Apart from pumped storage power plants, which are highly efficient, adiabatic compressed-air energy storage plants have great technological and economic potential considering their capacity, their energy storage volume and their conversion efficiency of up to 70%.

Therefore, we are promoting the development of the technology collaboration with industrial partners. The aim is to have progressed far enough by 2012 to be able to decide on the implemention of a first large-scale demonstration plant. We expect capacities of 200 – 300 MW at a location that needs to have a salt dome that can be developed into a salt cavern to permit compressed air to be stored.

In another energy storage project, we aim to improve the profitability of combined heat and power technology by decoupling heat and electricity generation with the aid of an atmospheric heat accumulator. We plan to implement the first pilot plant at a CHP plant location in the Ruhr area after the heat accumulator development activities have been completed.

Chart 18 As the last cornerstone of our CO_2 reduction strategy I would like to mentioned the retention and further development of nuclear energy-based electricity production. Of course one could

ask whether the use of nuclear energy is actually part of a sustainability strategy. If we consider the most pressing issues regarding energy supply in connection with climate change – i.e. CO_2 emissions – and the securing of a low-CO_2 energy supply both on the basis of electricity and, for instance, for seawater desalination and other processes, then it becomes clear that the use of nuclear energy has just as sustainable an effect as solar energy or CCS technology.

Our main focus is on obtaining a licence to operate for the nuclear power plants in Germany by concurrent R&D activities and on development work for the planned construction of nuclear power plants of the third generation outside Germany. In addition, of course, we are carrying out further activities to optimize the nuclear fuel cycle, including the permanent storage of spent fuel.

Chart 19 I hope that I have been able to give you a general overview of the activities of the RWE Group aimed at developing a sustainable energy supply. We pursue every path that has economic potential from the point of view of our business strategy. Many ideas we try to gain an understanding of by participating in capital venture projects, which also allows us to assess the likelihood of them being implemented. There are some paths that we are currently not pursuing, such as activities in the field of photovoltaics.

As shown in the last picture, the fact that our understanding of sustainability is correct and that we have the right basic alignment is confirmed by a multitude of assessments conducted by independent rating agencies that focus on sustainable management and behaviour.

Thank your very much for your attention. I hope that the congress will be a great success.