PROMOTION STRATEGIES AND SCENARIOS FOR AN AMBITIOUS MARKET INTRODUCTION OF RENEWABLES IN AUSTRIA

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Abstract – In this paper an ambitious scenario for increasing the market share of RES in Austria until 2010 is presented. The investigation is conducted by end-use and split up for heat, electricity and transport fuels and by technology. Existing barriers are identified and measures are proposed to overcome these barriers. The major results are that around 5,4 TWh/year of electricity (0,5% in 1999 to 7,8% in 2010), 180 PJ of heat (19,2% to 26,3%) and 3,5 PJ of transport fuels (0,3% to 1,8%) could be provided by "new renewables" in 2010. The most important RES are biomass for heat, wind for electricity generation and biofuels for transport. The final conclusion is that aside from economics the acceptance of "new" renewables will probably be the major barrier to meet the ambitious objectives.

1. INTRODUCTION

Currently world-wide supply of energy services in industrialised countries is characterised by a large share of fossil fuels and therefore is non-sustainable. This pattern has a high adverse environmental impact. Nevertheless, externalities of fuels have scarcely been considered till now.

In the light of these characteristics international confessions were made, such as the Kyoto protocol [UNFCCC 1997] and the EU white paper [European Commission 1997]. In Austria the "new electricity law" [ElWOG 2000] sets quotas for electricity production from "new" renewables[1] (4% until 2007). It establishes feed-in tariffs for almost all corresponding RES as a major promotion strategy. Only electricity produced in small hydro power plants (SHP, ≤10 MW) is promoted by tradable certificates. Furthermore, suppliers are committed to purchase RES electricity generated (except SHP).

Taken the targets being set in Austria an ambitious scenario for RES is presented in this study [Haas, Berger et al. 2001] which goes far beyond these goals. On the basis of technical potentials, existing barriers and historical developments of energy supply (split up for heat[2], electricity and transport fuels, see Figure 1) as well as trends for costs and efficiencies, promotion strategies are deducted.

Efficiency improvements of energy service supply, new storage mediums (e.g. H_2) or storage systems for energy, new energy conversion technologies (e.g. fuel cell) as well as potential energy savings through e.g. solar passive buildings are not considered in this study.

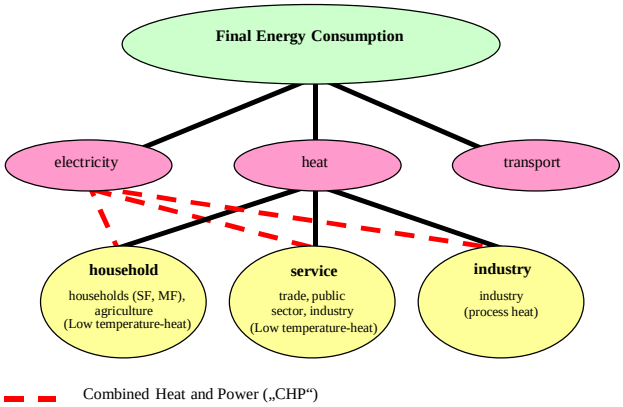

Figure 1 – Sectors differentiated in the study

Source: Haas, Berger et al 2001

2. HISTORICAL DEVELOPMENTS

2.1 Final energy consumption in Austria

Final energy consumption in Austria has increased by 58% from 1970 to 1998 (619 vs. 958 PJ/year). In the same period of time the share of fossil oil (fuel oil, diesel, petrol, etc.) has decreased from approx. 50% to 39%, the percentage of coal has dropped from 21% to 7%. Concerning demand for gas (11,1% in 1970 vs. 18,6% in 1998), electricity (12% in 1970 vs. 18,8% or 57 TWh in 1998)[3] and renewables (4,6% to 12,2%) their shares have increased considerably.

In 1998 about 28% of Austria's final energy consumption were allocated by the industrial sector, 27% by transport, 26% by households and only 19% by the service sector.

2.2 Energy from renewables

Apart from small hydro power (4.150 GWh) landfill gas (about 100 GWh), wind (around 90 GWh) and solid

[1] In Austria large hydropower (>10 MW) is excluded from the category of "new" renewables.

[2] Regarding heat it is differentiated between the sectors household, service and industry.

[3] Final consumption of electricity also includes pump storage systems.

biomass (about 52 GWh) are the major RES for electricity generation (see Table 1). The share of "new renewables" based on corresponding electricity consumption is approx. 0,5% in 1999. According to [ElWOG 2000] a 4% - quota[4] has to be reached in 2007.

Regarding heat production from renewables solid biomass is predominant (approx. 100 PJ in 1998). Around 4,1 PJ of environmental heat were converted to approx. 6,8 PJ of palpable heat by heat pumps. Furthermore about 2,7 PJ of solar thermal and 0,4 PJ of geothermal heat were produced in 2000.

Table 1 – Current heat and electricity production from RES

Source: Haas, Berger et al 2001

technology	electricity [GWh/year]	heat [TJ/year]	year
PV	3,2	-	2000
wind	90,4	-	2000
small hydro power	4.150,4	-	1998
solid biomass CHP	52	N/A	1999
biogas CHP	21,1	147	1999
landfill gas CHP	100	N/A	2000
sewage gas CHP	38	N/A	1999
geothermal CHP[5]	0	420	2000
solid biomass heat	-	≈100.000	1998
heat pump (cumulated)	-	6.751[6]	2000
solarthermal heat (cum.)[7]	-	2.691	2000

N/A: not available

3. TECHNICAL POTENTIALS

In principal it has to be differentiated between technical demand- and technical supply-potentials [Neubarth, Kaltschmitt 2000]. In this paper only the more restrictive of them are presented.

Austria is characterised by a large potential of solid biomass (see Figure 2, expressed in primary energy): about 200 PJ/year of (sustainable) primary energy from solid biomass might be used for heat production with or without CHP. In 1999 approx. 50% of this potential were exploited. Indicated by the arrow the potential of solid biomass might be raised in case this source is further supported in the future.

In contrast to solid biomass the potential of liquid biomass (Ethanol, Biodiesel) is much smaller (about 6 PJ).

It has to be stated that both, solid and liquid biomass potentials, are dependent on the use of arable land: either biomass is cultivated in order to produce heat and electricity or to manufacture commodities, such as panels, pulp and paper etc. In [Haas, Berger et al. 2001] approx. 10.000 ha land are earmarked for non energy use in 2010, less than 40.000 ha for the production of liquid biomass and about 100.000 ha for the cultivation of solid biomass for heat and electricity generation.[8]

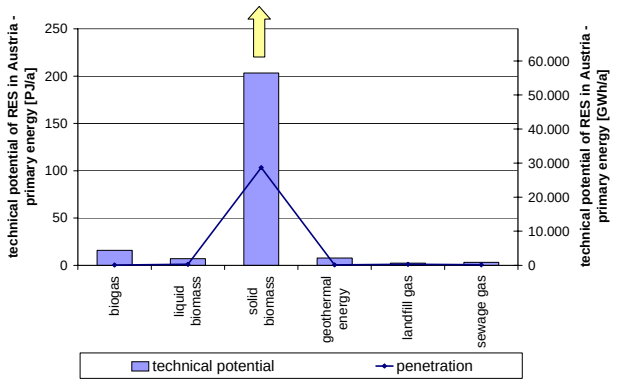

Figure 2 – Technical potentials of renewables and their penetration, primary energy

Source: Haas, Berger et al 2001

In Figure 3 technical potentials (expressed in final energy) of different RES technologies are compared. Solarthermal applications have the largest potential (65 PJ/year [Neubarth, Kaltschmitt 2000]). A large share has to be realised by promoting the equipment of multi-family-dwellings (MFD) with solar systems.

The technical potential of electricity from small hydro power plants amounts to approx. 11.320 GWh/year considering refurbishment of existing facilities (800 GWh/year). As indicated by an arrow the potential of electricity from wind might surpass 5.200 GWh/year in case this technology is further promoted.

Regarding heat pumps their theoretical potential is limited by Austria's heat demand only. The potential shown in Figure 3 is quite low because the authors of this paper (and of the study [Haas, Berger et al. 2001]) argue that heat pumps can only be counted as "real" RES technology if electricity used to operate them is 100% renewable. That is to say, their promotion is somehow doubtful in case that additional conventional electric capacity has to be build.

The technical potential for PV applications is subject to discussions, ranging from approx. 0,55 TWh to 9 TWh [TERES II 1996], depending on the boundary conditions considered.

[4] According to the Austrian ElWOG [ElWOG 2000] only "new renewables" are considered: Note that SHP and electricity generated in the paper & pulp industry are therefore not included.

[5] In January 2001 a geothermal plant went into operation in Altheim (Upper Austria): estimated electricity generation 3,8 GWh/year

[6] environmental heat: 4.113 TJ

[7] swimming pool heating, space & water heating

[8] It is estimated that about 150.000 ha arable land will be available in Austria in 2010. In 2000 there were approx. 100.000 ha fallow.

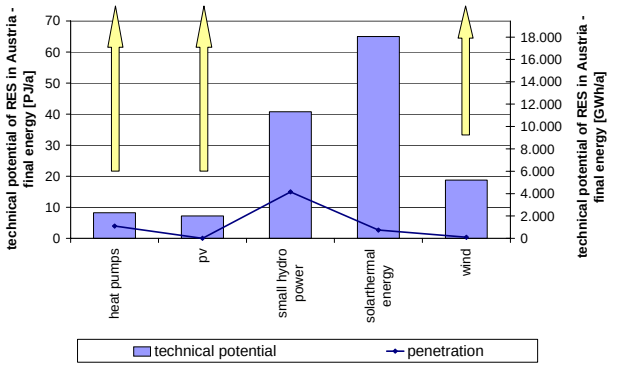

Figure 3 – Technical potentials of renewables and their penetration, final energy

Source: Haas, Berger et al 2001

4. COSTS AND EFFICIENCY[9]

In general current generation costs of RES are high compared to conventional technologies (see Figure 4). PV applications are currently out of an economic spectrum, but when considering historical developments of investment costs it has to be stated that compared to 1990 tremendous cost cuts have been realised. In the light of these developments the authors believe that slighter reductions will be realised until 2010, lowering the generating costs in Austria to approx. 407 EURO/MWh. This estimation also considers improvements in their performance[10].

Regarding electricity from wind the actual generating costs range from 79 to 142 EURO/MWh. Till 2010 they are expected to drop by approx. 15%. The costs of solid biomass CHP depicted in Figure 4 (111 to 253 EURO/MWh) only apply to systems with less than 10 MW_{el}. It is probable that costs decrease by about 40% in the timeframe of this paper. The corresponding costs for landfill gas CHP are the lowest compared to other RES technologies due to the following: according to Austrian standards systems for gathering landfill gas have to be installed on waste sites. Assuming that those facilities already exist their part of the investment costs for landfill gas CHP systems are therefore not considered.

Concerning heat generation solarthermal applications seem to be ranking upon the most expensive technologies (Figure 4 right hand side). This applies only to smaller solar systems (collector area 7-10 m²). Projections till 2010 reveal that cost savings of about 10% are probable. These reductions are basically due to performance improvements[11].

Heat production costs of solid biomass in households range from approx. 87 to 133 EURO/MWh depending on the fuels used (wood logs vs. pellets), costs for district heating with solid biomass have quite similar values. They are expected to drop by about 20% to 25% till 2010.

5. BARRIERS

An important barrier for renewables in Austria are high investment costs compared to conventional energy conversion systems (see Figure 5 and Figure 4). There is a lack of standardisation on the one hand and of maturity of renewable technologies on the other hand. Another impediment to RES dissemination are high transaction costs mainly due to obstructive regulations, promotion strategies and permit procedures respectively. Generators often cannot rely on the continuity of strategies since they tend to be subject to changes (“stop & go” – strategies) making long term-planning difficult. Last but not least certain technologies are lacking public acceptance and the general level of information is insufficient. In order to meet the ambitious objectives presented in the following chapter (6) certain technologies need to be stimulated to an extent that their acceptance may become one of their main barriers in the future.

Wind electricity generation as one of the RES technologies with a promising potential faces little acceptance in some regions dependent on tourism or in residential areas. In the past problems with the national rebate program arose, therefore increasing transaction costs for potential investors.

Especially PV systems struggle with low profitability but also high transaction costs. In Austria the latter are important since feed-in tariffs vary from province to province on the one hand and are not guaranteed for a longer period on the other hand. In addition transparency on the PV market is still insufficient and knowledge concerning new “building integrated PV systems” is still not well spread.

As regards heat from solid biomass in households there is a lack of systems for smaller heat loads (< 10 kW) in Austria. Moreover it was found that plumbers often have too little know-how about modern biomass systems. In addition existing promotion strategies lead to oversized and therefore too expensive heating systems. Concerning district heating operators are facing shortages of cheap fuels such as by-products from saw and wood processing industries, leading to higher heat production costs.

[9] In general costs are expressed as real value incl. Austrian VAT (20% in this case).

[10] In 1990 an average of 650 kWh/kW_p was achieved in Austria. The authors expect an increase to about 900 kWh/kW_p until 2010.

[11] In Austria performance ratios for water heating in standard or high efficient collectors were about 300 to 600 kWh/m²/year in 1999, in 2005 approx. 500 to 650 kWh/m²/year are expected. Ratios for space heating will increase from 250–400 to 350–500 kWh/m²/year [Faninger 1999].

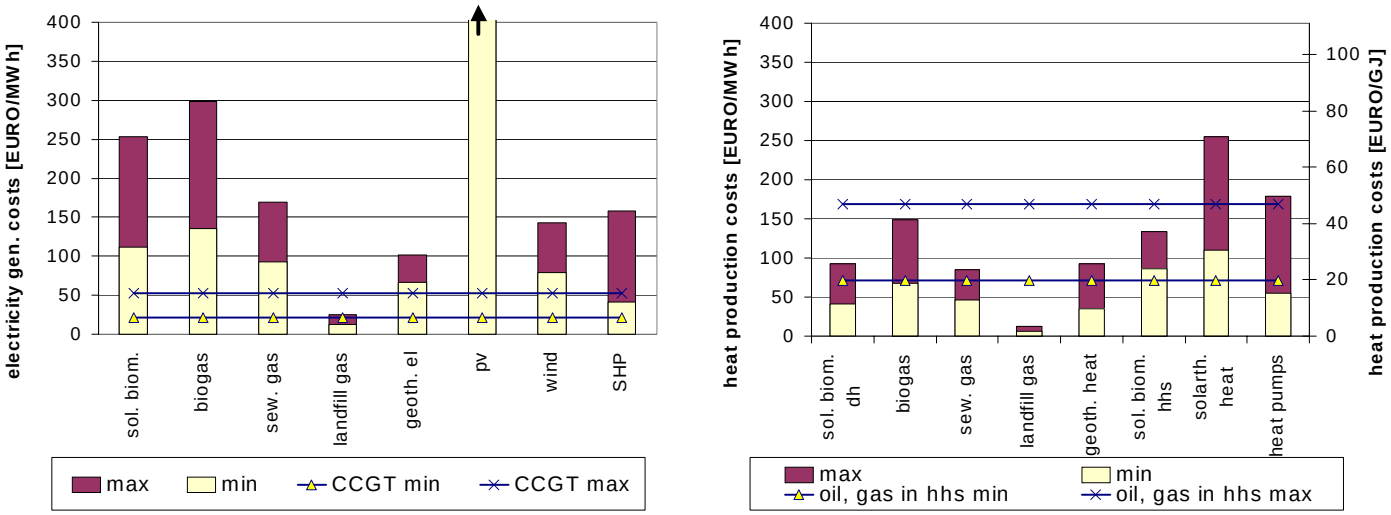

Figure 4 – Generation costs of renewables in Austria in 2000[12]

Source: Haas, Berger et al 2001

The same problem exists with biomass CHP plants. In addition insufficient market transparency and high investment costs for smaller systems are important barriers. Moreover efficiencies of existing technologies are still too low.

Liquid biomass is strongly dependent on available fallow which is subject to EU policy and may vary from year to year, i.e. there is a lack of clear long-term policy. In Austria cultivation of rape on available fallow is submitted to a bunch of regulations increasing transaction costs for farmers on the one hand. On the other hand there is no clear effort to develop engines / equipment especially for biofuels, i.e. machines running with biofuels nowadays have been optimised for fossil fuels and therefore biofuels are usually processed in order to render them as close to fossil fuels as possible.

barriers electricity	pv	wind	small hydro power new	small hydro power rehabilitation	sol. biomass - CHP big (>10 MWel)	sol. biomass - CHP small	landfill / sewage gas	biogas
high investment costs / low profitability	- - -	-	- -	-	-	- -	-	- - -
acceptance 1))		- -	- -		- -	-		
technical maturity	- -	-			-	- -	-	- -
level of information 2))	- -				-	- -	- -	- -
imperfekt market / low transparency 3))	- -				- -	- - -	- -	- -
high transaction costs	- -	-	- -	- -	- - -	- -	- -	- - -

barriers heat	sol. biomass households automatic	sol. biomass households manual	solarthermal hot water	solarthermal heating	sol. biomass district heating operator	sol. biomass district heating user	environmental heat	waste heat
high investment costs / low profitability	- -		-	- -	- -		- -	- -
acceptance 1))		-			-			-
technical maturity	-	-	- -	- -	-		-	- -
level of information 2))	-	-	-	- -	- -	-	-	- - -
imperfekt market / low transparency 3))	-	-		- -	- -	-	-	- -
comfort		- -						
high transaction costs	-	-		-	- -			- - -

1)) with regard to concerned parties; they are no operators und do not profit directly from this technology
2)) with regard to operators and users
3)) with regard to potential operators / investors, plumbers or similar actors

Figure 5 – Overview of major barriers for renewables in Austria in 2000

Source: Haas, Berger et al 2001

6. AN AMBITIOUS SCENARIO UNTIL 2010

Taken historical developments, technical potentials and existing barriers an ambitious scenario is deducted for the sectors electricity, heat and transportation in Austria till 2010.

As regards electricity generation the share of "new renewables" is expected to increase from approx. 0,5% in 1999 to 7,8% in 2010 (see Figure 6) whereas 8,25% of Austria's electricity demand might be covered by SHP in 2010 (vs. 7,45% in 1998). Therefore the 4% - quota for 2007 is largely surpassed. The substantial increase of

[12] Combined Cycle Gas Turbines (CCGT): specific operation costs are neglected due to strong variations of fuel costs (7 to 17 EURO/MWh)
Coal power plants: only variable costs of an old power plant (e.g. Germany) are considered

RES electricity generation in Austria is mainly based on two technologies, wind (plus 2,7 TWh in 2010 compared to 2000) and solid biomass in CHP (plus 1,6 TWh).

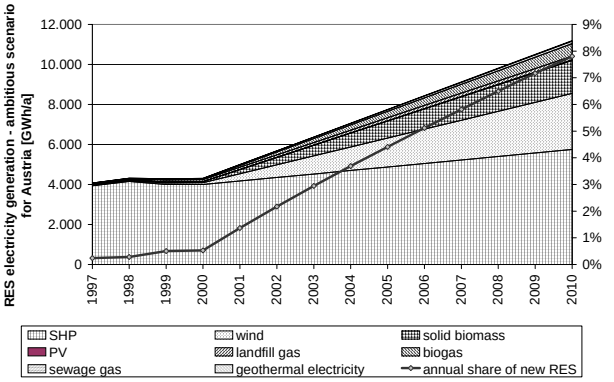

Figure 6 – Ambitious scenario for electricity in Austria till 2010

Source: Haas, Berger et al 2001

The ambitious scenario for the transport sector predicts an increase of the share of RES from 0,3% in 1999 to 1,8% in 2010 (relative to diesel consumption). This is based on the assumption of a substitution effect of diesel by biofuels: Compared to the production of about 27.000 t[13] in 2000 (equivalent to 1 PJ) approx. 94.000 t (=3,5 PJ) are expected to be produced in 2010.

Concerning heat production it is differentiated between the sectors households, service and industry respectively. The ambitious scenario predicts an increase of the share of renewables for households' heat demand from 33% (in 1999) to 54% (in 2010, see Figure 7)[14]. Compared to 1998 further 23,5 PJ heat will be produced from solid biomass (total individual and district heating 94 PJ), additional 7,6 PJ from solar systems (total 9,2 PJ) and approximately 6 PJ from other RES technologies (total 9 PJ).

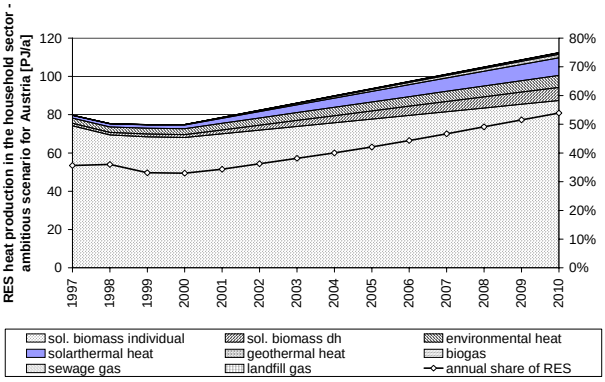

Figure 7 – Ambitious scenario for households' space and water heating in Austria till 2010

Source: Haas, Berger et al 2001

In the service sector the share of renewables might increase from 8% in 1998 to 19% in 2010. The main fuel employed is solid biomass (additional 16,9 PJ).

The industrial sector indicates the least promising increase in the share of renewables in the ambitious scenario (from 11% in 1998 to 12% in 2010). Again, in this sector solid biomass applications (additional 14 PJ) are dominating. Geothermal heat is contributing with supplementary 1 PJ.

7. MEASURES TO REALISE THE AMBITIOUS SCENARIO

In order to realise the ambitious scenario for electricity, heat and transport several measures have to be implemented. Apart from individual instruments for each technology the following overall measures are necessary:

- Competitiveness of RES technologies has to be achieved through financial incentives, such as rebates and feed-in tariffs.
- R&D expenditures for optimised energy systems - especially adapted to low energy buildings - must be increased in order to develop standardised components;
- R&D for both combined and compact heating systems (biomass and solarthermal energy) has to be further promoted;
- Market transparency has to be improved for several RES (such as solid biomass CHP, solarthermal systems, etc.) through new opportunities in E-commerce, e.g. homepages with benchmarks (for instance component prices, performance standards, etc.);
- Promotion strategies are to be monitored continuously in order to perceive problems & difficulties in time and to be able to learn from them; Competence centres with the purpose to overcome softbarriers must be set up for a defined period of time;

[13] Estimated by "Österreichisches Biotreibstoff Institut" [ÖBI 2000]; About 42% of the Austrian production (1998) were exported [Clement et al. 1998].

[14] According to an estimation of the "Austrian Institute of Economic Research" households' heat demand for space and water heating will decrease from 226 to 220 PJ/year in Austria till 2010.

- Detailed market analysis in the service sector (public, trade and small industries) have to be conducted in order to improve knowledge of particular needs with respect to RES supply (such as solarthermal systems);

In the following paragraphs individual measures for the three most promising technologies (wind, biomass and biofuels) are described in greater detail:

The major promotion strategy for **wind** are feed-in-tariffs guaranteed for 15 years. In addition simplifications of actual regulation and permit procedures are crucial for intensified wind dissemination. Rising problems with public acceptance have to be anticipated by involving locally concerned people already during the planning process and by financial participation of stakeholders.

With respect to **biomass heating** it has to be differentiated between district and individual heating. Overall promotion measures are to establish standards for both efficient provision of biomass and for logistic concepts as well as to enhance co-operation and information of major players. Moreover, market analysis have to be performed in order to develop standardised systems for specific target groups (single-family-dwellings, multi-family-dwellings, public buildings and district heating networks). In addition Contracting must be further supported.

The major instrument for the dissemination of biomass in households (local heating) is a simple and transparent rebate program coupled with obligatory consultant services. It has to be focused on households currently heating with fossil fuels particularly. In addition the development of standardised heating systems for both smaller heating loads and combined systems (solar & biomass) must be supported.

District heating with solid biomass must be promoted developing a plan for preference areas on a national level. Moreover operators have to be provided with sufficient information about how to plan and to run district heating plants in an optimal way. Public acceptance must be improved through professional image-campaigns.

Important measures for the dissemination of **liquid biomass** are to establish an EU-wide standard for biofuels on the one hand and to tighten standards for fossil fuels on the other hand. Additionally their use in niche markets must be obligatory and logistical concepts for used oil and fatty acids have to be supported.

8. CONCLUSIONS

An ambitious increase of the market share of RES in Austria till 2010 is possible if the proposed measures are realised. Moreover, suggested strategies will bring about fundamental changes of the Austrian energy supply system. In this context a substantial increase of the efficiency of energy services is crucial.

We believe that raising the market share of RES will lead to a higher price level for energy services but we are *convinced* that only an ambitious use of renewables will contribute to a sustainable supply of energy services on the long run.

The major future barriers to reach these ambitious goals are expected to be rising transaction costs and low acceptance of some technologies.

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