International experiences with tender procedures for renewable energy

A comparison of current developments in Brazil, France, Italy and South Africa

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Abstract

Tenders are a fast spreading instrument for the expansion of renewable energies. However, there is a need for current analysis of experiences and results as in many countries tenders were introduced only few years ago. The objective of this study is to provide an up-to-date comparison of tender results for wind power and photovoltaics in Brazil, France, Italy and South Africa. We analyze and discuss rates of completion, market concentration and auction prices, based on data and literature research as well as expert interviews.

Data on project status shows that rates of on-schedule completion are well below 100% ranging between 14% in Brazil and 41% in South Africa (wind). However, final rates of completion of 100% are possible (South Africa). With exception of France current data suggests cancellation rates of less than 5%. A systematic connection between project cancellations and the instrument of tenders could not be identified.

The market share of the five largest owners differs largely between the countries and ranges from 33% (Italy) to 70% (South Africa). Despite the high level in South Africa, the significant oversubscription of tender volumes suggests that free price formation likely was not constrained. Nevertheless, small actors (<50 MW total capacity) are rare in Brazil and South Africa. For Italy their share cannot be determined due to lack of disclosure obligations on ownership structure.

In all countries except Brazil auction prices have continuously fallen by 33% (Italy, wind energy) to 76% (South Africa, photovoltaics). In Brazil, the auction price increased from auction round eight to 14 from 50% to 85% of the first auction price. However, auction prices are highly dependent on factors outside of the support scheme of tenders (e.g. interest rates), so that their evolution and level are not a suitable indicator to determine whether tenders lead to minimal support costs.

1 Introduction and methodology

Tenders were utilized in early 2015 in at least 60 countries as an instrument to promote the expansion of renewable energy [1]. It should be noted that, despite the relatively large number of countries using tenders, they have become a widespread instrument of support for renewable energies only over the last 10 years [2]. Especially since 2011, the number of countries using tenders has increased greatly [2]. The Federal Government of Germany – one of the early big markets for renewables - also decided to introduce tenders and is preparing to implement tender procedures within the framework of the 2016 amendment to the Renewable Energy Sources Act (EEG) [3].

As a rule, tenders determine the assignment of guaranteed remuneration payments over long periods of time (often 20 years). The key differences to the widespread feed-in tariff models are the restriction of support to the group of successful bidders and the use of competition-based pricing. With the feed-in tariff model, support rates are determined through administrational regulations. Every operator of a renewable energy system is entitled to remuneration payments provided that he fulfills certain requirements and obligations (see e.g. [4]).

The theoretical advantages of a support scheme based on tenders lie first and foremost in the more precise steering of expansion and in the lower risk of excessive support that can be achieved through the competition-based determination of remuneration rates. One potential disadvantage is the fact that while tenders allow a capping of the expansion of renewable energy, it is impossible to ensure that the targeted expansion rates are actually achieved. There is also the risk of market concentration in the medium term, which can lead to market power and excessive rates of return for competitive actors. An overview of the opportunities and risks associated with tenders is given in Klessmann et al., 2016 [5], for example.

There is a wide range of literature on the topic of tenders and the associated international experience. In recent years alone, numerous studies were published that examined tender design and the experiences made with tenders in different countries, e.g. [2,6–15]. In addition, numerous case studies have been published, which analyzed the experiences of different countries with tenders for renewable energy (e.g. Brazil [16–19] and South Africa [20–22]). Furthermore, the country-specific experiences are at the focus of joint studies that focus on specific technologies (i.e. wind) or country groups (e.g. IEA countries) [23–26].

Tenders have only in recent years taken on a key role as a support scheme in the expansion of renewable energies. This means that, despite the range of literature, there is an ongoing need for analysis and evaluation of recent experiences made with tenders. All the more since an increasing number of countries is now making the switch to tenders as an instrument to promote the expansion of renewables. Moreover, there have been very few attempts so far to systematically compare the results of tenders and to explain these results in a country-specific context. There are few analyses of market concentration, despite the known risk and the potentially significant impacts on the efficiency of the support scheme and on support costs. Additionally, previous analyses were only able to estimate the completion rate of recent auction rounds, as the results were not yet (fully) available at the time of publication.

With this study, we hope to make a contribution to closing this gap. The aim of the study is to present an up-to-date comparison of key tender results in Brazil, France, Italy and South Africa, and to discuss the developments observed and their causes in qualitative terms. For this purpose, we will update the time series of the indicators “auction prices” and “rate of completion” in the countries examined. We will conduct the first-ever assessment of market concentration based on the indicators “cumulative number of market participants” and “market share of the five largest market actors.” We will also investigate the reasons for the development of tender results by way of expert interviews and a review of secondary literature. We will limit this study to the countries Brazil (wind), France (PV), Italy (wind) and South Africa (wind and PV). In the years 2013 and 2014, these countries showed an average technology-specific expansion of more than 200 MW and have been utilizing the instrument of tenders long enough for the completion deadline in at least one auction round to have expired.

Section 2 provides an overview of the tenders examined. In sections 3 to 5, the results of the auctions are presented and discussed. The conclusion follows in section 6.

2 Countries examined

We examined tenders as a support scheme in the countries Brazil, France, Italy and South Africa for the technologies of photovoltaics and wind power. Table 1 shows key background information on tenders in the countries examined. In Brazil and France, the completion deadlines of seven or eight rounds of auction are already expired, while Italy and South Africa, experience is limited to one or two auction rounds.

The overview shows that the motivation for introducing tenders varies considerably. In Brazil and South Africa, tenders are used to enable the large-scale expansion of photovoltaics and wind power. The objective is for both technologies to become an integral component of the energy mix. In France and Italy, by contrast, the emphasis was on limiting the expansion of photovoltaics and wind power.

Already the varying motivations for the introduction of tenders provide an indication of the different stages of progress in the expansion of the technologies of photovoltaics and wind power in the four countries. The share of photovoltaics and wind power in gross electricity production in Italy was 13% at the end of 2013. In France, the share was 4%, in Brazil 1%, while in South Africa it was just above zero.

Furthermore, the expansion of photovoltaics and wind power takes place under very different circumstances. Italy and France are among the industrialized countries with a relatively high per capita gross domestic product (GDP) of USD 35,463 and USD 39,328 respectively (at purchasing power parity in 2012) [27]. The per capita GDP of the two developing countries Brazil and South Africa is three times as small: USD 13,049 and USD 15,893 respectively (at purchasing power parity). In Brazil and South Africa, the economy grew by over 3% on average over the last ten years, while economic growth was under 1% in France and in Italy it was even on the decline [28].

The role of tenders in the expansion of (renewable) energy generation capacity also differs considerably from country to country. In Brazil, tenders have been the central element used since 2004 to expand the power plant park [9]. Since 2004, the generation capacities of the different technologies (e.g. hydropower, gas) with a capacity of over 90 GW have been awarded contracts through tenders.[1] When tenders for wind power were introduced in the year 2009, the specific characteristics of this technology were taken into account in the tender design. In South Africa, by contrast, the state electricity supply company Eskom, which generates 96% of South Africa's electricity, was responsible for the expansion of electricity generation capacity [20]. Until the introduction of tenders for renewable energy in the year 2011, independent electricity producers thus played only a minimal role. In South Africa, the instrument of tenders itself is also a regulatory

[1] Own analysis based on [29].

novelty. In Italy and France, tenders are only used for certain technology segments, while other (renewable) technologies have to refinance themselves purely through revenue from the electricity market or can profit from other support schemes. France, for example, uses a feed-in tariff in order to create financial incentives for the installation of small photovoltaic, wind power or hydropower plants [30]. In Italy, small wind plants and wind parks with a capacity of up to 5 MW receive a regulation-based remuneration (feed-in tariff). Incentives for photovoltaic systems are created through tax exemptions, certificates and self-consumption regulations [25].

Table 1 Overview of tenders in Brazil, France, Italy and South Africa

	Brazil	**France**	**Italy**	**South Africa**	**South Africa**
Technology	**Wind power**	**Photovoltaics 100–250 kW**	**Wind power**	**Wind power**	**Photovoltaics ground-mounted**
First auction round	12/2009	01/2012	12/2012	11/2011	11/2011
Auction rounds (until end of 2015)	15	8	3	4	4
Auction rounds with expired completion deadline	8	7	1	2	2
Contracted capacity	14,626 MW	268 MW	1,198 MW	3,357 MW	2,292 MW
Installed capacity before introduction of tenders	606 MW[2]	2,800 MW	8,102 MW	10 MW	67 MW
Support scheme before introduction of tenders	Feed-in tariff	Feed-in tariff	Quota system with tradable green electricity certificates	No instrument	No instrument
Motivation for introduction of tenders	Long-term promotion of wind power expansion	Limiting costs of PV expansion	Limiting annual costs of wind power expansion	Long-term promotion of wind power expansion	Long-term promotion of PV power expansion
Source: Own evaluation based on	[29,31,32]	[31,33–41]	[11,31,42–44]	[20,31,45]	[20,31,45]

[2] Before the introduction of tenders, 1,300 MW was contracted through a feed-in tariff called PROINFA.

3 Rate of completion

3.1 Development of indicators

Tenders allow regulators to actively steer the expansion of renewable energy. In the ideal case, all projects that are awarded a power purchase agreement in the tenders are completed within the deadline; i.e. the on-schedule rate of completion is 100%. In practice, however, delays in project completion can occur, or projects that have received contracts are cancelled during the planning or construction phase.

The data quality with regard to project status differs considerably from country to country. Only in Brazil does the regulatory authority publish the current project status on a monthly basis (see Table **2**). In South Africa, the last time the regulatory authority published such a status report was in April 2016. In Italy and France, no (public) monitoring takes place. For these countries, we have used secondary literature to estimate the current project status.

Table 2 Data availability/quality on project status

Brazil	**France**	**Italy**	**South Africa**
Project status is published monthly by the regulator ANEEL. [46,47]	No monitoring of project status. Only quarterly expansion figures (no connection to auction round) are published by the grid operator ERDF/ENEDIS. See e.g. [48–50].	No monitoring of project status. Only annual expansion figures (no connection to auction round) are published by Italian wind association. See e.g. [51–54]	Project status is published in irregular intervals by the department of energy. See e.g. [55–58] (Last update: 04/2016)

In Fig. **1** we show the current project status for photovoltaics and wind power in the countries Brazil, France, Italy and South Africa. This illustration takes into account all auction rounds with completion deadlines ending before January 2016. This precondition limits the dataset that can be used for this analysis. In Brazil, the completion deadline expired in eight out of fifteen auction rounds, in France in seven out of eight rounds, and Italy in one of three auction rounds and in South Africa in two of four auction rounds.

Fig. **1** shows that both the rates for on-schedule completion (black horizontal line) as well as the expected rates of actual completion without regard for deadline (color-coded) differ considerably among the four countries. A positive example is South Africa where 100% of all awarded photovoltaic and wind projects of the first two auction rounds are completed. However, the on-schedule completion rate is as low as 31% (photovoltaics) and 41% (wind energy).

With regard to on-schedule completion, Brazil represents a negative example, at 14%.[3] Nevertheless, the final rate of completion will likely end up being over 89%. The deadlines of the auction rounds reviewed in Brazil expired between July 2012 and January 2016. The rate of completion of 72% at the time the survey was conducted in April 2016 is significantly higher than the rate of on-schedule completion. In addition, at the time of the survey, some projects were still under construction, so there is a high likelihood that these projects will end up becoming operational. The percentage of contracted capacity that will definitively not be completed is currently at 2%.

In France, the total share of commissioned PV volume in the total volume of awarded PV volume is at around 44% (see Annex C). The available data does not allow any correlation of projects to individual auction rounds, so the rate of on-schedule completion cannot be determined. A reliable estimate of the final rate of completion is not possible, as there are no reliable sources of information on the status of those projects not yet completed.

In Italy, the deadline of one auction round has expired, and 74% of the awarded volume is already in operation. A share of 5% was under construction at the time of survey in February 2016, and 3% of projects were cancelled. The expected rate of final completion is at least 79%. For 19% of the awarded volume (four projects), the current status could not be determined.

Fig. **2** shows the process of implementation for individual auction rounds in Brazil and South Africa. The countries France and Italy could not be incorporated into this analysis, as the dates of commissioning had not (yet) been published. We normed the timeline to allow a better comparison of the auction rounds of the two countries. The zero point corresponds to the time when the winners of the auctions were announced. 100% is the point at which the original completion deadline expired. Fig. **2** also shows the significant differences in delays between South Africa and Brazil. While in South Africa project developers typically exceed the implementation deadline only by a few months, some project developers in Brazil require more than twice as long as is provided for in tender regulations.

Fig. 3 shows the rate of implementation for individual auction rounds, dependent on the number of months since announcement of the winning bids. In contrast to Fig. **2**, the progress in both of the Brazilian auction rounds (from the year 2013) is notable; here, after only 30 months, 51% and 78% of contracted capacity was already operational. Compared to the auction rounds from 2009 to 2012, the implementation periods are significantly shorter.

[3] Held et al., 2014 [13] assumed a much higher on-schedule completion rate of 35% to 60%.

Fig. 1 Project status and rates of completion. Own depiction based on Annex 2, Annex 4, Annex 7, Annex 8 and [29,46,59,60]

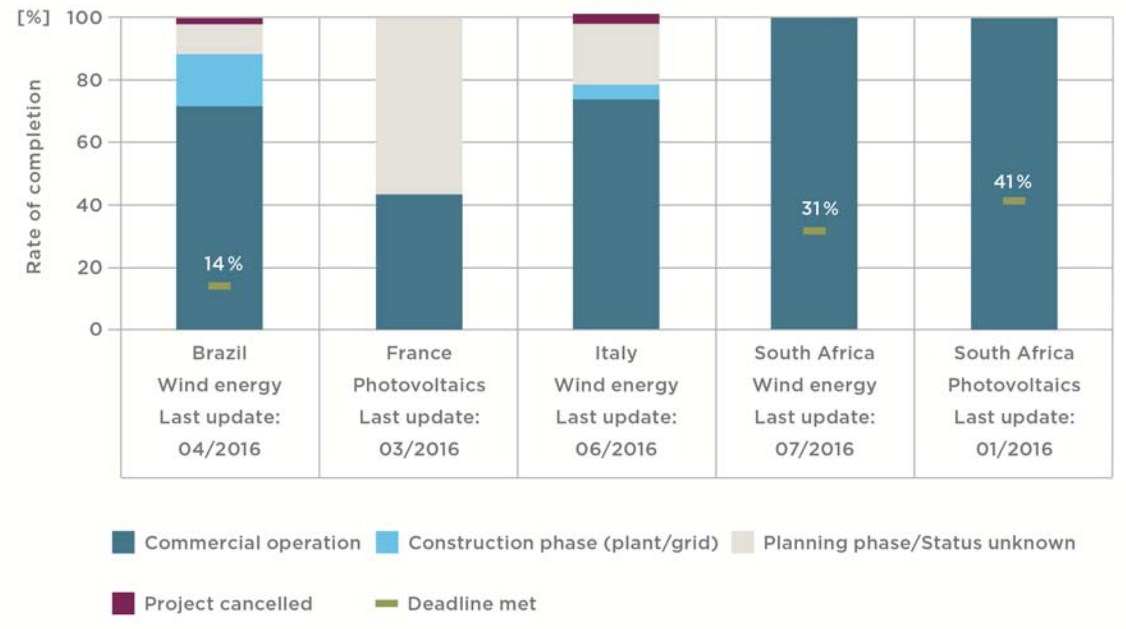


Fig. 2 Rates of completion of individual auction rounds dependent on expiration of completion deadline. Own depiction based on Annex H, Annex I and [29,46]

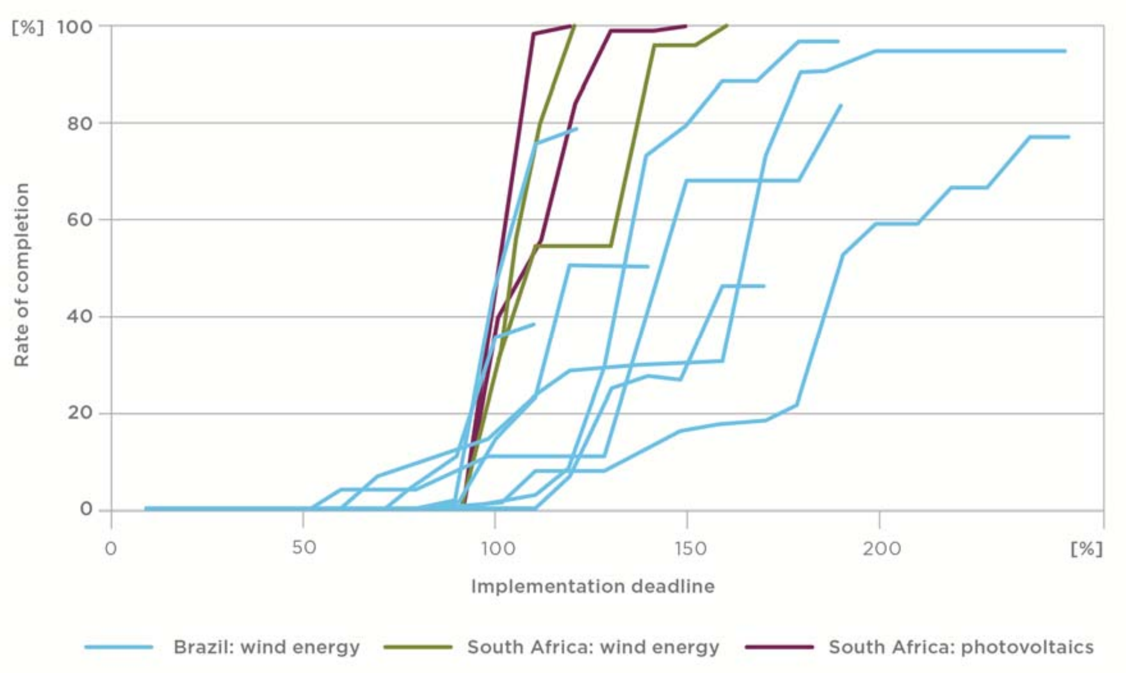
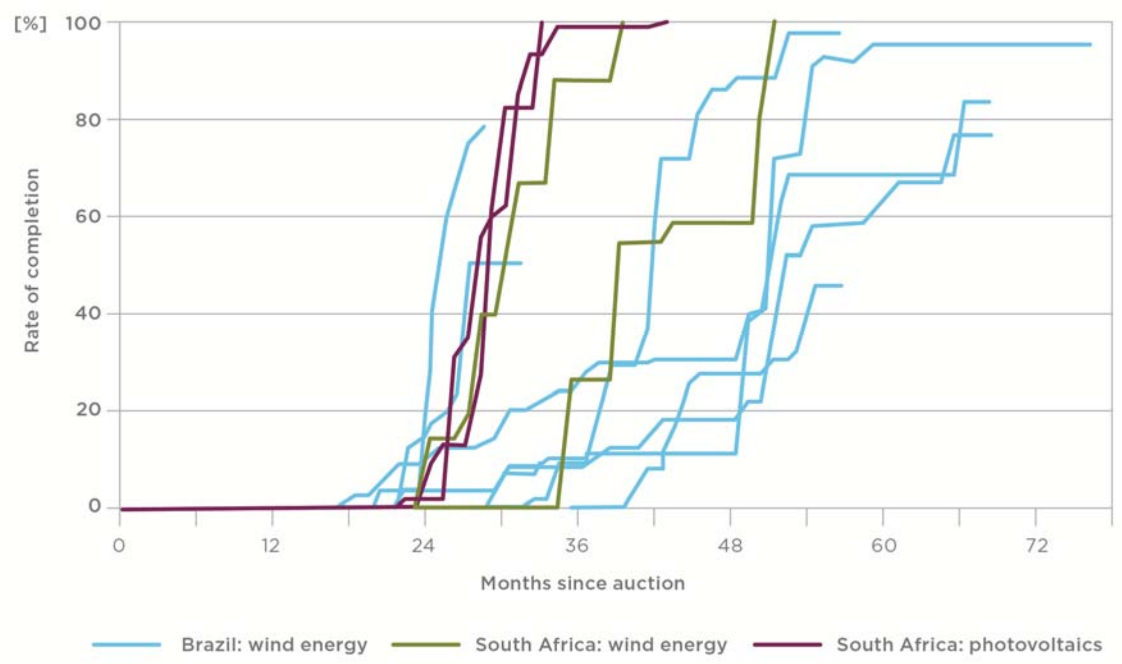


Fig. 3 Rates of completion of individual auction rounds dependent on time period since announcement of winning bid. Own depiction based on Annex H, Annex I and [29,46]



3.2 Project delays differ considerably between countries examined

The significant shortcomings in terms of on-schedule rates of completion (see Fig. **1**) raise the question of the causes of project delays. Table **3** summarizes the reasons for project delays and cancellations; these were determined by way of literature research and expert interviews. While not making any claim to completeness, this list shows the variety of possible factors of influence.

The evaluation in Table **3** indicates that delays in grid connection can be a central cause of project delays in Brazil, France, Italy and South Africa. Currently in Brazil, 30% of capacity awarded that reached the completion deadline was affected by delays in grid connection. However, the evaluation in Fig. 3 shows that the implementation periods for wind power projects in Brazil decreased significantly since the project developer became responsible for the grid connection. In France, the project report of the EU project PV-Legal states that in 2011 (tenders began in 2012), PV projects required between nine and 51 months for completion [61]. Grid connection posed one of the central problems. The successor to the EU project PV-Legal shows that in recent years, this problem has been significantly mitigated; the waiting period for grid connection is now six months at most [62].

In Brazil, environmental feasibility studies are given as another reason for the delayed commissioning of wind power projects [9,63,64]. Also, there are a number of other external factors (not specific to support schemes) that also have an impact on project duration [63]. For example, due to the required local content share, wind power plants were for a time not available in sufficient numbers [2,63]; in other cases, there were delays in the conclusion of financing agreements with the Brazilian

Development Bank BNDES [8,9,63]. Some auction rounds had very short implementation periods of less than three years, which also had an effect on the rate of on-schedule completion [63]. Some project developers have also been affected by the bankruptcy of the Brazilian wind turbine manufacturer IMPSA, and were as a result forced to look for new turbine suppliers [63,65]. In Italy, legal disputes with wind farm opponents or municipalities caused also delays in individual cases [66–68].

From the examples provided it can be concluded that external factors play a central role in the on-schedule rate of completion. However, the reasons for delays and the scope of the individual reasons are country- or project-specific and can differ significantly, even among countries that share a similar technological development status at the time tenders are introduced (such as Brazil and South Africa). Analysis also shows, particularly in the case of Brazil, that the rate of on-schedule completion does not allow reliable conclusions to be drawn about the final rate of completion.

With regard to the support scheme of tenders, the experience gained in South Africa shows that it is fundamentally possible to achieve a relatively precise steering of the expansion of renewable energy, i.e. with individual delays of several months. The experience in Brazil, however, shows that tenders do not automatically bring about a precise steering of expansion, and that a number of different factors can have an influence on the duration of implementation. To what extent the risk of delays can be reduced through tender design, and what implications this has on other political objectives (e.g. keeping support costs as low as possible) must be analyzed on a case-by-case basis.

Table 3 Factors of influence on the rates of completion in Brazil, France, Italy and South Africa

	Factors of influence
Brazil Wind	· Grid connection delayed (30% of all currently delayed projects) [63] · Environmental permits delayed [9,63,64] · Supply of wind power plants restricted by local content requirement [2,63] · Bankruptcy of wind turbine manufacturer IMPSA [63,65] · Delays in financing agreements from BNDES [8,9,63] · Project management shortcomings [9,63] · Short implementation periods of two years [63]
Italy Wind	· Grid connection delayed [69] · Legal disputes [66–68]
South Africa Wind	· Grid connection delayed [70,71] · Harsh wind conditions delays construction work [72]
South Africa Ground-mounted PV	· Delay is typically just a few months.
France PV 100–250 kWp	· Grid connection delayed [61,62]

3.3 Project cancellations for individual reasons, not systematic

For Brazil, several studies expressed the fear that the decreasing auction prices do not reflect the actual costs, and that project cancellations can be expected as a result [9,11,13,16]. The data from the auction rounds with expired completion deadlines suggests that the risk of project cancellation in Brazil has thus far been overestimated. In the first four auction rounds, for example, completion rates of 98% to 100% can be expected, despite falling prices. However, a final assessment of the project cancellations in the first eight auction rounds is not yet possible, as it is in practice not uncommon for wind power plants in Brazil to become operational after delays of up to several years.

Nevertheless, project cancellations do occur in Brazil as well. So far, from the first eight auction rounds (implementation date expired), eight wind power projects with a capacity of 214 MW have been terminated, or the probability of their completion has been classified by the network agency ANEEL as low [63]. This corresponds to 2% of the contracted capacity of those eight auction rounds. This applies in particular to the projects of the project developer Bioenergy [63], which was forced to abandon all of its projects. A media report identifies two reasons for this situation [73]: On the one hand, there was a legal dispute regarding land usage rights with the Spanish project developer Mortifer, as a result of which Bioenergy was not able to secure the financing of its projects. The delays also undermined the plan to complete the wind power plants before the deadline and market the electricity on the spot market until the official start of remuneration payments, which due to the temporary water shortage had promised to generate very high revenues.

In France, information is only available on capacity of those projects (segment 100–250 kWp) that were installed after the introduction of tenders. Accordingly, only 44% of all contracted projects have been implemented to date. Because there is no project-specific monitoring in France, it is not possible to make any conclusive statements about the (final) rate of completion for individual auction rounds. However, grid connection data suggests that a significant percentage of all rooftop system projects in France (which includes the examined segment of 100–250 kWp) are cancelled [74]. In 2011, i.e. before the introduction of tenders, 42% of projects in the rooftop segment with a system size of over 36 kWp were cancelled after a grid connection offer was applied for [74].[4] In 2012, that number was 57%. 49% of all projects were terminated after the network operator had provided an individual offer with the costs of a grid connection [74]. There could also be a causal connection between the project cancellations and the grid connection costs, since those costs, according to [75], are in part very high and could therefore jeopardize the economic viability of individual projects.

[4] To what extent this applies to projects from the tender segment examined (100–250 kWp) is not known.

In Italy, an 18 MW project from the Italian electricity provider ENEL is the only project from the first auction round (implementation deadline expired) known to have been cancelled. The reason, according to media reports, was a legal dispute. ENEL decided to abandon the project after irregularities were discovered in the environmental feasibility studies and the public prosecutor launched an investigation [76].

In South Africa, by contrast, a final completion rate of 100% for wind power and photovoltaics has already been achieved. The rate of completion in South Africa is thus above the expectations of various actors, e.g. [11], who expressed doubt as to the completion of individual projects.

The few known cases of project cancellations to date do not allow a systemization of the reasons for cancellation. So far, other than the case of France, they seem to be exceptions. Legal disputes such as those involving project developers Bioenergy (Brazil) or ENEL (Italy) could arise with any other support scheme and thus prevent the completion of projects. The data in France suggests that the grid connection issue is a specifically French problem. The evaluation therefore shows that although project cancellations do occur, a systematic connection to the instrument of tenders cannot be identified based on the available data.

4 Market concentration

4.1 Development of indicators

The design of support measures is partly responsible for determining which groups of actors participate financially in the expansion of renewable energy. A sufficient number of actors (low market concentration) is a prerequisite for competition, free price formation and, as a result, for the lowest possible auction prices. In the following sections we will analyze how the indicators “cumulative number of owners,” “cumulative market share of the five largest owners”[5] and “balance of supply and demand” have developed in the four countries examined.

The available data on the owners of wind power projects varies according to countries (see Table **4**). Brazil is the only country that publishes comprehensive information on ownership structure and the participating companies. The analyses used the respective majority owner of the project companies as of April 2016.[6] In South Africa the analyses is based primarily on public project presentations to the National Energy Regulator of South Africa (NERSA), which include the respective owners at the time of the auction. In Italy, the owners of the project companies were identified, insofar as possible, through secondary literature. In certain cases, the owners of the project companies could not be identified using publically accessible information. Furthermore, proprietary connections between investors could not be ruled out in South Africa or in Italy, as in these countries detailed ownership structures are not published. As a result, the indicators for the countries Italy and South Africa, in contrast to those for Brazil, must be considered as estimates. For France, the indicators were not calculated, as it is expected that the limited system sizes (100–250 kWp) and the associated high number of winning bids[7] will result in low market concentration.

Table 4 Availability/quality of data on ownership structure

Brazil	**France**	**Italy**	**South Africa**
Database with complete ownership structure of companies currently involved [77].	Names of project companies at the time of auction [34–40].	Names of project companies/owners at the time of auction [42–44].	Names of project companies at the time of auction [45]. Names of major shareholders mostly publicly available.

[5] Cumulative amount across all auction rounds.

[6] The selection methodology is described in detail in [63].

[7] In den first eight auction rounds, between 88 and 218 bids per round won.

Fehler! Verweisquelle konnte nicht gefunden werden. shows how the cumulative number of owners has changed from one auction round to the next. When new actors are successful in the auctions, the number of owners increases. However, if only the existing actors win bids, the number of owners remains constant. The photovoltaic segment in France, which is focused on rooftop installations in residential and commercial buildings, is not included in this diagram due to the high number of owners resulting from the small system size of 100–250 kWp. **Fehler! Verweisquelle konnte nicht gefunden werden.** shows significant differences between the countries studied in the development of the number of owners. For wind power, the number of owners has steadily increased in Brazil and Italy. In Brazil, the number has risen from 16 to 49 owners within 12 rounds. In Italy, the number has risen from 15 to 33 actors within three rounds. In South Africa, the number of owners increased from eight to 16 and in the photovoltaic segment from 13 to 18 actors within four auction rounds. In contrast to Brazil and Italy, the number of majority owners in South Africa has increased only very slowly for wind and not at all for PV in the last round of auctions.

Fig. 5 shows the development of the cumulative market share of the five largest owners, although the composition of these groups can shift from one auction round to the next. There are differences between countries with regard to both the shares of the five largest owners and the qualitative development of this indicator. In Brazil, the share of the five largest owners decreased within seven rounds from 60% to 31%, before there was an increase to 37%. The market concentration remained steady at this level over the last three auction rounds that were analyzed. In South Africa, the indicator for both technologies fell from the first to the second auction round before rising slightly to (almost) 70%. The current share of the five largest actors in South Africa is thus higher than that in Brazil or Italy. In Italy, the share of the five largest actors fell within three auction rounds from 58% to 33%.

Fig. 4 Development of cumulative number of owners. Own depiction based on Annex **F**, Annex H, Annex I and [29,77].

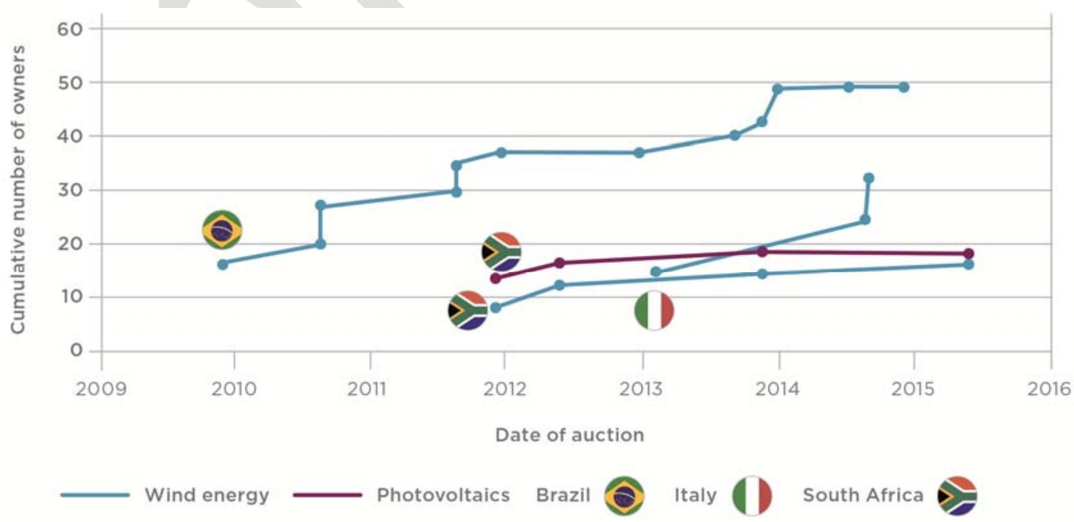


Fig. 5 Development of cumulative market share of the five largest owners. Own depiction based on Annex **F**, Annex H, Annex I and [29,77].

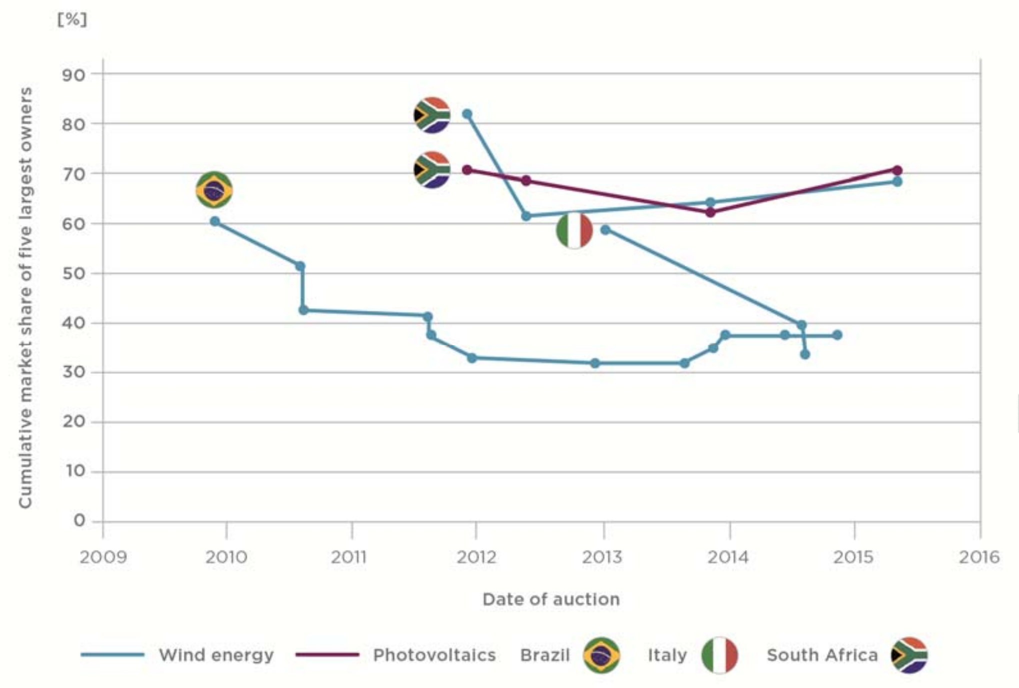


Fig. **6** shows the proportion of offered capacity to awarded capacity for every auction round. In South Africa, in contrast to Brazil, France and Italy, there is no publication of the technology-specific capacity offered. For this reason we have calculated the indicator based on the offered and awarded capacity of renewable energy sources.[8] In Brazil, the pre-qualified capacity in all auction rounds is at least five times bigger than the awarded capacity. The two outliers, with a proportion of over 40, are a result of the relatively small amount of awarded capacity in the relevant auction rounds. In South Africa, the proportion of capacity offered to capacity awarded is increasing steadily with exception of the fourth round. The increase in the first three auction rounds is attributable to a tripling of the volume offered, while the decrease in the fourth auction round is attributable to awarding twice as much bids as originally planned. In Italy, the capacity offered increases in the first three auction rounds. At the same time, the awarded capacity is decreasing, so that the proportion of supply and demand is gradually increasing to 3.5. In France, the proportion of capacity offered to capacity awarded has increased from 1.5 to 4.7. In all four countries, an upward trend can thus be identified.

[8] In South Africa, tenders were carried out for different renewable energy technologies in the four auction rounds. In addition to wind power and photovoltaics, the tenders also auctioned capacity for hydropower, biomass, biogas, CSP and mine gas. Photovoltaics and wind power, however, made up between 83% and 97% of the awarded capacity in the four auction rounds.

Fig. 6 Proportion of pre-qualified or offered capacity to awarded capacity. Own depiction based on Annex C and [20,34–40,78–93]

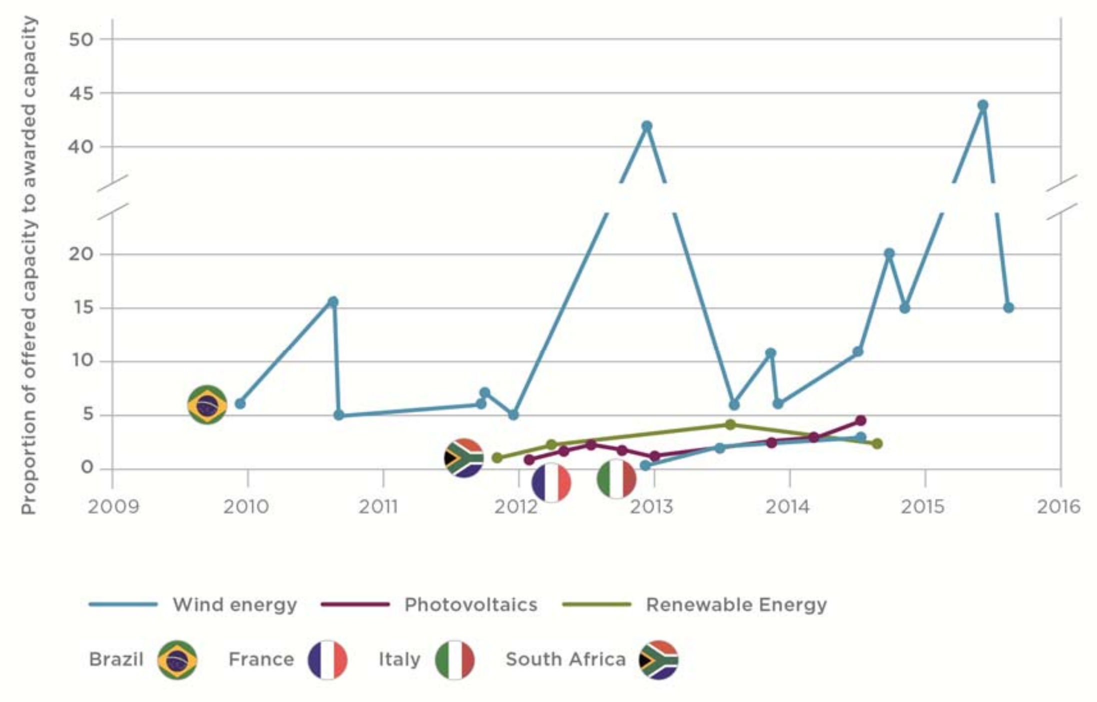


Table **5** compares the number of actors who own wind power plants with a total capacity of up to 50 MW, by country. Only those wind farms were taken into consideration which were awarded a power purchase agreement in the tenders. Wind farms that were financed through other support schemes (e.g. feed-in tariffs) are not included in this table. Brazil and South Africa are characterized by the fact that only a relatively small number of the winning actors own wind power plants with a total capacity of less than 50 MW. In Italy, by contrast, 24 out of 33 actors have a cumulative capacity of less than 50 MW. In the case of Italy, it is not possible to determine whether these are small actors or not, as a majority of the capacity already installed was in place before the introduction of tenders. Random samplings have shown that the companies in question were also previously active in the Italian wind market and, as a result, that they own a larger capacity in total.

Table 5 Number of small actors and average capacity of the five smallest actors. Own depiction based on Annex **F**, Annex H, Annex I and [29,77]

		Brazil	South Africa	Italy	South Africa
		Wind	Wind	Wind	PV
Number of actors with a cumulative capacity from tenders	≤ 10 MW	0	0	1	2
	≤ 20 MW	0	0	11	3
	≤ 30 MW	3	1	16	6
	≤ 40 MW	5	2	19	7
	≤ 50 MW	7	2	24	7
Total number of actors with winning bids		51	16	33	18

4.2 Sufficient competition for free price formation

In Brazil and Italy, three of the indicators employed – "cumulative number of owners," "cumulative market share of the five largest owners" and "proportion of capacity offered to capacity awarded" – suggest that there is functioning competition and free price formation. The capacity offered is many times higher than the capacity awarded. Moreover, the proportion has been increasing slightly over time. The cumulative market share of the five largest owners has been declining or has remained constant over the last auction rounds, while the number of owners has gradually increased. In Italy, there is also evidence that the market share of the largest owners has not increased as a result of the introduction of tenders. According to 2015 data by [53], the market share of the five largest operators at the time of commissioning before introduction of tenders was 39%.[9] The market share of the five largest owners for the capacity awarded through tenders is at 33%.

In the wind segment in South Africa, the indicators are at first glance somewhat ambiguous. On the one hand, the proportion of capacity offered to capacity awarded increased from 2 to 4 and declined thereafter to 3. On the other hand, the market share of the five largest owners is consistently over 60% and increased in the fourth auction round to 70%. However, an analysis of the winning bidders in the wind power segment shows that only four of the 15 winning bidders were successful in more than one auction round, and furthermore that only one bidder was successful three times. There is therefore no indication of a dominance of individual companies. On the whole, we can conclude that in the South African wind power segment as well, there is sufficient competition as to enable free

[9] The list by ANEV [53] also includes project companies, so it cannot be ruled out that individual project companies are among the five largest operators. There is no better source of data available for Italy. IEA Wind, for example, apparently uses the same source of data (see [94]). According to the 2013 annual report, the market share of the ten largest operators is 54%. However, no source is cited. According to data from [53], the market share of the five largest actors is nearly identical, at 53.3%.

price formation. In the photovoltaic segment, the situation is similar to that in the wind segment, so that the overall picture provided by the indicators is also one of a functioning competitive system. This conclusion is notable because, prior to the introduction of tenders for renewable energy, the state energy provider Eskom generated 96% of the country's electricity, which meant that the role of independent electricity producers was minimal [20].

The position paper of the German Wind Energy Association emphasizes that there has been a narrowing of the market in South Africa, with eight successful bidders in the first auction round and only four in the second round [95]. The number of successful bidders per auction round, however, is not sufficient to identify a market concentration. Instead, in the second auction round, four bidders won who were not awarded contracts in the first auction round. This means that after round two, twelve instead of eight actors were active in the South African wind market, and the cumulative market share of the five largest owners fell from 82% to 62%.

In summary it can be concluded that the markets in the countries examined show differing degrees of market concentration. Nevertheless, the indicators suggest that there is sufficient competition in these markets to enable free price formation.

4.3 Only few small actors

How has the instrument of tenders affected the participation of small actors? In South Africa, it is not possible to make a conclusive statement on this question, as before the introduction of tenders no notable expansion of photovoltaics and wind power had taken place.

In Brazil, on the other hand, there was already a support scheme for wind power in place entitled PROINFA, which had the general characteristic of a feed-in tariff. Altogether, this program funded some 1,300 MW of wind power. Twelve companies became eligible for funding for their wind farms (see Annex A). As with tenders, a notable participation of small actors in this segment did not come about. This is an indication that there are many more factors in addition to the support scheme which can influence the market entry of small actors.

In Italy, before the introduction of tenders, there was a quota system with tradable green electricity certificates, which played a central role in expanding Italy's volume of installed wind capacity to 9 GW by the end of 2015 [96,97]. However, the lack of a databank on ownership structures in Italy (as exists in Brazil, for example) means that there is an insufficient basis of data that could be used to compare ownership structures before and after the introduction of tenders. Only the Italian Wind Energy Association ANEV publishes an annual report that lists the operators at the time of commissioning [51–53]. However, not only is this list incomplete,[10] it also contains project companies whose owners cannot be definitively identified and verified using publically available data. As a result, it is not possible to make quantitative statements regarding the number of small actors before and after the introduction of tenders.

In the case of France, we did not carry out any analyses because a large number of owners can be expected due to the tender segment of 100–250 kW.[11] A detailed verification of the ownership structure cannot be carried out using publically available data.

For small projects, South Africa and Italy also offer additional support measures. In Italy there is a support program in place for projects between 60 kW and 5 MW in size. Projects in this segment are eligible to receive an administratively determined remuneration upon successful registration [26,94]. The eligible capacity, however, is restricted to 60 MW. In practice, this segment is only relevant for small-scale wind projects. 59% of projects are smaller than 500 kW, and 99% of projects are smaller than 1 MW (see Annex G).

The analyses conducted do not allow any conclusive statements as to whether and to what degree the instrument of tenders contributes to the fact that small actors do not play a relevant role in Brazil and South Africa. This would require further country-specific analyses. The role of small actors can be influenced both by the tender design (see for example [98]) as well as by external factors (see for example [99,100]). The significant external factors include planning law, which determines the complexity and the costs of the pre-development phase, or cultural factors such as cooperative-based or energy policy activity. In addition, there is a wide range of literature on non-economic barriers to the expansion of renewables`(see for example [101–103]). These barriers could have a particularly significant impact on the participation of risk-averse, small actors.

In summary it can be concluded that small actors play a negligible role in tenders in the countries Brazil and South Africa. In Italy, the question cannot be conclusively answered due to the lack of data on ownership structures before the introduction of tenders. The question as to what degree the support measure of tenders is a contributing factor to this situation is not the focus of this study.

[10] Small companies/project developers are subsumed under the category “Altri”.

[11] In France, the bidder is published. Due to the relatively small project size of 100–250 kW, it seems plausible that the project developer is active in the bidding process for the later owner.

5 Auction prices

5.1 Development of indicators

The remuneration rates for electricity from photovoltaics and wind power are determined through tenders. Together with the awarded and installed capacity, the auction prices determine the costs that electricity customers or taxpayers have to pay for the expansion of renewables. This is why the absolute level and the development of the auction prices are of great political significance.

The auction prices are depicted for Brazil and Italy as capacity-weighted average values. In France and South Africa, the simple average value is used, as the individual bids of the awarded projects are not published by the regulatory authority (see Table 6).

Table 6 Availability/quality of data on auction prices. All countries use pay as bid procedure.

Brazil	France	Italy	South Africa
Project-specific bids of each winning project (nominal prices) [29].	Unweighted average value of all projects awarded (nominal prices) [34–40].	Project-specific bids of each project awarded (nominal prices) [42–44].	Unweighted average value of all projects awarded in rounds 1 & 2 and project-specific bids of each project awarded in rounds 3 & 4 (indexed prices) [91,93,104]. Nominal prices are published in secondary literature [105].

Fig. 7 shows the relative development of inflation-adjusted auction prices in the countries Brazil, France, Italy and South Africa. The auction prices were normed for this diagram in order to illustrate the relative changes over time in the local currency and to enable the comparability of the countries. The auction price reached in the first auction round serves as the reference value for the subsequent auction rounds. Fig. 8 show the absolute development of auction prices. The auction prices in this diagram have been converted and US dollars.

In France, Italy and South Africa, the prices have been falling steadily from the first to the last auction rounds. In Brazil, the auction prices have also been falling in the first auction rounds. Starting in round eight, however, prices increased again. The increase is dependent on the currency selected and is greatest in the inflation-adjusted view in local currency (see Fig. 7). In US dollars, although a price increase can be identified starting in round eight, the auction price remains relatively constant, between 50 and 60 USD/MWh (see Fig. 8). The exchange rate thus has a significant influence on the relative development of the auction prices.

Fig. 8 also shows that the absolute level of the auction prices varies greatly between the countries. For example, the auction prices for wind power in Brazil are between 52 and 82 USD/MWh, in Italy between 124 and 156 USD/MWh and in South Africa between 58 and 140 USD/MWh. For wind power, the auction prices have fallen most significantly in South Africa and are by now at the level of prices in Brazil. It is also notable that the price increase in Brazil occurred while prices in Italy and South Africa continued to fall.

Fig. 7 Relative development of auction prices (adjusted for inflation). Own analysis and depiction based on Annex AFehler! Verweisquelle konnte nicht gefunden werden.

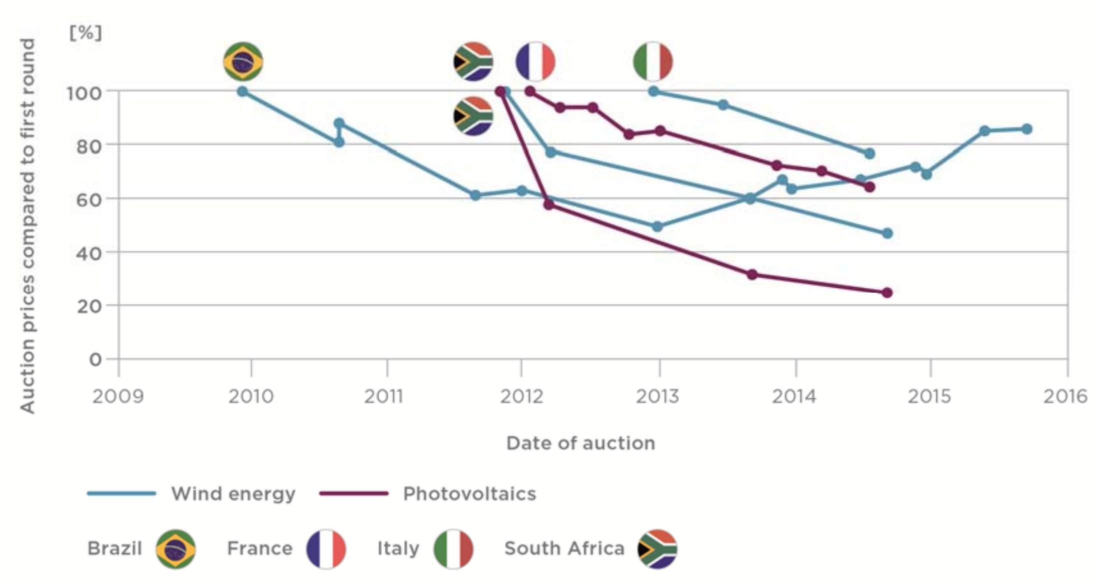
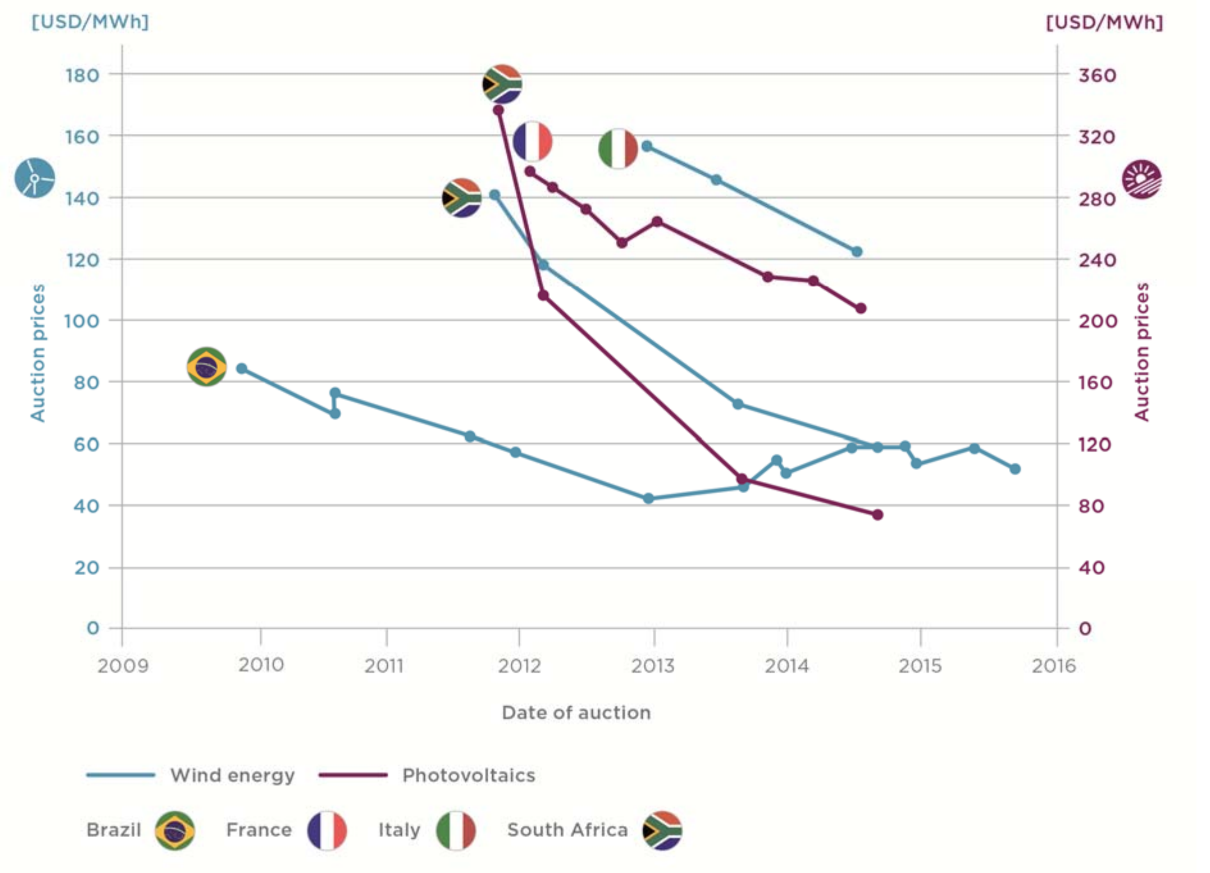


Fig. 8 Absolute development of auction prices in USD/MWh (exchange rate: month of auction). Own analysis and depiction based on Annex A**Fehler! Verweisquelle konnte nicht gefunden werden.**



5.2 Causes of auction price development

In all four countries examined, auction prices declined over time, with the exception of the Brazilian auction rounds between 2012 and 2015. One important cause of the declines in prices for photovoltaic projects was the global price drops for PV modules[12] [106]. The price development for wind turbines since 2011, however, is ambiguous [106]. For example, the price index for wind turbines in China and the price index for wind turbines in the United States (wind farm size 5-100 MW) remained virtually constant. The wind turbine price index published by Bloomberg Finance, however, shows a falling trend. In South Africa, experts expressly pointed out the falling costs for renewable energy systems [20]. In Brazil, they pointed out the high degree of competition among turbine manufacturers during the first years, which might have also led to low system costs [63]. Increasing competition (Brazil from 2009 to 2012, South Africa, Italy) and learning effects (Brazil from 2009 to 2012, South Africa) have, according to various actors in the respective energy sector, contributed significantly to falling auction prices [20,63,69,107]. In addition, the overall falling interest rate in the eurozone [108] likely contributed to a decline in capital costs in France and Italy. In Brazil, the lowering of the Brazilian prime interest rate in the period between 2009 and end of 2012 may have also encouraged the decline in auction prices. This view suggests that the development of the prime interest rate has a direct influence on the weighted average cost of capital (WACC). In addition to the overall interest rate, the WACC is also principally dependent on the risks perceived by capital providers. The effects of the risks on the WACC in Europe are analyzed for example by [109]. However, there is no public data available on the development of the WACC for wind and PV projects in the countries examined. Table **7** summarizes additional factors that have an influence on the auction prices.

The causes of the intensification of competition are partly country-specific. In Brazil, with the introduction of tenders, wind power became an integral component of the future expansion mix of renewable energy (alongside hydropower and biomass). Tenders were introduced during the global financial crisis. Since Brazil was less impacted by the crisis than other countries, it became a relatively interesting market for wind power. Many international project developers, investors and wind turbine manufacturers located to Brazil [63]. In Italy, the introduction of tenders was accompanied by a capping of annual expansion to 500 MW [69]. That amounts to half of the annual expansion until then. In addition, there was a certain degree of uncertainty following the 2014 auction round, as the ordinance for subsequent auction rounds was subject to delays. The relatively intense competition in the 2014 auction round may thus have been influenced by a pull-forward effect. In Italy, the price

[12] Annex J depicts the cost degression for photovoltaic modules together with the development of auction prices.

reduction may therefore be attributable to the heightened level of competition between established providers and a concentration on the premium locations.

But how can the increase in the Brazilian auction prices as of the eighth round in August 2013 be explained? An important regulatory change with implications for prices took place with the transfer of responsibility for the grid connection, including the associated risks and costs, to the project developer [9,63,110]. At the same time, the accelerated devaluation of the Brazilian real versus the US dollar and the euro drove the price of import components up and thus increased costs and prices [63,111,112]. There were, however, no indications of a price-driving market concentration. In the phase of increasing prices in Brazil, the total number of owners continued to grow. The market share of the five largest actors remained constant. The pre-qualified capacity in the respective auction rounds was many times higher than the awarded capacity. It can therefore be assumed that there were enough actors represented on the market to ensure intensive competition and free price formation.

How can these findings be interpreted? On the one hand, the support scheme influences the costs for project developers, for example through the allocation of risks. On the other hand, the support scheme determines to what degree the cost changes – regardless of whether they are caused by the scheme itself or by external factors – influence the prices and remuneration rates. The effects of the support scheme on the costs cannot be assessed using the data examined in this study. However, the time series of the auction prices in conjunction with statements by experts suggest that the transfer of cost changes to auction prices using the instrument of tenders works well. The decreasing costs for project developers are reflected in falling auction prices. The price increase in Brazil between 2012 and 2015 is another indication that the transfer of cost increase to price increase through tenders is taking place without significant delays.

Especially in the early market phase with significant cost degression, tenders make it possible for remuneration rates to react rapidly to falling costs. Both in Brazil and in South Africa, this effect is likely to have been influential in the early phase of tenders. In both countries, tenders were introduced at a time when the national wind power market was not yet very developed. Before the introduction of tenders, Brazil had an installed wind capacity of only 606 MW (8,715 MW at the end of 2015) and South Africa only a modest 67 MW (1,053 MW at the end of 2015) [31,97].

Table 7 Characteristics of the specific tenders and external factors with an influence on auction prices.

	Characteristics of the specific tenders	External factors
Brazil wind	↑ Responsibility for grid connection devolved from grid operators to project developers [9,63]. ↑ Local content requirements increase (BNDES) [63,113]. ↑ BNDES raises interest rate [63]. ↑ Revenue is coupled to p90[13] forecast (instead of p50) [9,63]. ↑ Penalty fees if actual generation remains below forecast [9,63].	↓ Increasing competition through appeal of Brazilian market (global financial crisis) [16,63] ↓ Overall learning effects [32,63] ↑ Stronger devaluation of real vs. USD and euro, import components become more expensive [63,111]. ↑ Prime interest rate rises [63,114].
Italy wind	↓ Demand-side restriction: Annual growth target reduced by half [69]. ↓ Delays in tender ordinance for the years 2015 and 2016 increased supply in 2014 [69].	
South Africa wind	No price influencing changes known.	↓ Increasing competition [20,107] ↓ Overall learning effects [20] ↓ Declining costs for wind turbines [20]
South Africa Ground-mounted photovoltaics	No price influencing changes known.	↓ Increasing competition [20,107] ↓ Overall learning effects [20] ↓ Falling costs for PV modules [20] (see also Annex J)
France PV 100–250 kW	↑ CO_2 balance of PV components was added to bid price as selection criteria [41].	↓ Falling costs for PV modules (see Annex J) ↓ Increasing competition (see Fig. **6**)

[13] The probability that the generation forecast is met or exceeded is 90%.

5.3 An insufficient indicator to show minimization of costs of support

In tenders for the expansion of renewable energy, only those project developers receive power purchase agreements (PPA) who offer the lowest remuneration rates (e.g. in EUR/MWh) for future electricity feed-in. For the project developers, the remuneration rates offered are composed of, in simplified terms, the sum of expected costs (including risk markups) and the desired returns, divided by the expected electricity generation. The competition associated with tenders is meant to create cost pressure and lower the bidders' expectations with regard to returns. This is supposed to ensure that the expansion of renewable energy takes place with support costs kept to a minimum.

Revenue and costs are dependent on the specific design of tenders, e.g. pre-qualification requirements or allocation of responsibility and contractual penalties. In the four countries examined, there are differences in the following revenue- and cost-relevant factors:

- Deadlines: Which deadlines must be met?
- Remuneration over time: Does the project developer or the consumer/state assume the inflation risk?
- Remuneration logic: Is the capacity (MW) or the generation (MWh) remunerated?
- Penalties for deviations from forecast: Are penalties imposed for over- or under-supply?
- Penalties for delay and cancellation: How high are the penalties? How high is the risk that projects must be cancelled? Are there exceptions for force majeure?
- Responsibility for grid connection: Who carries the responsibility (and the associated costs and risks) for the grid connection? Do producers (alongside consumers) have to pay network charges?
- Technological requirements: What is the required local content for the manufacturing of wind power plants? How high is the risk of system failures due to specific environmental circumstances?

In addition, various external factors have a significant influence on the revenue and cost situation, and are at the same time country-specific:

- Wind potential: How many full load hours can be achieved? What is the previous wind forecast rating for the particular location?
- Financing: Does the local development bank offer favorable financing conditions? How high is the country's typical interest rate for debt capital and equity capital?
- Risks for externally caused delays: How high is the risk that the environmental feasibility study for the grid connection will take significantly longer than planned? How high is the risk of legal disputes arising?
- Infrastructure: What are the regulations for transport of heavy loads? Are additional investments in infrastructure necessary?
- Learning curve: How advanced is the industrial development of the respective technology in the particular country?

The project developers have to take the (variable) country-specific factors into account in their cost and revenues estimates. Comparisons of support costs based on auction prices would only be possible if these factors did not differ between the countries. In practice, of course, this is not the case. The differences in auction prices between countries are attributable to a multitude of factors. It is thus not possible to draw a conclusion regarding the capacity of the country-specific financing instrument to minimize support costs on the basis of auction prices alone. Instead, an additional detailed cost analysis would need to be conducted.

In order to compare the characteristics of financing instruments in minimizing the cost of support, the relevant literature utilizes, in addition to the auction prices (remuneration per energy unit), also the Remuneration Level Indicator (RLI) or the Remuneration Adequacy Indicator (RAI) [115]. The RLI takes into account the wind potential and discount rate in order to improve the comparability of returns (Table 8). The inclusion of these factors, however, is not possible without using estimates and forecasts – as is the case with all future-oriented calculations (data uncertainty). The RAI builds on the RLI and compares the revenues with a generic cost estimate. The country-specific cost differences, however, are also not taken into account with these indicators (see e.g. [103]). The RAI is, compared to auction prices, a better (but also not an optimal) indicator for the capability of the support scheme to minimize the support costs. However, good cost estimates (a component of the RAI) require large amounts of data, also because access to company cost information is often difficult. This could be one reason why in previous studies generic cost estimates have been used.

Table 8 Indicators to measure the minimization of support costs. Own depiction based on [115].

Indicator	**Additional assumptions**
Remuneration per energy unit	none
Remuneration Level Indicator	e.g. wind potential, discount rate
Remuneration Adequacy Indicator	e.g. wind potential, discount rate, investment costs (generic), O&M costs (generic)

6 Conclusion

The objective of this study is to present an up-to-date comparison of key results of tenders in Brazil, France, Italy and South Africa, and to discuss in qualitative terms the developments observed as well as their causes. For this purpose, we analyzed and compared the indicators rates of completion, market concentration, market participation of small actors and auction prices for Brazil, France, Italy and South Africa in their development over time. The following conclusions can be drawn from the results described:

1. Although rates of completion of 100% can be empirically confirmed for South Africa, they are in most cases not attained on-schedule. On-schedule completion rates range between 14% in Brazil and 41% in South Africa (wind). The analysis indicates that delays are frequently attributable to facts that lie outside of the support measure of tenders.

2. Data suggests that there are individual reasons for project cancellations. One exception is France, where there may be a connection to the grid connection regulations. A systematic connection between project cancellations and the instrument of tenders cannot be identified based on the available data.

3. In none of the countries examined is the market concentration so high that free price formation is restricted or that market power presents a problem. Since experience in Italy and South Africa is based on a very short time period, it is advisable to continue to monitor the market concentration in those countries.

4. Small actors are not common, or their share cannot be identified due to lack of disclosure obligations. Brazil and South Africa are not suitable cases to answer the question of whether tenders impede the participation of small actors, as in these countries small actors have never had a role in the promotion of renewables. Italy is the only country that could provide interesting insight with regard to this question. However, since in Italy there are no disclosure obligations regarding ownership structures, a relevant estimate would require considerable effort in terms of data collection.

5. Auction prices are highly dependent upon factors outside of the support scheme of tenders, as well as upon individual regulations in the design of the support measure, which often vary considerably from one country to the next. For this reason, auction prices alone are not a suitable indicator to determine whether tenders lead to lower support costs.

6. The availability of data on the implementation status of winning projects and the ownership structure of project companies is problematic for the assessment of the instrument of tenders. With regard to disclosure obligations, Brazil is a positive example, collecting information on project status, for example, on a monthly basis, and maintaining a detailed databank on ownership structures. For a country like Germany, which has formulated the expressed goal of

maintaining a diversity of actors, this example could be a useful approach with regard to verifying target attainment.

7. Despite the quite broad deployment, tenders are still a relatively new instrument in the promotion of renewable energy. For this reason, the indicators examined in this study and the conclusions reached constitute interim findings. Based on the relatively low number of auction rounds in Italy or South Africa, transition effects could also play a role. In Brazil, due to the long delays in project completion, conclusive statements are often not possible. For this reason, it will be necessary to conduct on-going monitoring of the Instrument of tenders in order to be able to assess the practical effects of the instrument at an early stage.

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Annex

Annex A Auction prices

The tables A.1, A.2, A.3, A.4 and A.5 show the auction prices for wind energy in Brasil, photovoltaics, in France, wind energy in italy and photovoltaics and wind energy in South Africa. The country specific consumer price index was used to calculate the inflation adjusted prices.

Table A.1 Auction prices for wind energy in Brasil. Own analyses based on [29,116,117].

Auction date	Nominal BRL/MWh	Inflation adjusted BRL/MWh	USD/MWh	Consumer price index	Exchange rate USD
14.12.2009	148	214	84	3018	0,57
25.08.2010	123	172	70	3112	0,57
26.08.2010	134	187	76	3112	0,57
17.08.2011	99	130	62	3337	0,63
18.08.2011	100	130	62	3337	0,63
20.12.2011	105	134	58	3404	0,54
14.12.2012	88	106	42	3602	0,48
23.08.2013	111	129	47	3726	0,43
18.11.2013	124	143	54	3781	0,44
13.12.2013	119	136	51	3815	0,43
06.06.2014	130	143	58	3958	0,45
31.10.2014	142	154	58	4008	0,41
28.11.2014	136	147	53	4028	0,39
27.04.2015	177	182	58	4245	0,33
21.08.2015	181	181	52	4347	0,29

Table A.2 Auction prices for photovoltaics in France. Own analyses based on [34–40,116,118].

Auction date	Nominal EUR/MWh	Inflation adjusted EUR/MWh	USD/MWh	Consumer price index	Exchange rate USD
20.01.2012	229	236	295	97,0	1,29
31.03.2012	218	222	288	98,4	1,32
30.06.2012	220	224	274	98,6	1,25
30.09.2012	194	197	250	98,5	1,29
31.12.2012	200	203	263	98,9	1,31
31.10.2013	168	170	230	99,4	1,36
28.02.2014	165	166	226	99,7	1,37
30.06.2014	153	153	208	100,2	1,36

Table A.3 Auction prices for wind energy in Italy. Own analyses based on [42–44,116,118–120].

Auction date	Nominal EUR/MWh	Inflation adjusted EUR/MWh	USD/MWh	Consumer price index	Exchange rate USD
06.12.2012	117	118	156	99,9	1,33
10.06.2013	112	113	148	100,5	1,32
26.06.2014	91	91	124	100,8	1,36

Table A.4 Auction prices for wind energy in South Africa. Own analyses based on [105,116,121].

Auction date	Nominal ZAR/MWh	Inflation adjusted ZAR/MWh	USD/MWh	Consumer price index	Exchange rate USD
04.11.2011	1.140	1.339	140	94,5	0,12
05.03.2012	900	1.032	118	96,8	0,13
19.08.2013	740	788	73	104,3	0,10
18.08.2014	620	620	58	111	0,09

Table A.5 Auction prices for photovoltaics in South Africa. Own analyses based on [105,116,121].

Auction date	Nominal ZAR/MWh	Inflation adjusted ZAR/MWh	USD/MWh	Consumer price index	Exchange rate USD
04.11.2011	2.760	3.242	338	94,5	0,12
05.03.2012	1.650	1.892	217	96,8	0,13
19.08.2013	990	1.054	98	104,3	0,10
18.08.2014	790	790	74	111,0	0,09

Annex B – Brazil: Actor structure PROINFA

PROINFA is the name of the feed-in tariff legislation for wind power that was in effect before the introduction of tenders. Altogether, 1,300 MW of power capacity was funded through PROINFA. Table B.1 lists the companies that installed wind power plants within the framework of PROINFA.

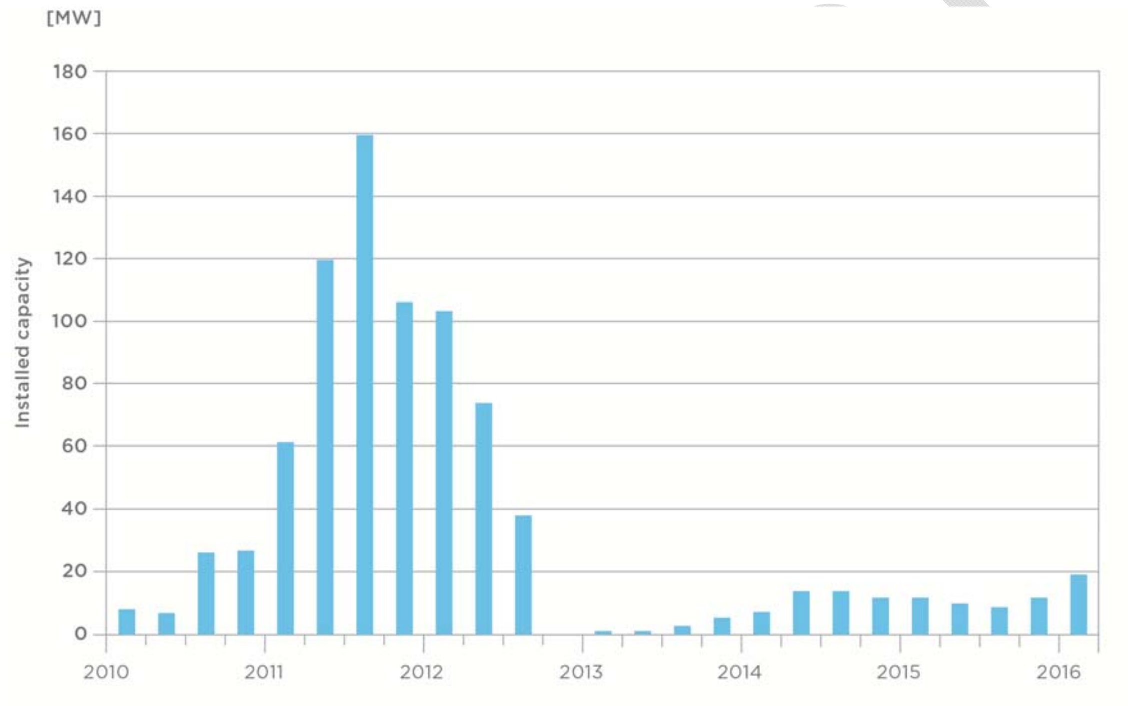
Table B.1 Actor structure PROINFA. Own analyses based on [29,77,122]

Company	PROINFA [MW]	Tenders [MW]	Total [MW]
Omega Energia Renovável S.A.	28	136	164
Cedin do Brasil S.A.	6	0	6
CPFL Energias Renováveis S.A.	425	691	1,116
EDP Renováveis Brasil S.A.	79	236	315
Elecnor S.A.	108	373	481
ENERGIMP S.A	322	331	653
IBERDROLA S.A.	49	432	481
Multiner S.A.	152	0	152
Pacific Hydro International Pty Ltda.	58	0	58
Queiroz Galvão S/A	5	122	126
Tractebel Energia S/A	44	274	317
Gestamp Eólica SL	25	377	402

Annex C – France: Status of photovoltaic projects

Fig. C.1 shows the photovoltaic installations of the analyzed tender segment 100–250 kWp. For the calculation of the rate of completion, we have assumed that all installations as of the year 2013 were awarded a contract in the tenders. The installed capacity as of the year 2013 amounts to 117 MW. The contracted capacity in the tenders amounts to 268 MW.

Fig. C.1 Photovoltaic installations in the segment 100–250 kWp. Own analysis based on [48–50,123]



Annex D – France: Offered and awarded capacity

Table D.1 Offered and awarded capacity. Source: Own analysis based on [34–40]

Date of auction	Capacity offered	Capacity awarded	Proportion of capacity offered to capacity awarded
20.01.2012	68	45	1,5
31.03.2012	47	21	2,2
30.06.2012	53	19	2,9
30.09.2012	81	31	2,6
31.12.2012	54	30	1,8
31.10.2013	124	40	3,1
28.02.2014	144	41	3,5
30.06.2014	189	41	4,7

Annex E – Italy: Status of wind power projects

We determined the status of winning projects initially through Internet research. Both project planners and local press report on the completion of wind power projects. In a second step, we contacted project planners, local authorities and the Italian renewable energy agency "Gestore dei Sistemi Energetici" to clarify the status of projects not yet determined. For projects in Table 4 showing the status "unknown", authorities also do not have any information on the project status. In this way we can rule out the possibility that these projects are in operation or under construction.

Table E.1 Status of wind power projects in Italy

Round	Number of bids	Company	Capacity [MW]	Status	Source for status
1	FER000681	EDP RENEWABLES ITALIA SRL	14	Commercial operation	[124]
1	FER000678	EDP RENEWABLES ITALIA SRL	16	Commercial operation	[124]
1	FER000490	GAMESA ENERGIA ITALIA SPA	16	Status unknown	
1	FER000581	ELETTRO SANNIO WIND 2 SRL	10	Commercial operation	[125]
1	FER000765	EDP RENEWABLES ITALIA SRL	10	Commercial operation	[126]
1	FER000811	C&C OPPIDO LUCANO SRL	20	Construction phase	[127]
1	FER001115	LATERZA WIND 2 SRL	12	Commercial operation	[128]
1	FER000672	PONTE ALBANITO SRL	27	Commercial operation	[129]
1	FER001186	BREATHE ENERGIA IN MOVIMENTO S.R.L.	51	Commercial operation	[130]
1	FER000868	E-VENTO CIRO' SRL	30	Status unknown	
1	FER000743	ALFA WIND SRL	30	Commercial operation	[131]
1	FER000688	ANDALI ENERGIA	36	In planning phase	[132]
1	FER001145	EOLSIPONTO SRL	17	Commercial operation	[133]
1	FER000411	FRI-EL SAN CANIO SRL	24	Commercial operation	[134]
1	FER000800	NUOVA ENERGIA SRL	72	Commercial operation	[135]
1	FER000540	ENEL GREEN POWER SPA	12	Project cancelled	[76]
1	FER000721	SAVA ENERGIA SRL	10	Commercial operation	[136]
1	FER000643	ERG EOLICA BASILICATA S.R.L.	34	Commercial operation	[137]

Annex F – Italy: Owners of winning projects

In Italy, the state-run renewable energy agency “Gestore dei Sistemi Energetici” carries out the tenders and announces the winning bidders. In many cases, the winning bidders are project companies. In Italy there is no publically accessible database on ownership structure, as there is in Brazil for example.

Despite this fact, we were able to identify the owners of project companies using Internet research in order to estimate the market concentration in the tender segment for wind power. As a search term we used the name of the project company. We were able to identify the owners of 43 of the 49 winning project companies participating in the three auction rounds. For six project companies, the owners are still not known. For our calculations of the indicator “market share of the five largest actors,” we assume that the project companies for which we were not able to identify an owner are not among the five largest owners. We also assume that the owners which we identified act independently of each other. Table F.1 shows the complete list of winning bids and their owners.

Table F.1 Owners of winning projects in Italy

Winning bidder	Owner identified	Allocation	Source
EDP RENEWABLES ITALIA SRL	Energias de Portugal	Name	
GAMESA ENERGIA ITALIA SPA	Gamesa	Name	
GAMESA ENERGIA ITALIA SRL	Gamesa	Name	
ELETTRO SANNIO WIND 2 SRL	PLT Energia	Web search	[138]
C&C OPPIDO LUCANO SRL	C&C Energy	Name	
LATERZA WIND 2 SRL	Asja	Web search	[139]
PONTE ALBANITO SRL	Renexia	Web search	[140]
BREATHE ENERGIA IN MOVIMENTO SRL	BayWa AG	Web search	[141]
E-VENTO CIRO' SRL	Gruppo Waste Italia	Web search	[142]
ALFA WIND SRL	WSB Group	Web search	[143]
ANDALI ENERGIA	Estra SpA	Web search	[144]
EOLSIPONTO SRL	Banco Santander	Web search	[145]
FRI-EL SAN CANIO SRL	FRI-EL Green Power	Name	
NUOVA ENERGIA SRL	FRI-EL Green Power	Web search	[146]
ENEL GREEN POWER SPA	Enel Group	Name	
SAVA ENERGIA SRL		No parent company found	
ERG EOLICA BASILICATA SRL	ERG	Name	
EUROWIND LACEDONIA SRL		No parent company found	
DAUNIA MONTELEONE SRL	Daunia Energia	Name	
CLEAN ENERGY 1 SRL	NovEnergia	Web search	[147]
EOLICA CANCELLARA	Energreen Investment Europe		[148]
ASJA AMBIENTE ITALIA SPA	Asja	Name	

MELTEMI ENERGIA SRL	Asja	Web search	[149]
VENTISEI		Company is bankrupt	[150]
TARIFA ENERGIA S.R.L.	Tozzi Holding	Web search	[151]
TRE TOZZI RENEWABLE ENERGY SPA	Tozzi Holding	Name	
EDISON ENERGIE SPECIALI SPA	Edison	Name	
EWE EUROPEAN WIND ENERGY S.R.L.	EWE	Name	
ALISEA SRL SOCIETA' UNIPERSONALE	BayWa	Web search	[152]
MARCHE ENERGIE RINNOVABILI SRL		No parent company found	
FINPOWER WIND	Finpower Project	Name	
PARCO EOLICO DI TURSI E COLOBRARO SRL	PLT Energia	Web search	[153]
MAIT SPA	MAIT	Name	
DYNAMICA SRL	PLT Energia	Web search	[138]
DELSIS SRL	AREN Electric Power	Web search	[154]
TORRETTA WIND SRL	Gruppo Maresca	Web search	[155]
PARCO EOLICO BUSETO SRL	Elettrostudio Energia	Web search	[156]
LUCKY WIND 4 SRL	?	?	
LUCANIA WIND ENERGY	Daunia Energia	Web search	[157]
SERRA CARPANETO 3 SRL	?	?	
ELETTROVIT POWER SRL	Elettrovit	Name	
C&C LUCANIA SRL	C&C Energy	Name	
BURGENTIA ENERGIA SRL	PLC System	Web search	[158]
BISACCIA WIND SRL	Gruppo Maresca	Web search	[159]
ENERGIA PULITA SRL	PLC System	Web search	[160]

Annex G – Italy: Project size of 60 kW to 5 MW segment

In Italy, small-scale wind power plants and wind power plants with a capacity of up to 5 MW are eligible to receive a legally prescribed feed-in tariff. The available quota however, is limited to 60 MW per year. Table G.1 shows the number of projects according to capacity category. Accordingly, the projects that are typically funded have a system size of less than 1,000 kW or even 500 kW.

Table G.1 Number of projects in wind segment 60 kW to 5 MW. Source: Own analysis based on [161–163].

Capacity [MW]	Year 2012	Year 2013	Year 2014
0–500	309	0	150
501–1.000	4	61	37
1.001–2.000	0	0	0
2.001–3.000	0	0	2
3.001–5.000	0	0	0

Annex H - South Africa: winning wind power projects

The project specific commercial operation date (COD) – both achieved COD and COD as per power purchase agreement – can be found in [58]. The two projects Amakhala Wind Project and Tsitsikamma Community Wind Farm were missing in that document. Their COD as per power purchase agreement was estimated by the last COD as per power purchase agreement of the auction round.

Table H.1 South Africa: winning wind power projects

Auction round	**Project Name**	**Owner identified**	**Source**	**Project status**	**Source**
1	Cookhouse Wind Farm	Globeleq	[164]	Commercial operation	[58]
1	Dassieklip Wind Energy Facility	BioTherm Energy	[165]	Commercial operation	[58]
1	Dorper Wind Farm	Sumitomo	[166]	Commercial operation	[58]
1	Hopefield Wind Farm	AIIM	[167]	Commercial operation	[58]
1	Jeffreys Bay	Mainstream Renewable Power	[168]	Commercial operation	[58]
1	Kouga Red Cap Wind Farm - Oyster Bay	Red Cap	[169]	Commercial operation	[58]
1	Metrowind Van Stadens Wind Farm	Metrowind	[170]	Commercial operation	[58]
1	Nobelsfontein Phase 1	Gestamp	[171]	Commercial operation	[58]
2	Amakhala Wind Project	Cennergi	[172]	Commercial operation	[173]
2	Chaba Wind Power	Innowind	[174]	Commercial operation	[58]
2	Gouda Wind Project	Acciona	[175,176]	Commercial operation	[58]
2	Grassridge Onshore Wind Project	Innowind	[174]	Commercial operation	[58]
2	Tsitsikamma Community Wind Farm	Cennergi	[177]	Commercial operation	[178]
2	Waainek Wind Power	Innowind	[174]	Commercial operation	[58]
2	Wind Farm West Coast 1	GDF SUEZ	[179]	Commercial operation	[58]
3	Khobab Wind	Mainstream Renewable Power	[180]		
3	Loeriesfontein 2	Mainstream Renewable Power	[181]		
3	Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility	Mulilo Renewable Energy	[182]		
3	Longyuan Mulilo Green Energy De Aar 2 North Wind Energy Facility	Mulilo Renewable Energy	[183]		
3	Nojoli Wind Farm	Enel Green Power	[184]		
3	Noupoort	Mainstream Renewable Power	[185]		

3	Red Cap - Gibson Bay	Enel Green Power	[186]		
4	Copperton Windfarm	Gestamp	[187]		
4	Excelsior Wind Energy Facility	BioTherm Energy	[188]		
4	Garob Wind Farm	Enel Green Power	[189]		
4	Golden Valley Wind	Biotherm Energy	[190]		
4	Kangnas	Mainstream Renewable Power	[191]		
4	Oyster Bay Wind Farm	Enel Green Power	[192]		
4	Perdekraal East	Mainstream Renewable Power	[193]		
4	Roggeveld Wind Farm	Building Energy	[194]		
4	The Karusa Wind Farm	Enel Green Power	[195]		
4	The Nxuba Wind Farm	Enel Green Power	[196]		
4	The Soetwater Wind Farm	ENEL Green Power	[197]		
4	Wesley-Ciskei	EDF	[198]		

Annex I - South Africa: Winning photovoltaic projects

Table I.1 South Africa: Winning photovoltaic projects

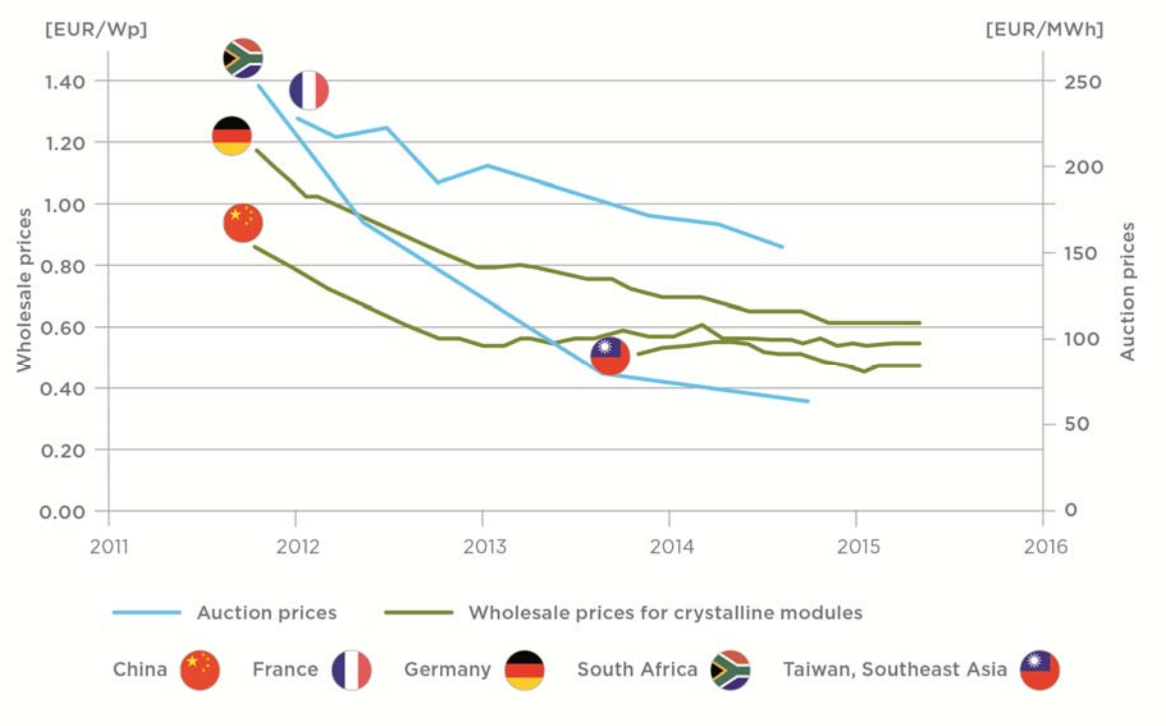
Auction round	Project Name	Owner identified	Source	Project status	Source
1	RustMo1 Solar Farm	Inspired Evolution	[199]	Commercial operation	[58]
1	Greefspan PV Power Plant	AE-AMD	[200]	Commercial operation	[58]
1	Herbert PV Power Plant	AE-AMD	[200]	Commercial operation	[58]
1	Letsatsi Solar Photovoltaic Park	SolarReserve	[201]	Commercial operation	[58]
1	Lesedi Solar Photovoltaic Park	SolarReserve	[202]	Commercial operation	[58]
1	Kathu Solar Plant	Building Energy	[203]	Commercial operation	[58]
1	South African Mainstream Renewable Power De Aar PV RF (Pty) Ltd	Mainstream Renewable Power	[204]	Commercial operation	[58]
1	South African Mainstream Renewable Power Droogfontein (RF) (Pty) Ltd	Mainstream Renewable Power	[205]	Commercial operation	[58]
1	Kalkbult	Scatec	[206]	Commercial operation	[58]
1	Mulilo Solar PV De Aar	Gestamp	[207]	Commercial operation	[58]
1	Aries Solar Energy Facility	BioTherm Energy	[188]	Commercial operation	[58]
1	Konkoonsies Solar Energy Facility	BioTherm Energy	[188]	Commercial operation	[58]
1	Witkop Solar Park	CHINT/ ASK & MEMC	[208]	Commercial operation	[58]
1	Soutpan Solar Park	SunEdison	[209]	Commercial operation	[58]
1	Touwsrivier Solar Park	Soitec	[210]	Commercial operation	[58]
1	Solar Capital De Aar	Solar Capital	[211]	Commercial operation	[58]
1	Mulilo Solar PV Prieska	Gestamp	[212]	Commercial operation	[58]
1	Slimsun Swartland Solar Park	Franco Afrique Technologies	[213]	Commercial operation	[58]
2	Upington Airport	Enel Green Power	[214]	Commercial operation	[58]
2	Linde	Scatec	[215]	Commercial operation	[58]
2	Dreunberg	Scatec	[215]	Commercial operation	[58]
2	Jasper Power Company	SolarReserve	[216]	Commercial operation	[58]

2	Sishen Solar Facility	Acciona	[217]	Commercial operation	[58]
2	Boshoff Solar Park	SunEdison	[218,218]	Commercial operation	[58]
2	Vredendal Solar Park	Solaire Direct	[219]	Commercial operation	[58]
2	Solar Capital De Aar 3	Solar Capital	[220]	Commercial operation	[58]
2	Aurora-Rietvlei Solar Power	Solaire Direct	[221]	Commercial operation	[58]
3	TOM BURKE SOLAR PARK	Enel Green Power	[222]		
3	Adams Solar PV 2	Enel Green Power	[223]		
3	Electra Capital (Pty) Ltd	Enel Green Power	[224]		
3	Mulilo Sonnedix Prieska PV	Sonnedix	[225]		
3	Mulilo Prieska PV	Total Energie	[226]		
3	Pulida Solar Park	Enel Green Power	[227]		
4	Aggeneys Solar Project	BioTherm Energy	[188]		
4	Droogfontein 2	SunEdison	[228]		
4	Solar Dyason's Klip 1	Scatec	[229]		
4	Dyason's Klip 2	Scatec	[230]		
4	Konkoonsies II Solar Facility	BioTherm Energy	[188]		
4	Sirius Solar PV Project One	Scatec	[215]		
4	De Wildt	SunEdison	[218]		
4	Greefspan PV Power Plant No. 2 Solar Park	SunEdison	[231]		
4	Bokamoso	SunEdison	[218]		
4	Zeerust	SunEdison	[218]		
4	Waterloo Solar Park	SunEdison	[218]		
4	Solar Capital Orange	Solar Capital	[232]		

Annex J – Price development for photovoltaic modules

Fig. J.1 shows the price development of photovoltaic modules in the period from November 2011 (first auction round in South Africa) to the beginning of 2015. Wholesale prices for modules from China dropped steadily until the end of 2012 and have since then remained nearly constant.

Fig. J.1 Price development photovoltaic modules. Source: Own depiction based on [233]



Annex K Development of prime interest rates in Brazil, Europe and South Africa

Fig. K.1 Development of prime interest rates in Brazil, Europe and South Africa. Source: Own depiction based on [108,114].