Financing the Energy Transition in Times of Financial Market Instability

by Claudia Kemfert and Dorothea Schäfer

One of the most pressing public priorities in Germany at present is how to organize the energy transition. However, the cost of stabilizing the financial sector as well as the fiscal pact and the debt brake mean that the government has limited financial resources. Consequently, the availability of private capital, whether in the form of equity or debt, is becoming a decisive factor in the success of the German energy transition. Recently, there have been increasing indications that banks are very reluctant to provide loans and are focusing on the potential risks of financing the switch to renewable energy. At the same time, however, the financial sector is also wrestling with political decision-makers about the capital requirements of the loans concerned. Yet, reducing the capital base in the banking sector is out of the question. Instead, the government should also call for appropriate involvement of the major banks in financing the energy transition in return for implicit guarantees for those banks, just as financial aid from the government was linked to loans being granted to SMEs in 2008. At the same time, the risks have to be spread more widely. Know-how and financial strength of private equity funds may be of help here.

Following the catastrophe in Japan in 2011, the German government decided to bring forward their decision to shut down nuclear power stations in Germany and introduce a sustainable energy transition. Eight nuclear power stations were irreversibly removed from the grid in spring 2011 as part of a moratorium. The aim is to gradually decommission all other nuclear power stations that are currently still in operation by 2022 and to increase the proportion of renewable energy from 20 percent at present to 35 percent within eight years. At the same time, energy efficiency, particularly building energy efficiency, is to be improved considerably. The target share of renewable energy in power production for 2050 is 80 percent.

The growth in renewable energy means that expansion, further development, and optimization of the power grid have high priority on the political agenda.[1] On the one hand, new power lines from the north of Germany to the south would have to be set up to transport the power generated by the offshore wind farms to the west and south of the country, where more and more nuclear and coal-fired power stations are being closed down. On the other hand, expansion of the European power grid is essential, particularly in order to make full use of geological advantages for power production from renewable energy, to improve trade, and to improve the grid. Finally, intelligent distribution systems are needed to optimize the volatile supply and demand of electricity. In addition to the expansion of capacities for storing energy, smart and market-optimized demand-side management

1 There are various different scenarios for grid expansion, see Dena Netzstudie II: Integration erneuerbarer Energien in die deutsche Stromversorgung im Zeitraum 2015–2020 mit Ausblick 2025, www.dena.de/fileadmin/user_upload/Download/Dokumente/Studien___Umfragen/Endbericht_dena-Netzstudie_II.PDF. Various scenarios are presented by the Forum for Integration of Renewable Energy, www.forum-netzintegration.de/uploads/media/DUH_Broschuere_NetzintEE_2010_01.pdf. The Federal Network Agency itself estimates the additional costs of the energy transition alone at around one billion euros per year. See A. Schröder, C. Gerbaulet, P.-Y. Oei, and C. von Hirschhausen, „In Ruhe planen: Netzausbau in Deutschland und Europa auf den Prüfstand," Wochenbericht des DIW Berlin, no. 20 (2012).

Table 1

Investment in Renewable Energy
In million euros

	Water[1]	Wind	Photo-voltaics	Energy import	Collectors	Biomass heat[1]	Biogas/bio-mass combined heat and power[1]	Energy import[1]	Geothermal energy	Local heating networks	Total electricity	Total heat	Total invest-ment
2000	**90**	**2 145**	**264**	**0**	**514**	**950**	**480**	**60**	**0**	**103**	**2 979**	**1 524**	**4 503**
2001	54	3 404	627	0	731	1 966	436	71	0	355	4 520	2 768	7 288
2002	88	4 091	594	0	432	2 476	576	87	0	455	5 349	2 994	8 343
2003	91	3 234	729	0	564	2 672	926	101	0	642	4 980	3 338	8 318
2004	94	2 464	3 048	0	573	1 988	745	116	0	819	6 351	1 677	9 028
2005	**96**	**2 179**	**4 077**	**0**	**714**	**1 626**	**1 051**	**145**	**0**	**875**	**7 403**	**2 485**	**9 888**
2006	92	2 639	3 494	0	1 041	1 910	2 191	238	0	885	8 415	3 188	11 603
2007	83	1 996	4 544	0	692	2 379	2 848	618	39	991	9 509	3 689	13 198
2008	84	2 021	7 007	0	901	1 660	1 356	1 066	0	1 045	10 468	3 627	14 095
2009	81	2 384	11 799	0	666	1 497	1 741	1 138	42	1 067	16 046	3 300	19 346
2010	**87**	**2 666**	**23 800**	**0**	**827**	**1 625**	**1 256**	**1 281**	**40**	**758**	**27 848**	**3 733**	**31 581**
2011	88	2 754	15 000	0	1 056	1 713	1 129	1 350	77	763	19 048	4 119	23 168
2012	101	3 001	9 240	0	1 280	1 627	1 070	1 391	105	773	13 516	4 298	17 814
2013	114	3 250	7 200	0	1 494	1 722	1 017	1 429	130	793	11 712	4 645	16 356
2014	128	3 680	6 270	0	1 672	1 831	1 093	1 450	162	843	11 332	4 953	16 285
2015	**142**	**4 148**	**5 490**	**0**	**1 814**	**1 918**	**1 019**	**1 468**	**198**	**852**	**10 996**	**5 200**	**16 197**
2016	158	4 456	4 670	0	1 932	1 996	1 104	1 474	241	895	10 627	5 402	16 030
2017	183	4 778	4 125	0	2 018	1 928	1 109	1 479	291	888	10 486	5 425	15 911
2018	184	5 121	3 710	370	1 996	1 735	943	1 475	348	865	10 676	5 207	15 882
2019	195	5 854	3 354	720	1 910	1 644	928	1 481	408	889	11 456	5 036	16 495
2020	**195**	**6 204**	**3 048**	**980**	**1 866**	**1 536**	**552**	**1 486**	**496**	**829**	**11 475**	**4 889**	**16 364**
2030	287	5 349	2 525	2 255	2 060	1 399	1 657	1 580	568	1 059	12 658	5 039	17 697
2040	315	4 523	3 498	3 240	2 950	1 511	1 044	1 690	960	1 291	13 580	6 151	19 731
2050	**346**	**4 792**	**2 223**	**4 155**	**3 630**	**1 302**	**1 534**	**1 785**	**1 440**	**1 242**	**14 490**	**6 717**	**21 207**
Average for the years 2010 to 2020	143	4 174	7 810	188	1 624	1 752	1 020	1 433	227	832	13 561	4 810	18 371
Total for the years 2010 to 2020	**1 574**	**45 911**	**85 907**	**2 070**	**17 865**	**19 276**	**11 220**	**15 766**	**2 495**	**9 147**	**149 176**	**52 907**	**202 083**
Average for the years 2021 to 2050	316	4 888	2 749	3 217	2 880	1 401	1 418	1 685	989	1 197	13 576	5 969	19 545
Total for the years 2021 to 2050	9 470	146 636	82 461	96 500	86 400	42 125	42 530	50 550	29 680	35 925	407 277	179 075	586 353

1 Estimated for 2000 on the basis of the Jahrbuch Erneuerbare Energien 2001.
Sources: DLR, IWES, IFNE 2010, "Langfristszenarien und Strategien für den Ausbau der erneubaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global," Leitstudie 2010.

Over 200 billion euros investment in renewable energy is expected this decade.

also plays a significant role in the energy transition. For instance, energy-intensive industries could adapt their demand behavior to the market situation if attractive financial compensations were available. A clever market design should take this into consideration.

Hundreds of Billions Needed for Investment in Energy Transition

If the share of renewable energy is to be doubled, according to an estimate by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), cumulative investment of up to around 200 billion euros will be required in the next ten years (see Table 1).[2] Other studies indicate that cumulative investment of up to 235 billion euros is needed over a period of several decades.[3] The Hamburg Institute of International Economics (HWWI) recently estimated the present value of energy transition costs until 2030 at 335 billion euros. This estimate is based on 250 billion euros for the support of renewable energy and 85 billion euros for additional investment, plants, cables, storage, and power plant capacities.[4]

For expanding the grid alone, the Federal Network Agency (BNA) forecasts a requirement of 20 to 25 billion euros over the next 15 years.[5] The German government-owned development bank Kreditanstalt für Wiederaufbau (KfW) estimates the investment needed for improving building energy efficiency over the next ten years to be up to 75 billion euros.[6] Investment of up to 15 billion euros will be necessary for additional gas-fired power station capacities of up to ten gigawatts.[7] It should be taken into account that not all these investments can be attributed solely to the energy transition. In many cases, construction of new power plants as well as replacement and maintenance of networks would also be carried out if there were no energy transition.[8] Recently, there have been increasing indications, however, that finding this funding might prove difficult.

Focus on Risk as Obstacle to Financing

The hurdles for external financing are especially high if projects are classified as new and therefore of high risk.[9] The chances of success and potential for profit are difficult to assess in these circumstances. It may be possible to come up with answers to questions of technical feasibility and market placement for innovations using probability scenarios if necessary. External financiers often lack the relevant information and knowledge to be able to conduct adequate project risk assessment. This applies in particular if there is no or insufficient historical data available or if a large proportion of expenditure is spent on human and material resources, which cannot be pledged as collateral for loans. The costs of plant investments may be lower because of a high degree of specialized technology and a lack of marketability. This asset specifity makes it difficult for lenders to accept the investment as collateral.

Potential financiers often assess the risks inherent in financing the energy transition as very high. Investment in power plant capacities in particular is consi-

Table 2

Overview of Tariff Rates[1] for Hydropower

In cents per kilowatt hour

Year of commissioning	up to 500 kW	up to 2 MW	up to 5 MW	up to 10 MW	up to 20 MW	up to 50 MW	from 50 MW
2012	12.70	8.30	6.30	5.50	5.30	4.20	3.40
2013	12.57	8.22	6.24	5.45	5.25	4.16	3.37
2014	12.45	8.13	6.17	5.39	5.19	4.12	3.33
2015	12.32	8.05	6.11	5.34	5.14	4.08	3.30
2016	12.20	7.97	6.05	5.28	5.09	4.03	3.27
2017	12.08	7.89	5.99	5.23	5.04	3.99	3.23
2018	11.96	7.81	5.93	5.18	4.99	3.95	3.20
2019	11.84	7.74	5.87	5.13	4.94	3.91	3.17
2020	11.72	7.66	5.81	5.08	4.89	3.88	3.14
2021	11.60	7.58	5.76	5.02	4.84	3.84	3.11

1 In accordance with Section 23 of the EEG, degression of 1.0 percent, tariff period of 20 years.
Source: BMU (2012): tariffs, degression, and calculation examples in accordance with the new Renewable Energy Sources Act (EEG) of August 4, 2011.

Tariffs for hydropower are relatively constant.

2 See BMU, Ausbau erneuerbarer Energien im Strombereich. EEG-Vergütungen, -Differenzkosten und -Umlage sowie ausgewählte Nutzeneffekte bis zum Jahr 2030 (Berlin: 2008); BMU „Leitstudie 2010" Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global (Berlin: 2010), 23.

3 See Prognos, Investitionen durch den Ausbau erneuerbarer Energien in Deutschland (2010); Prognos, Konsequenzen eines Ausstiegs aus der Kernenergie bis 2022 für Deutschland und Bayern (2011), and Erdmann, Kosten des Ausbaus erneuerbarer Energien 2011 (Berlin: vbw-Studie, 2011).

4 M. Bräuninger and S. Schulze, Konsequenzen der Energiewende (2012). www.hwwi.org/fileadmin/hwwi/Publikationen/Studien/HWWI-Studie-Energiewende-2012.pdf. This study does not differentiate between pure investment and differential costs, however. Consequently, it does not indicate which costs can be attributed to the energy transition alone, and which would be incurred even if there were no energy transition.

5 See Bundesnetzagentur, Monitoringbericht (2011), 177ff. However, the Federal Network Agency (BNA) itself concedes that grid expansion can only partially be attributed to the energy transition itself, since replacement and repair of the power grid would have been necessary even if no energy transition had occurred.

6 See KfW, Der energetische Sanierungsbedarf und der Neubaubedarf von Gebäuden der kommunalen und sozialen Infrastruktur (2011). Study conducted by the Bremer Energieinstitut on behalf of the KfW, www.kfw.de/kfw/de/KfW-Konzern/Medien/Aktuelles/Pressearchiv/2012/20120104_55429.jsp.

7 T. Traber and C. Kemfert, „Nachhaltige Energieversorgung: Beim Brückenschlag das Ziel nicht aus dem Auge verlieren," Wochenbericht des DIW Berlin, no. 23 (2010).

8 T. Traber and C. Kemfert, Die Auswirkungen des Atomausstiegs in Deutschland auf Strompreise und Klimaschutz in Deutschland und Europa (2012). Study commissioned by Greenpeace e.V., www.greenpeace.de/fileadmin/gpd/user_upload/themen/atomkraft/Gutachten_DIW.pdf. The Federal Network Agency recently also confirmed that the grid expansion mentioned in the grid development plan is only to be partially attributed to the energy transition itself, see www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetGas/GasNetzEntwicklung/NetzEntwicklungsPlan/NetzEntwicklungsPlan_node.html.

9 T. Spencer, K. Bernoth, L. Chancel, G. Emmanuel , and K. Neuhoff, „'Grüne' Investitionen in einem europäischen Wachstumspaket," Wochenbericht des DIW Berlin, no. 25 (2012).

Table 3

Tariffs[1] for Power from Landfill, Sewage, and Mine Gas
In cents per kilowatt hour

Year of commissioning	Landfill gas (Section 24)		Sewage gas (Section 25)		Mine gas (Section 26)		
	up to 500 kW_{el}	up to 5 MW_{el}	up to 500 kW_{el}	up to 5 MW_{el}	up to 1 MW_{el}	up to 5 MW_{el}	over 5 MW_{el}
2012	8.60	5.89	6.79	5.89	6.84	4.93	3.98
2013	8.47	5.80	6.69	5.80	6.74	4.86	3.92
2014	8.34	5.71	6.59	5.71	6.64	4.78	3.86
2015	8.22	5.63	6.49	5.63	6.54	4.71	3.80
2016	8.10	5.54	6.39	5.54	6.44	4.64	3.75
2017	7.97	5.46	6.30	5.46	6.34	4.57	3.69
2018	7.85	5.38	6.20	5.38	6.25	4.50	3.63
2019	7.74	5.30	6.11	5.30	6.15	4.44	3.58
2020	7.62	5.22	6.02	5.22	6.06	4.37	3.53
2021	7.51	5.14	5.93	5.14	5.97	4.30	3.47

1 In accordance with Sections 24-26 of the EEG, degression of 1.5 percent, tariff period of 20 years.
Source: BMU (2012): tariffs, degression, and calculation examples in accordance with the new Renewable Energy Sources Act (EEG) of August 4, 2011.

Tariffs for power from landfills, sewage, and mine gas continue to fall.

Table 4

New Tariffs[1] for Power from Solar Energy
In cents per kilowatt hour

Commissioning	Installed plant capacity				Free-standing installation up to 10 MW
	up to 10 kW	up to 40 kW[2]	up to 1 MW[2]	up to 10 MW	
1 April 2012	19.50	18.50	16.50	13.50	13.50
1 May 2012	19.31	18.32	16.34	13.37	13.37
1 June 2012	19.11	18.13	16.17	13.23	13.23
1 July 2012	18.92	17.95	16.01	13.10	13.10
1 August 2012	18.73	17.77	15.85	12.97	12.97
1 September 2012	18.54	17.59	15.69	12.84	12.84
1 October 2012	18.36	17.42	15.53	12.71	12.71
1 November 2012	To be announced by Federal Network Agency by October 31, 2012 at the latest, depending on additions in July, August, and September 2012				

1 In accordance with the PV amendment, degression of 1 percent per month.
2 Share of total electricity eligible for tariffs 90 percent.
Source: BMU (2012): Vergütungssätze EEG neu.

Tariffs for power from solar energy have fallen significantly but are still profitable.

dered to be of high risk. Financial institutions cite innovation and technology risks, but political risks and obstacles are also constantly under discussion in the context of justifying the reluctance to make funding available. The fundamental question arises whether the focus on risk by potential financiers is justified given that the Renewable Energy Sources Act (EEG) has radically changed the German energy market.

Table 5

Basic Tariffs for Plants Producing Energy from Biomass[1]
In cents per kilowatt hour

Year of commissioning	up to 150 kW_{el}	150–500 kW_{el}	500 kW_{el}–5 MW_{el}	5–20 MW_{el}
2012	14.30	12.30	11.00	6.00
2013	14.01	12.05	10.78	5.88
2014	13.73	11.81	10.56	5.76
2015	13.46	11.58	10.35	5.65
2016	13.19	11.35	10.15	5.53
2017	12.93	11.12	9.94	5.42
2018	12.67	10.90	9.74	5.32
2019	12.41	10.68	9.55	5.21
2020	12.17	10.46	9.36	5.10
2021	11.92	10.26	9.17	5.00

1 Within the meaning of the Ordinance on the Generation of Electricity from Biomass (BiomasseV) as applicable from January 2012. Degression of 2 percent, tariff period of 20 years (not including input-related additional tariffs in accordance with input tariff classes I or II).
Source: BMU (2012): tariffs, degression, and calculation examples in accordance with the new Renewable Energy Sources Act (EEG) of August 4, 2011.

Tariffs for energy from biomass vary greatly according to the size of the plant.

EEG Provides Relatively High Degree of Planning Predictability

The EEG supports renewable energy by guaranteeing feed-in tariffs and prioritizing power from renewable sources for 20 years.[10] There are fixed tariffs for the various technologies for the next ten years (see Tables 2 to 7).[11] If there are changes to the EEG, rights are protected for projects installed under the old regime. Both of these factors reduce risks for investors. The proportion of power generated from renewable energy has steadily increased over the past few years and now makes up 20 percent of total power consumption (see Table 8).

10 See Act on Granting Priority to Renewable Energy Sources (Renewable Energy Sources Act), www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/eeg_2012_bf.pdf.

11 J. Diekmann, C. Kemfert, and K. Neuhoff, „The Proposed Adjustment of Germany's Renewable Energy Law: A Critical Assessment," Economic Bulletin, no. 6 (2012).

Table 6

Tariffs for Power from Biowaste and Small Slurry Biogas Plants and from Geothermal Energy[1]
In cents per kilowatt hour

Year of commissioning	Biowaste fermentation		Slurry biogas plants up to 75 kW_{el}	Geo-thermal energy[2]
	up to 500 kW_{el}	500 kW_{el} to 20 Mw_{el}		
2012	16.00	14.00	25.00	25.00
2013	15.68	13.72	24.50	25.00
2014	15.37	13.45	24.01	25.00
2015	15.06	13.18	23.53	25.00
2016	14.76	12.91	23.06	25.00
2017	14.46	12.65	22.60	25.00
2018	14.17	12.40	22.15	23.75
2019	13.89	12.15	21.70	22.56
2020	13.61	11.91	21.27	21.43
2021	13.34	11.67	20.84	20.36

1 In accordance with Sections 27a and b of the EEG.
2 Degression of 5 percent from 2018, tariff period of 20 years.
Source: BMU (2012): tariffs, degression, and calculation examples in accordance with the new Renewable Energy Sources Act (EEG) of August 4, 2011.

Tariffs for power from biowaste and geothermal energy have fallen slightly.

In the last few years, mainly as a result of growing levels of power production, the EEG surcharge increased to 3.5 cents per kilowatt hour. The total tariffs amounted to 13 billion euros in 2010 (see Tables 9 and 10).[12] Various studies point to an increase in the surcharge up to 5.1 cents per kilowatt hour over the next ten years.[13] Certainly, there are increasing voices calling for more limitations on the EEG surcharge and the abolition of the priority regulation in order to better optimize grid congestion and reduce costs. Both proposals discourage investors, but since no changes to the basic EEG concept are expected, further investments are associated with low risks.

Renewable Energy Largely Financed by Private Individuals

A large share of investment to date in renewable energy has also been made by private individuals. Overall, they account for 40 percent of installed capacity.

12 See Übertragungsnetzbetreiber (ÜNB), Prognosekonzept und Berechnung der ÜNB (2012).

13 See BSW 2011/Prognos 2011, Kosten der Solarstromförderung (2011); Erdmann, Kosten des Ausbaus ; T. Traber, C. Kemfert, J. Diekmann, „Strompreise: Künftig nur noch geringe Erhöhung durch erneuerbare Energien," Wochenbericht des DIW Berlin, no. 6 (2011).

Table 7

Tariffs for Power from Onshore and Offshore Wind Energy
In cents per kilowatt hour

Year of commissioning	Onshore[2]					Offshore[3]		
	Basic tariff	Initial tariff	System service bonus	Wind energy repowering	Small wind farms up to 50 kW	Basic tariff	Higher initial tariff	Initial tariff in compression model
2012	4.87	8.93	0.48	0.50	8.93	3.5	15.0	19.0
2013	4.80	8.80	0.47	0.49	8.80	3.5	15.0	19.0
2014	4.72	8.66	0.47	0.49	8.66	3.5	15.0	19.0
2015	4.65	8.53	0.46	0.48	8.53	3.5	15.0	19.0
2016	4.58	8.41	–	0.47	8.41	3.5	15.0	19.0
2017	4.52	8.28	–	0.46	8.28	3.5	15.0	19.0
2018	4.45	8.16	–	0.46	8.16	3.26	13.95	–
2019	4.38	8.03	–	0.45	8.03	3.03	12.97	–
2020	4.32	7.91	–	0.44	7.91	2.82	12.07	–
2021	4.25	7.79	–	0.44	7.79	2.62	11.22	–

1 In accordance with Sections 29–31 of the EEG.
2 Degression of 1.5 percent, tariff period of 20 years.
3 Degression of 7 percent as of 2018, tariff period of 20 years.
Source: BMU (2012): tariffs, degression, and calculation examples in accordance with the new Renewable Energy Sources Act (EEG) of August 4, 2011.

Tariffs for power from offshore wind farms will fall significantly—but only from 2018 onwards.

Table 8

Key Data on Renewable Energy in Germany
In percent

	2010	2011	Change
Share of renewable energy in total power consumption	17.1	20.0	17.0
Final energy from renewable energy sources in billion kilowatt hours	104	122	17.3
Share of heat from renewable energy in total thermal energy consumption	10.2	10.4	2.0
Share of renewable energy in total fuel consumption	5.8	5.6	–3.4
Share of renewable energy in total final energy consumption	11.3	12.2	8.0
Share of renewable energy in total primary energy consumption	9.7	10.9	12.4
Total final energy from renewable energy in billion kilowatt hours	284	295	3.9
Greenhouse gas emissions avoided through renewable energy in million tonnes	120	129	7.5
Investment in construction of renewable energy plants in billion euros	27.8	22.9	–17.6
Revenue from operation of renewable energy plants in billion euros	11.6	13.1	12.9

Source: BMU (2012): Informationen zur Kalkulation der EEG-Umlage für das Jahr 2012.

Renewable energy is continuing to gain ground in Germany.

Table 9

EEG Differential Costs and EEG Surcharge

	2009[1]	2010[2]	2010[1]	2011[2]	2012[2]
EEG power generation in gigawatt hours	75 053	90 231	80 699	97 995	113 519
EEG tariffs (after deduction of the grid charges avoided) in billion euros	10.5	12.3	12.8	16.7	17.6
Total EEG costs to be apportioned (EEG differential costs in a broader sense) in billion euros	5.3	8.2	9.35	13.5	14.1
EEG surcharge for non-privileged electricity consumers (e.g. households, businesses) in cents per kWh	1.30	2.05	2.30	3.53	3.59
EEG costs for a sample household (3,500 kWh per year) in euros per month	3.83	5.95	6.70	10.30	10.50
Average EEG household electricity price[3]					
in cents per kWh	23.2	23.7	–	25.2	25.5
in percent	6	9	10	14	14

1 EEG annual account.
2 Forecasts by transmission system operators (TSOs) dated October 15 of preceding year.
3 BDEW, last updated March 7, 2012.
Source: BMU (2012): Erneuerbare Energien 2011.

The EEG surcharge has increased.

Lagging far behind them are project developers with 14 percent and banks/funds (eleven percent) and farmers (eleven percent) (see figure). A relatively small share of 6.5 percent is contributed by the four major energy suppliers.[14]

The renovation of buildings is also largely financed by private investment, supported by low-interest loans from the KfW's building renovation program.[15] The German government has decided to increase the amount of money available from just below 900 million to 1.5 billion euros per year, but its implementation is not currently supported by the federal states. The increased funding for the KfW's building renovation program is to be provided by the Energy and Climate Fund. This in turn comes mainly from the sale of CO_2 emission certificates. The price of CO_2 certificates has fallen dramatically as a result of the economic crisis. Within one year, it has plummeted from over 15 euros per emission right for one tonne of CO_2 to well under ten euros.[16] If no adjustments are made to EU emissions trading, a further drop in the price of CO_2 certificates is to be expected. In order to bring in more revenue from emissions trading, emission reduction targets would have to be made stricter and the number of emission certificates be reduced at EU level.[17] At current prices, money cannot be generated by the sale of certificates. An alternative form of financing may be necessary until prices recover.

Investment in the power grids requires private capital. The costs may be passed on in grid charges. However, some authors argue that the current incentive regulations with fixed tariffs in fact pose an obstacle to investment because investors are afraid they might not get sufficient returns. For instance, an ex-post necessity test for grid investments would result in a high degree

14 See Agentur erneuerbare Energien, Eigentumsverteilung erneuerbarer Energien 2011(2011), www.unendlich-viel-energie.de/de/wirtschaft/detailansicht/article/572/eigentumsverteilung-an-erneuerbaren-energien-anlagen-2010.html.

15 See KfW (2011): www.kfw.de/kfw/de/Inlandsfoerderung/Programmuebersicht/Sozial_Investieren_-_Energetische_Gebaeudesanierung/index.jsp.

16 See Sachverständigenrat, Gesamtwirtschaftliche Konsequenzen der Energiewende und Reformansätze (2012), www.energie-innovativ.de/fileadmin/Web-Dateien-Energie-Innovativ/Dokumente/Expertenworkshop/Pr%C3%A4sentation_Christoph_Schmidt.pdf.

17 Traber and Kemfert (2012), Auswirkungen des Atomausstiegs.

Table 10

Electricity for Which Tariffs Were Paid in Accordance with the EEG
In gigawatt hours

	2000	2002	2004	2006	2008	2009	2010
Total final consumption	**344 663**	**465 346**	**487 627**	**495 203**	**493 506**	**466 055**	**485 465**
For information only: privileged final consumption	–	–	36 865	70 161	77 991	65 023	80 665
Total electricity for which tariffs were paid in accordance with the EEG	**10 391.0**	**24 969.9**	**38 511.2**	**51 545.2**	**71 147.9**	**75 053.4**	**80 698.9**
Hydropower	4 114.0	6 579.3	4 616.1	4 923.9	4 981.5	4 877.0	5 049.0
Biogases	–	–	2 588.6	2 789.2	2 208.2	2 019.5	1 160.0
Biomass	586.0	2 442.0	5 241.0	10 901.6	18 947.0	22 979.9	25 145.9
Geothermal energy	–	–	0.2	0.4	17.6	18.8	27.7
Wind energy (onshore and offshore)	5 662.0	15 786.2	25 508.8	30 709.9	40 573.7	38 579.7	37 633.8
Solar energy	29.0	162.4	556.5	2 220.3	4 419.8	6 578.3	11 682.5
Average tariff in cents per kWh[1]	**8.50**	**8.91**	**9.29**	**10.88**	**12.25**	**13.95**	**15.86**
Total tariffs in billion euros	**0.88**	**2.23**	**3.16**	**5.81**	**9.02**	**10.78**	**13.18**
Electricity from renewable energy sources for which no tariffs were paid	26 827	20 678	17 541	20 112	21 841	19 564	23 627
Total electricity from renewable energy sources	**37 218**	**45 648**	**56 052**	**71 657**	**92 989**	**94 618**	**104 326**
For information only: EEG quota in percent	3.01	5.37	8.48	12.01	17.13	18.58	20.02

1 The average tariff is a weighted average calculated from the individual tariffs.
Source: BMU (2012): Informationen zur Kalkulation der EEG-Umlage für das Jahr 2012.

Total tariffs in 2010 amounted to just over 13 billion euros.

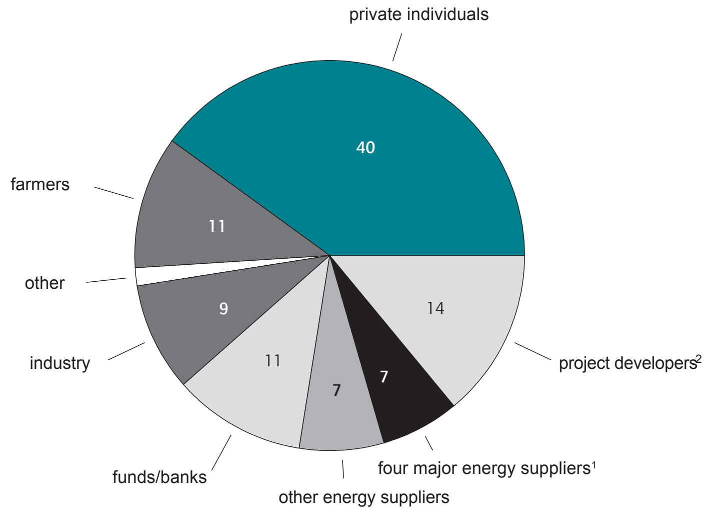
of uncertainty as to whether the regulations allow investment costs to be recouped.[18] The underlying fear of a surplus of grid capacity seems to be somewhat hypothetical, however, in view of the congestion seen with the on-schedule connection of offshore wind farms to the grid. Federal Economics and Environment Ministries only recently agreed on measures to compensate the wind farm operators for financial losses resulting from not being connected.[19]

Investor Caution Despite Guaranteed Payments

All in all, it can be said that there is a distinct lack of barriers to investment in the current structure of the EEG. This is largely due to feed-in tariffs being fixed over a period of 20 years. In addition, the priority scheme for

Figure

Investors in Renewable Energy
In percent



1 The four major energy suppliers are E.on, Vattenfall, RWE, and EnBW.
2 Project developers are commissioned to plan and complete projects.
Source: Deutschland hat unendlich viel Energie, trend research 2011.

Renewable energy is in the hands of private individuals.

18 Some authors contend that the current incentive regulations with fixed tariffs pose an obstacle to investment if the regulator makes recognition of the investment dependent on an ex-post necessity test because then the investment risk is borne solely by the network operator, see G. Brunekreeft and R. Meyer, „Netzinvestitionen im Strommarkt: Anreiz- oder Hemmniswirkungen der deutschen Anreizregulierung? Energiewirtschaftliche Tagesfragen," vol. 61, issue 1/2, (2011): 2-5.

19 „Rösler und Altmaier einigen sich in der Offshore-Haftung," ZEIT ONLINE, July 3, 2012, www.zeit.de/wirtschaft/2012-07/offshore-windenergie-haftung.

renewable energy has increased guaranteed payments. However, the persistent demands of many economic bodies (the Monopolies Commission, the Advisory Council of the Treasury, the Council of Experts) and many lobby associations for the abolition or adjustment of either the EEG itself or guaranteed payments are causing reluctance among investors.[20] This has led to regulatory uncertainty and doubts for potential investors, mainly since they cannot exclude unpredictable, very short-term and non-transparent political decisions about fundamental changes to the payment provisions of the EEG. Although the regulatory risk is certainly cushioned by protection for plants that have already been built, it can seriously undermine investors' willingness to invest in plants currently in the planning phase.

Financing the Energy Transition

In order to guarantee investor access to credit and to reduce the likelihood of shortages in external financing for energy transition projects, there is an urgent need to stabilize the banking sector. Stabilization efforts should focus on strengthening the banks' capital base.[21] Only recently, a study on lending by German banks in recent decades has shown that high capital ratios are associated with high levels of lending.[22]

Financial institutions are persistently demanding politicians to set energy transition loans at the lowest risk weighting possible (and therefore lowest possible capital adequacy requirement). This is yet another indication that banks tend to use risk weighting under Basel III as a vehicle to push politicians to make wide-ranging concessions on capital adequacy. The basis for such demands would be nullified by the fundamental abandonment of risk weighting and the introduction of a minimum unweighted capital ratio of, for example, five percent.[23] The Swiss banking supervisory authority has been striving for a ratio of equity to total unweighted assets of five percent for their major banks. To quickly increase the banks' capital base, temporary bans on dividends and bonuses should be no more taboo than direct capital injections into the banks by the public sector.[24]

Public funds, currently in very short supply, must be set aside to be available when capital shortage in the banking sector calls for public supply of equity capital in order to stabilize a financial system which is still in crisis mode. Consequently, the financial scope for co-financing the energy transition with more government funds than current levels is very limited. In addition, the fiscal pact approved by the Bundestag with a deficit limit of 0.5 percent of gross domestic product sets tight limits on raising additional funds on the debt markets. As a result, the government cannot fill in gaps suddenly emerging in planned private contributions to financing the energy transition.

Demanding a Service in Return for Bank Bailout

Coupling financial market stabilization with financing the energy transition could help in this situation. Since the beginning of the financial crisis, the government has given major banks an implicit guarantee facility without the banks having to provide a substantial service in return. The support requirements in the first manifestation of the Special Financial Market Stabilization Funds (SoFFin) in 2008 provide a model for coupling macro-economic necessities with protecting the functionality of the financial system.[25] At that time, capital assistance to banks was linked to, among other things, granting ample SME loans. Following this example, the government could require the banking sector to participate adequately in financing the energy transition in return for government efforts to stabilize the financial markets. The energy transition could be accomplished without compromising capital requirements and the equally expensive stabilization of the banking sector.

20 They refer to the high economic costs and argue that the EEG is incompatible with the emission trading scheme, see Monopolies Commission, Energie 2011: Wettbewerbsentwicklung mit Licht und Schatten (2011). Special Report, www.monopolkommission.de/; Council of Experts: Annual Report 2011/12. Chapter Six: Energiepolitik: Erfolgreiche Energiewende nur im Europäischen Kontext, www.sachverstaendigenrat-wirtschaft.de/fileadmin/dateiablage/download/publikationen/arbeitspapier_03_2012.pdf; Report by the Advisory Council of the Federal Ministry of Finances, Klimapolitik zwischen Emissionsvermeidung und Anpassung (2010), www.bundesfinanzministerium.de/Content/DE/Standardartikel/Ministerium/Geschaeftsbereich/Wissenschaftlicher_Beirat/Gutachten_und_Stellungnahmen/Ausgewaehlte_Texte/0903111a3002.pdf?__blob=publicationFile&v=2.

21 D. Schäfer, „Banken: Leverage Ratio ist das bessere Risikomaß," Wochenbericht des DIW Berlin, no. 46 (2011); S. Binder and D. Schäfer, „Banken werden immer größer," Wochenbericht des DIW Berlin, no. 32 (2011).

22 C. M. Buch and E. Prieto, „Do Better Capitalized Banks Lend Less? Long-Run Panel Evidence from Germany," University of Tübingen Working Papers in Economics and Finance, no.37 (2011).

23 The insurance industry is also currently struggling with politicians and regulators about the risk weighting of long-term infrastructure investment in the context of Solvency II, the future regulations on capital for insurance companies, see www.gdv.de/wp-content/uploads/2012/04/Positionspapier.pdf.

24 The unweighted capital ratio is the ratio of capital to total assets. The weighted capital ratio is the ratio of capital to risk-weighted net asset positions. Risk-weighted net assets are usually much smaller than total assets.

25 See Bundesanstalt für Finanzmarktstabilisierung, Sonderfonds Finanzmarktstabilisierung, www.fmsa. de/de/fmsa/soffin/.

Spreading Risk—Bundling Capital and Structured Debt Financing

In addition to calling for reasonable participation by the banks, policy-makers should also focus more on potential capital providers. New infrastructure projects generally require substantial equity financing. For example, private equity (PE) could play an enhanced role in investment properties such as offshore wind farms[26] or new power lines. It can be assumed that the PE sector has accumulated considerable expertise that could be used to finance infrastructure projects in the field of renewable energy. The funding model could be based on the technique of structured buyout financing (see box). The core of this technique is to found a project company through a private equity house which receives all the equity and the capital borrowed from many financial institutions. The project company is the actual financier and operator of the infrastructure facility. The aim of this technique is to raise high volumes of funding whilst, at the same time, restricting and spreading the risk. In many energy transition projects, liability is not just limited to the project but extends to the parent company as well, but with this funding model, liability is limited to the equity contributed.[27]

No Fear of "Locusts"

Private equity firms or "locusts"[28] typically have an investment horizon of five to ten years at most. In order to pay their own investors, they have to sell their stake in the project company, and therefore in the infrastructure facility, probably even during the life of the long-term loan. If the loan is subsequently sold on by the investing partner before the end of its term, the original lenders become assignors. Their claims can be included in the structured financing strategy of the new owners, but the new owner can also repay the loans early if the financing of the purchase object is restructured. Banks usually secure themselves through specific agreements in the loan contract. These covenants could, for instance, determine that the loan must be repaid prior to expiration if there is a change in ownership.[29]

If, from the individual bank's point of view, the volume of infrastructure loans on its own books remains too high, some of those loans could be securitized and offered for sale in tranches with different degrees of risk to interested investors, such as institutional investors or hedge funds.[30] The investment risk is further spread by securitizing the loan. The "waterfall principle" also ensures that in the event of difficulties in repaying the loans, it is the high risk and therefore high interest installments that are liable for the losses first. In the event of less serious payment difficulties, the tranches classified as less risky do not participate in the losses. They are therefore particularly attractive for investors looking for safe, long-term investments, such as insurancecompanies.

Structured finance models of the type described above have the advantage of spreading the risks of these new long-term infrastructure investments across many investors. This can prevent the risk premiums demanded by private investors being prohibitive. Lenders are also protected from directly participating in all losses by the project company's equity cushion.

Government Support Needed in Start-Up Phase

In the early stages of this kind of project financing, government involvement will probably be needed to support the introduction of such financial models. In the initial phase, it would be advantageous if the KfW and the European Investment Bank were committed as potential equity investors or as lead bank within a consortium of lenders.

Incorporating Project Bonds

Under the proposed funding model, some of the debt financing could be raised with the aid of guaranteed project bonds. EU member states and the European Parlia-

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26 The EEG uses the following definition: an „offshore facility" is a wind energy system that has been built at sea measured at a distance of at least three nautical miles from the shoreline. See the Act to Restructure the Legal Framework for the Promotion of Electricity Generation from Renewable Energy Sources.

27 The willingness of potential equity investors to finance these projects depends largely on whether liability is restricted to the equity capital and, in the event of losses greater than the amount of equity, that liability does not extend to the investors' external assets. See the liability problems arising from the grid connection of the offshore wind project in the North Sea by grid operator Tennet, www.tennettso.de/site/news/2012/februar/offshore-strukturlosung.html.

28 In 2005, the German politician Franz Müntefering compared private equity funds with "swarms of locusts" that fall on companies, devour all they can, and then move on.

29 D. Schäfer and A. Fisher, „Die Bedeutung von Buy-Outs/Ins für unternehmerische Effizienz, Effektivität und Corporate Governance." Report commissioned by the German and Venture Capital Association (BVK), Politikberatung kompakt, no. 38 (2008), DIW Berlin.

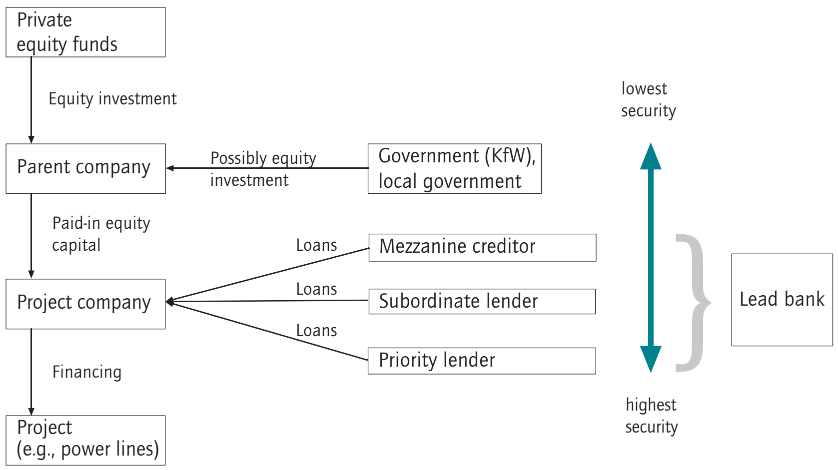
30 According to the law passed in 2010 on the implementation of the amended Banking Directive and the Capital Adequacy Directive, part of the loan must remain on the banks' books.

Box

Financing Renewable Energy Plants

Figure

Financing Model for the Energy Transition



Source: DIW Berlin.

In order to achieve adequate risk diversification for investments in infrastructure, a consortium could initially be formed consisting of several investing partners (including energy companies and local government). The various investing partners would contribute funds to a joint parent company. The parent company would, in turn, create a project company specifically for the investment, with 100% of its shares held by the parent company. The actual investment would be financed by capital contributions from the parent company (paid-in equity capital) and by syndicated debt capital in the form of loans with different priorities and mezzanine financing[1] which the "project company" receives. The debt is syndicated, which means it comes from a consortium of financial institutions put together by a lead bank. Traditionally, the lead bank guarantees the provision of all debt financing. The syndication of debt capital allows for more financial options[2] and additional risk diversification (see figure).

The project company would be the investor and owner of the infrastructure facility. The loans are collateralized by the project company's assets and possibly by shareholder guarantees. The debt capital is serviced by revenue from the project company.

The debt financing might consist of bullet loans, as is typically the case with leveraged buyouts. The advantage of long-term bullet loans is the lack of interest until maturity. Only a small fraction of priority debt should be amortizing and be repaid during the term.

Subordinated loans are collateralized less than creditor claims that have priority in the event of insolvency. This results in a higher risk premium. Subordinated bonds could, for example, be bought by hedge funds.

1 Mezzanine financing is debt that also has certain attributes of equity. For example, silent equity is a form of mezzanine financing.

2 An individual bank with large exposure can very quickly run into conflict with the provisions of the Banking Act for large loans ment recently approved this type of bond.[31] They are issued by private borrowers and are guaranteed through the European Investment Bank (EIB). The EIB's claims are then partially protected by the EU budget. The EIB's guarantee shields private debt investors against losses so the risk premium required by private investors can be reduced. Currently, around 230 million euros from the EU budget have been set aside for project bonds in a pilot phase lasting until the end of 2013. However, only a modest ten million euros has been earmarked for energy projects. This amount should be increased significantly.

It will be difficult to assess exactly how much additional debt financing can be generated from these EU funds. It largely depends on the investors' need for security. Although the EIB is a guarantor of the project bonds, the value of the guarantee will depend to a large extent on whether investors believe the EIB's reinsurance via the EU budget is adequate. In order to comprehensively explore funding options and financing models, it may be helpful to host a round-table discussion with all policy-makers and potential financiers, ranging from private equity and hedge funds, private banks, and insurance companies to government-owned banks with development mandates.

Mobilizing Additional Revenue for Bridging Loans

As long as the revenue from emissions trading remains low, additional revenue must be mobilized for the necessary bridge financing so as not to jeopardize government deficit targets. The financial transaction tax could make an important contribution here. The European Commission has estimated the annual revenue of the financial transaction tax (FTT) across the EU at 57 billion euros. Based on these figures, revenue in Germany from FTT is estimated at over ten billion euros.[32] Part of this revenue could flow directly or indirectly (via the KfW or the EIB) into government investments in the necessary infrastructure facilities and be used to increase the guaranteed sum for project bonds.

Conclusion

The successful implementation of the energy transition requires significant investment. The financing of renewable energy through the EEG generally increases predictability for investors. Adequate financial stability and risk diversification is needed to finance large-scale energy transition projects, such as large offshore or onshore wind farms or major infrastructure projects. The government should insist that, in return for an implicit guarantee framework, major banks should contribute to financing the energy transition. The government should take urgent measures to rapidly increase the equity base of banks. The cost of initial funding of the energy transition could be cushioned by the provision of revenue from improved emissions trading or from additional tax revenues. In addition, the risks should be spread over many stakeholders to reduce the likelihood of private equity firms moving in. A round table on these issues could be helpful here.

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31 See press release from the EU Parliament, www.europarl.europa.eu/news/de/pressroom/content/20120705IPR48349/html/Testphase-f%C3%B-Cr-neue-Projektanleihen-Parlament-stimmt-EU-Garantien-zu.

32 D. Schäfer and M. Karl, „Finanztransaktionsteuer: Ökonomische und fiskalische Effekte der Einführung einer Finanztransaktionsteuer für Deutschland," Politikberatung kompakt, no. 64 (2012), DIW Berlin.

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