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Analysing patterns and trends in auctions for renewable electricity

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ABSTRACT

Auctions have become the main instrument of choice to support renewable electricity around the world. This is probably due to their alleged virtues in terms of efficiency. However, whether auctions will meet their expectations and be successful will depend on the choice of design elements in particular settings. Although the analysis of the advantages and drawbacks of different design elements has received considerable attention in the literature, this is not the case with the real-world adoption of different design elements across different regions and renewable electricity technologies and overtime. The aim of this paper is to cover this gap in the literature. Using a database of 90 renewable electricity auctions from around the world, built by the authors, this article analyzes different patterns of adoption of design elements overtime, across continents and technologies. The results of the analysis show that, indeed, large differences across regions and overtime can be observed for some design elements. Regarding regional differences, this is the case for geographical diversity, local content requirements, remuneration form, auction form and disclosure of ceiling prices. Some design elements clearly show a distinct pattern over time: volume metric, size diversity, selection criteria, auction format, auction type, pricing rule and ceiling prices. In contrast, the differences across technologies are less marked and are circumscribed to geographical diversity, auction format and remuneration form. Several possible explanations for the patterns and trends in auction design are proposed.

Introduction

Auctions have become the main instrument to support electricity from renewable energy sources (RES-E) worldwide. According to (IRENA, 2019a), 106 countries had held at least one RES-E auction by the end of 2018, up from 6 countries in 2005 (IRENA, 2017). The success in the adoption of this instrument is probably related to its alleged advantages with respect to administratively-set price-based support regarding cost-efficiency and minimization of the costs of supporting the deployment of renewable energy projects. However, there is a widespread consensus that whether those advantages materialize depends on how auctions are designed, i.e. on the choice of their design elements (del Río, 2017a; del Río & Linares, 2014; IRENA, 2015).[1]

Two closely related topics in RES-E auctions have captured the attention of researchers: the results of auctions and their design. An emerging academic literature has paid attention to the results of RES-E auctions worldwide, focusing on different aspects of their functioning, including India (Bose & Sarkar, 2019; Shrimali, Konda, & Farooquee, 2016; Thapar, Sharma, & Verma, 2018), South Africa (Eberhard & Naude, 2016), Germany (Grashof et al., 2020; Lundberg, 2019), Australia (Buckman, Sibley, & Bourne, 2014; Buckman, Sibley, & Ward, 2019), Italy (Cassetta et al., 2017) and Brazil (Bayer, 2018; Bayer, Berthold, & de Freitas, 2018; Bayer, Schäuble, & Ferrari, 2018; Viana & Ramos, 2018), among others. Those contributions have overwhelmingly analysed the impact of auctions on two main aspects (the effectiveness in deployment and the costs of support), although there are some exceptions e.g. the assessment of the impact on community wind projects in Germany (Grashof, 2019). The performance of auctions in particular countries has also been analysed in two EU-funded research projects

Abbreviations: CfD, contract for difference; CSP, concentrated solar power; EU, European Union; fFIP, fixed feed-in premium; FIP, feed-in premium; FIT, feed-in tariff; IEA, International Energy Agency; IRENA, International Renewable Energy Agency; LCOE, levelized cost of electricity; LCR, local content rules; MT, multi-technology; MW, Megawatt; MWh, Megawatt hour; PAB, pay-as-bid; PPA, power purchase agreement; PV, photovoltaics; RES, renewable energy sources; RES-E, electricity from renewable energy sources; RET, renewable energy technology; SCR, seller concentration rules; sFIP, sliding feed-in premium; TN, technology-neutral; TS, technology-specific; U.K., United Kingdom.

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[1] However, some authors argue that it is the structural features of auctions as such (i.e., the instrument) which have the most influential impact on different criteria and goals (efficiency, effectiveness, actor diversity etc.…) and that it is not only (or not fundamentally) an issue of auction design [see, e.g., Jacobs et al. (2020)].

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(AURES and AURES II).[2] Comparative analyses of RES-E auctions in several countries have also been performed by, e.g. Bayer, Schäuble, et al. (2018); del Río & Linares (2014); Dobrotkova, Surana, & Audinet (2018); Lucas, del Río, & Sokona (2017); Winkler, Magosch, & Ragwitz (2018).

On the other hand, several contributions have assessed RES-E auction design, covering different aspects and using different methodologies. Some authors have focused on the theoretical advantages and disadvantages of one design element versus another. For example Kreiss, Ehrhart, & Haufe (2017) assess the implications of financial and physical prequalifications and penalties on the functioning of RES-E auctions. Haufe & Ehrhart (2018) compare two formats that can be used in renewable energy auctions (pay-as-bid versus uniform pricing). Using simulations with agent-based modeling applied to the Danish auction scheme (Welisch, 2019) analyze the impact of an schedule of auction rounds and their volumes on auction performance. Using the same method (agent-based simulation modeling) Anatolitis & Welisch, (2017) compare pay-as bid vs. uniform pricing, with simulations of the future German onshore wind power auctions.

Other authors take a broader approach and provide a general assessment of several design elements, illustrating the pros and cons of the respective choices with examples of auctions from around the world. In this latter case, work carried out by IRENA and in the aforementioned AURES research project stands out in addition to other contributions (Gephart, Klessmann, & Wigand, 2017; GIZ, 2015; Held et al., 2014). IRENA (IRENA, 2015) identifies different design elements and classifies them into several categories, providing an analysis of their strengths and weaknesses. This framework is used in subsequent reports by IRENA to assess auction experiences from around the world (IRENA 2017; IRENA 2019a). A taxonomy of design elements is provided in the AURES project (del Río et al., 2015), together with a multicriteria assessment framework to analyze the functioning of auctions and the positive and negative aspects of alternative design choices (del Río, 2015; del Río, Wigan, & Steinhilber, 2015).

On the other hand, there are several empirical contributions on RES auction design. Case studies identify the choice of specific design elements and how they have worked in specific circumstances. Again, the AURES and AURES II projects provide a considerable amount of information in this regard, with country case studies from around the world.[3] A few studies outside these two projects have also focused on how the auctions in specific countries have been designed, e.g. Sarı & Saygın, (2018) for Turkey, Cassetta et al. (2017) for Italy and Lundberg (2019) for Germany (see also Section 3). There are also several empirical analyses on the design elements adopted in countries in specific regions, including Latin America (Factor, 2017; Hochberg & Poudineh, 2018; Viscidi & Yepez, 2019), sub-Saharan Africa (Kruger & Eberhard, 2018; Lucas et al., 2017), "developing countries" (IRENA, 2013) or Europe (CEER, 2018). All these contributions identify auction design elements in their particular settings and try to assess their functioning in those regions or countries.

However, although the analysis of the advantages and disadvantages of alternative design choices has received considerable attention in the literature, this is not the case with the comparative adoption of different design elements across different regions. Furthermore, the analysis of the different design elements per technology or application has also received scant attention in the academic literature, being circumscribed to only one technology, such as concentrated solar power (del Río & Mir-Artigues, 2019), or application, such as off-grid auctions (Lucas, del Río, & Cabeza, 2020). Finally, the adoption of different design elements over time has not been systematically investigated.

This article covers this gap in the literature. Using a database of 90 renewable electricity auctions from around the world in the 1991–2021 period, built by the authors, it analyzes different patterns of adoption of design elements across continents, technologies and overtime.

The relevance of this analysis is clear. First, as mentioned above, the focus on design elements is justified by its relevance as a main factor in the success of the auctions (del Río, 2017a; del Río & Linares, 2014; IRENA, 2015; IRENA, 2019a). The comparison across regions, technologies and overtime is deemed relevant because it allows us to infer lessons on the choices being made and derive policy implications on the future design of auctions for RES. Governments willing to adopt auctions may infer relevant lessons on how other countries have done it in the past in similar regions or for similar technologies. The historical comparison is also relevant, because it shows how best practices have been adopted overtime and how other design elements have not had the same degree of success.

The next section describes the different design element categories and possible choices within each category. Section 3 describes the methodology. The results of the analysis are provided and discussed in Sections 4 and 5, respectively. Section 6 concludes.

Auction design elements

Several contributions have identified and classified the different design elements in RES-E auctions (e.g., del Río, 2017a; del Río, et al., 2015; del Río & Linares, 2014; IRENA, 2015). Here, the classification in del Río (2017a) is followed. Table 1 describes each design element.

Materials and methods

This paper mainly draws on secondary material collected in desktop research. For the purposes of this paper, a database was built. This database draws on the following information sources on the design of past and present RES auctions from around the world:

1) Case studies performed by the authors in the context of the AURES and AURES II projects or outside these projects. These include auctions in Portugal in 2005–2008 (del Río, 2016a) and 2019 (del Río, 2019a), Mexico (del Río, 2017b; del Río, 2019b), South Africa (del Río, 2016b), Spain (del Río, 2016c; del Río, 2017c; del Río, 2018), Peru (del Río, 2017d), Chile (del Río, 2017e; del Río et al., 2019), Zambia (del Río, 2017f), other countries in Sub-Saharan Africa (Lucas et al., 2017) and CSP auctions in India, South Africa, United Arab Emirates, Morocco and South Australia (del Río & Mir-Artigues, 2019; Mir-Artigues, Del Río, & Caldés Gómez, 2019).
2) Other case studies from the AURES and AURES II projects (see footnote 3). These case studies, which are publicly available in the respective websites, were undertaken using official documents and stakeholder interviews.
3) Publicly available databases on renewable energy support schemes in general (the IEA/IRENA Global Renewable Energy Policies and Measures Database, with a world-wide scope, and the RES-Legal database, with an EU-wide scope) and auctions in particular (the AURES II database, with an EU-wide scope).[4]
4) Case studies on RES-E auctions performed by other authors and published in energy journals with the highest impact factors. After including relevant terms in the search engines of the journals, we ended up with fifty-nine articles on renewable energy auctions. These papers were read and some of them were not included in the final selection, either because their focus was not on auction design, but on the comparison of auctions with other alternatives, or because they had a theoretical focus, as mentioned in the Introduction. Only those which specifically provided data on the design of RES-E

[2] See http://auresproject.eu/ and http://aures2project.eu/

[3] Including Denmark, Netherlands, Germany, U.K., Italy, Ireland, France, Portugal, Mexico, Brazil, Peru, Chile, California, South Africa and China. A synthesis analysis is provided by (Wigan et al., 2016) The recent EU-funded AURESII project has provided additional case studies on Argentina, Chile, Alberta (Canada), Denmark, Germany, Netherlands, Poland, U.K., Portugal, Greece and Mexico.

[4] IEA/IRENA (https://www.iea.org/policiesandmeasures/renewableenergy), RES-LEGAL (http://www.res-legal.eu/home/), AURES II (http://aures2project.eu/auction-database/).

Table 1
Auction design elements: description of options.

Design element categories	Description of alternatives
1. Metrics for volume setting and disclosure	The volume in renewable electricity auctions can be set in terms of capacity (MW), generation (MWh) or budget (e.g., million €) terms.
2. Timing (schedule)	A schedule of auctions implies a commitment to launch an auction at regular intervals. The alternative is to organize ad-hoc auctions, i.e. set at irregular intervals. Even if there isn't an schedule of auctions, these may be organized on a regular basis (i.e., with a high frequency).
3. Diversity (technological, geographical, actor and size)	Auctions can be organized which are neutral with respect to the participation or awarding of technologies, locations, actors and project sizes. In contrast, a specific sort of those categories can be promoted through several options (see del Río, 2017a). A relevant distinction is between technology-neutral (TN) and technology-specific auctions (TS). All electricity generation technologies (renewable or non-renewable) are in principle eligible to participate and be awarded in TN auctions. Only one technology is eligible to participate in TS auctions, or several of them in multi-technology auctions (MT). Auctions can also be geographically neutral (no requirement to deploy the project in a given location) or geographically-diverse (the location is either pre-selected by the government or an incentive to locate in given places is provided). In actor-neutral auctions, large actors are likely to dominate participation and awarding, since they are more likely to offer low bids.
4. Participating conditions	-Local content rules (LCRs). Some countries require that the equipment used in the projects awarded in the auction is manufactured domestically. -Seller concentration rules (SCRs): In order to ensure competition, the auction may be cancelled if there is not a minimum number of participants (e.g. Colombia and Portugal). -Information provision: Governments may support participation in the auction by providing information to potential bidders (e.g., measurement of resource potentials). -Material or financial prequalification requirements. They may fall on the bidder (e.g., previous experience, a good financial record or economic guarantees) or on the project (e.g., pre-development of sites or possession of administrative permits) and mitigate the risk of non-realization.
5. Remuneration type	Either generation (MWh) or capacity (MW) may be remunerated in RES-E auctions
6. Remuneration form	Awarded bidders may receive a full payment. This can be done in the form of a feed-in tariff (FIT) or a long-term Power Purchase Agreement (PPA) signed with the State. Alternatively, they may receive a premium, which is additional to the market price (feed-in premium, FIP). Under fixed FIPs, a constant amount of support which complements the spot market price is granted. Thus, the total remuneration in this case depends on the evolution of the market price. Sliding FIPs cover the difference between the average market price and the strike price set in the auction. Sliding FIPs can be one-side or two-side (commonly known as contract-for-differences).
7. Selection criteria	The award criterion may be only the lowest price (price-only auctions) or the lowest price and other criteria, such as local industry or employment creation (multi-criteria auctions).
8. Auction format	Auctions can be single-item or multiple-item ones. In the former, a single bidder is awarded a single product, i.e., the product cannot be split into several units. In the latter, several bidders may be awarded the total amount of auctioned volume.
9. Auction type	Auctions can be dynamic or static. In dynamic auctions, bidders interact with each other when submitting their bids, and can adjust them accordingly. In static (also called sealed bid) auctions, bidders provide undisclosed bids to the auctioneer, who then ranks the projects accordingly.
10. Pricing rules	Under pay-as-bid pricing, awarded bidders receive the price they have bid for. Under uniform pricing, all bidders receive the same (clearing) price (Wigan et al., 2016).
11. Existence and disclosure of ceiling prices	A ceiling on bid prices means that bids above such price are not considered in the bidding procedure.
12. Realization periods	The awarded projects should be built by a given date

Source: Own elaboration. See del Río (2017a); IRENA (2015) for further details.

auctions in specific countries were considered. These included Cassetta et al. (2017) for Italy, Lundberg (2019) for Germany, Boute (2012); Rice (2014); Smeets (2017) for Russia, Nasirov et al. (2019) for Chile, Bose & Sarkar (2019) for India, Buckman et al. (2014); Buckman et al. (2019) for the Australian Capital Territory, Mitchell (2000); Mitchell & Connor (2004) for the U.K., and Wang (2010); Yu et al. (2009) for China, among others. Some academic contributions considered several countries, such as Azuela et al. (2014); Bayer, Schäuble, et al. (2018); del Río & Linares (2014); del Río & Mir-Artigues (2019); Dobrotkova et al. (2018); Winkler et al. (2018).

5) Case studies of specific countries which have not been published in journals: Hochberg & Poudineh (2018); Kruger & Eberhard (2018); Sarı & Saygın. (2018); Tongsopit (2017); Viscidi & Yepez (2019).
6) Information on specific auctions included in reports from international organizations, such as IRENA (IRENA, 2013; IRENA, 2015; IRENA, 2017; IRENA, 2019a), the World Bank (Maurer & Barroso, 2011), the European Bank for Reconstruction and Development (European Bank for Reconstruction and Development, 2018), the Council of European Energy Regulators (CEER, 2018), EU projects (Held et al., 2014; Mora et al., 2017) and other organizations (Factor, 2017). Also, some countries have been particularly active in supporting case studies on RES-E auctions or providing insights on auction design: such as Germany, through the German Energy Agency (Schenuit, 2018) and the German Society for International Cooperation (De Lovinfosse, Janeiro, & Gephart, 2013; GIZ, 2015) and the US through USAID, the US Agency for International Development (USAID, 2019a) (see also the case studies in Table 2).
7) Official information from countries organizing auctions, including regulations (laws, decrees or ministerial orders) or the request for proposals, which provided relevant details on design elements. It is sometimes available in the government websites, and particularly in the websites of the ministerial departments in charge of auction design (usually the ministry of energy). Google searches also allowed us to identify other official information, such as presentations or press notes.
8) Other secondary sources, including information from newspapers specialized in energy matters and press releases (by different types of stakeholders). When specific design elements in the previous sources were not available, we have consulted renewable energy journals, such as PV-Magazine, CSP Today, PV Tech, Windpower Monthly and Renewables Now, among others.
9) Expert consultations. As a last resort, we consulted experts in particular countries in a very small number of cases for a very small number of design elements. Even so, it has been impossible to identify these data in a few cases, which have finally been recorded as “non-available” data and excluded from the averages which are calculated per continent, technology or year.

For many design elements, data were triangulated using several of the aforementioned information sources.

Information on the design elements was available for 90 RES auctions from around the globe (Table 2). Different auction rounds are grouped under the same auction. Not all auctions correspond to one country. In some cases, we included more than one auction per country. We did this when the design of those auctions was significantly different for distinct technologies in the same country, i.e., at least for one

Table 2
Auctions included in our analysis.

Country	Technology	Period	References
Europe (35)			
Albania	PV	2018, 2020	(Bellini, 2018a; Bellini, 2018b; Bellini, 2020; Bhambhani, 2020; Government of Albania Ministry of Infrastructures and Energy, 2018; IEA, 2018a; Jonuzaj, 2018; Rojo Martín, 2020)
Croatia	All RETs	2019	AURES II database. http://aures2project.eu/auction-database/
Denmark	Wind off-shore	2005–2015	(Garzón & Kitzing, 2019; Kitzing & Wendring, 2015), AURES II database. http://aures2project.eu/auction-database/
Denmark	Small PV	2016	(Garzón & Kitzing, 2019), AURES II database. http://aures2project.eu/auction-database/
Denmark	Technologically neutral	2018–2019	(Garzón & Kitzing, 2019), AURES II database. http://aures2project.eu/auction-database/
Finland	All RES	2018	AURES II database. http://aures2project.eu/auction-database/
France	Off-shore wind	2012, 2013, 2017	AURES II database. http://aures2project.eu/auction-database/
France	Small PV (rooftop) 100–250 kW	2012–2014	(Bayer, Schäuble, et al., 2018), AURES II database. http://aures2project.eu/auction-database/
France	Biomass	2017	AURES II database. http://aures2project.eu/auction-database/
France	PV	2017-2019	AURES II database. http://aures2project.eu/auction-database/
France	Wind	2017-2019	AURES II database. http://aures2project.eu/auction-database/
France	Hydro	2018–2020	AURES II database. http://aures2project.eu/auction-database/
Germany	PV (ground-mounted)	2015–2016	(Batz & Müsgens, 2019; Sach, 2019), AURES II database. http://aures2project.eu/auction-database/
Germany	Wind.	2017	(Lundberg, 2019; Sach, 2019), AURES II database. http://aures2project.eu/auction-database/
Greece	PV, Wind	2016	(Anatolitis, 2019), AURES II database. http://aures2project.eu/auction-database/
Hungary	All RES	2019	AURES II database. http://aures2project.eu/auction-database/
Ireland	Wind, biomass, hydro	1995–2003	(del Río & Linares, 2014; DMNR, 2003)
Italy	Wind, biomass, hydro, geotermal	2012–2015	(Bayer, Schäuble, et al., 2018; Cassetta et al., 2017)
Italy	<5 MW. All RES (except PV)	2016	AURES II database. http://aures2project.eu/auction-database/
Italy	>5 MW. All RES (except PV)	2016	AURES II database. http://aures2project.eu/auction-database/
Lithuania	Hydro, wind	2015	AURES II database. http://aures2project.eu/auction-database/
Luxemburg	PV	2018	AURES II database. http://aures2project.eu/auction-database/
Malta	PV	2018	AURES II database. http://aures2project.eu/auction-database/
Netherlands	All RES (also heating and & cooling)	2011–2016	(Jakob, 2019), AURES II database. http://aures2project.eu/auction-database/
Poland	All RES	2016	(Diallo, 2019), AURES II database. http://aures2project.eu/auction-database/
Portugal	Wind, biomass	2006–2008	(del Río, 2016a)
Portugal	PV	2019	(del Río, 2019a; Government of Portugal, 2019a; Government of Portugal, 2019b)
Russia	Small hydro, Wind, PV	2013	(Boute, 2012; Rice, 2014; Smeets, 2017)
Slovakia	All RETs	2020	(Alfa Diallo, Dézsi, Bartek-Lesi, Szabó, & Mezősi, 2020)
Slovenia	All RES	2016–2018	AURES II database. http://aures2project.eu/auction-database/
Spain	All RES	2016–2017	(del Río, 2016c; del Río, 2017c; del Río, 2018)
Spain	All RETs	2021	(Government of Spain, 2020)
Ukraine	All RETs	2020–2021	(Anatolitis & Grundlach, 2020)
United Kingdom (CfD)	All RES	2015-	(Woodman & Fitch-Roy, 2019)
United Kingdom (NFFO)	All RES	1991–1998	(Edge, 2006; Mitchell, 2000; Mitchell & Connor, 2004)
America (15)			
Alberta (Canada)	All RES	2018	(Menzies & Marquardt, 2019)
Argentina	All RES	2016	(CAMMESA, 2020; Factor, 2017; Kruger, Eberhard, & Swartz, 2018; Menzies, Marquardt, & Spieler, 2019; OLADE, 2020; Viscidi & Yepez, 2019)
Brazil	Wind, hydro, biomass	2007–2014	(Bayer, 2018; Bayer, Berthold, et al., 2018; Förster & Amazo, 2016; Hochberg & Poudineh, 2018; Kruger et al., 2018; OLADE, 2020; Rego, 2013; Rego & de Oliveira Ribeiro, 2018; Romeiro, Almeida, & Losekann, 2020; Viana & Ramos, 2018; Viscidi & Yepez, 2019)
Brazil	PV	2014	(Azuela et al., 2014; Hochberg & Poudineh, 2018; Kruger et al., 2018; OLADE, 2020; Viana & Ramos, 2018; Viscidi & Yepez, 2019)
California	All RES	2011–2015	(Fitch-Roy, 2015)
Chile	All RES (also non-RES)	2015	(del Río, 2017e; del Río et al., 2019; Kruger et al., 2018; Nasirov et al., 2019; OLADE, 2020; Viscidi & Yepez, 2019)
Colombia	All RES	2019	(Government of Colombia, 2019a; Government of Colombia, 2019b; OLADE, 2020; USAID, 2019b)
Ecuador	Wind, PV	2019	(Bhambhani, 2019; Fenés, 2019; Resources, Government of Ecuador Ministry of Energy and Natural Nonrenewable Resources, 2019; Sánchez Molina, 2020)
El Salvador	Wind, biogas, small hydro, PV	2014 and 2016	(OLADE, 2020; Molina, SCHAREN-GUIVEL, & HYMAN, 2018)
Jamaica	All RES	2015	(OLADE, 2020; Viscidi & Yepez, 2019)
Mexico	All RES	2016	(del Río, 2017b; del Río, 2019b; Hochberg & Poudineh, 2018; Kruger et al., 2018; Molina et al., 2018; OLADE, 2020; Viscidi & Yepez, 2019)
Panama	Wind, PV, hydro	2011–2014	(OLADE, 2020)
Peru	All RES	2009–2015	(del Río, 2017d; Kruger et al., 2018; Molina et al., 2018; OLADE, 2020; Viscidi & Yepez, 2019)
Quebec (Canada)	Wind	2005–2009	(del Río & Linares, 2014)
Uruguay	Wind, biomass, hydro, PV	2006–2013	(Factor, 2017; OLADE, 2020)
Africa (14)			
Algeria	PV	2017	(Bellini, 2018c; Climatescope, 2018a; Government of Algeria, 2017; RES4MED, 2018)
Egypt	Wind	2014	(Climatescope, 2018b; IRENA, 2018a)
Egypt	PV	2017	(Bellini, 2017a; IRENA, 2018a; RES4MED, 2018)
Ethiopia	PV	2017	(IEA, 2018b; Keating, 2019a; Groenendaal, 2018; Scaling Solar, 2021)
Ghana	PV	2015–2016	(Lucas et al., 2017)
Magadascar	PV	2018	(Kenning, 2018a; Petrova, 2018a; Scaling Solar, 2018a; Scaling Solar, 2018b)
Morocco	Wind, PV, CSP	2011–2013	(del Río & Mir-Artigues, 2019; Kruger et al., 2018)

Table 2 (*continued*)

Country	Technology	Period	References
Namibia	PV	2017	(Clover, 2017; Eberhard & Kruger, 2019; IRENA, 2019b; O&G Links, 2017)
Senegal	PV	2018	(IRENA, 2019b; Bellini, 2019a; Bellini, 2018d; Petrova, 2019a; International Finance Corporation (IFC), 2019; Rani, 2019; Rojo Martín, 2019; Lawrence, 2018)
South Africa	All RES	2011–2014	(del Río, 2016b; IRENA, 2018b; Kruger & Eberhard, 2018; Lucas et al., 2017; Montmasson-Clair & Ryan, 2014)
Tunisia	PV	2018, 2019	(Bellini, 2018e; Clifford Change, 2019; Hall, 2019a; Kenning, 2019)
Tunisia	Wind on-shore	2019	(Clifford Change, 2019; Dodd, 2019; Petrova, 2019b; Shumkov, 2018)
Uganda	Small PV	2015	(IRENA, 2018b; Lucas et al., 2017; Meyer, Tenenbaum, & Hosier, 2015)
Zambia	PV	2016	(Kruger, Stritzke, & Trotter, 2019; Lucas et al., 2017)
Asia (23)			
Abu Dhabi (UAE)	CSP	2010	(Kruger et al., 2018; Mir-Artigues et al., 2019)
Armenia	PV	2017	(Bellini, 2017b; Bellini, 2018f; Kenning, 2018b; Petrova, 2018b; World Bank, 2018)
Cambodia	PV	2019	(Asian Development Bank, 2019; Bajaj, 2019; EDC, 2019; Hall, 2019b; Keating, 2019b; Stuurman, Alao, & Kruger, 2019)
China	Wind	2003–2007	(Steinhilber, 2016)
China	PV ground-mounted	2019	(Bellini & Hall, 2019; China Energy Portal, 2019; Göß, 2019; Hall, 2019c; Haugwitz, 2019)
Dubai (UAE)	PV, CSP	2012–2016	(del Río & Mir-Artigues, 2019; Kruger et al., 2018)
India	PV, CSP	2010–2014	(Azuela et al., 2014; del Río & Mir-Artigues, 2019; ENEL, 2018; Khana & Barroso, 2014; Kruger et al., 2018)
India	Wind	2017–2018	(Clean Technica, 2017; IRENA, 2017; Singh, 2016)
Indonesia	Solar, geotermal	2013	(PWC, 2018; Tongsopit, 2017)
Israel	PV	2017	(IEA, 2017; ReNews.biz, 2018)
Japan	PV	2017	(Bermudez, 2018; Bellini, 2019b; Bellini, 2019c; Bellini, 2019d; U.S. International Trade Administration, 2019; Beetz, 2017; Clover, 2016; Matsuda, Umino, & Morita, 2018; Power Technology, 2019; Richter, 2019; Government of Japan, 2011; IEA, 2020; Publicover, 2017; Publicover, 2018)
Jordan	PV, wind	2013, 2015, 2018	(Al Rahahleh, 2018; Chadha, 2015; EDAMA, 2019; Hamed & Bressler, 2019; IEA, 2013; Knaack, 2014; MEDREG, 2019; PV Magazine, 2018a; PV Magazine, 2018b; RES4MED, 2019; Reuters, 2015; Tsagas, 2015a; Tsagas, 2015b; Tsagas, 2015c)
Kazakhstan	RES (wind on-shore, PV, SH, biogas)	2018–2019	(Government of Kazakhstan, 2018; IPP Journal, 2018; KOREM, 2019; KOREM, 2020; KOREM & USAID, 2020; Tazmakina, 2019; USAID, 2019c)
Kazakhstan	PV	2019	(Government of Kazakhstan, 2018; IPP Journal, 2018; KOREM, 2019; KOREM, 2020; KOREM & USAID, 2020; Tazmakina, 2019; USAID, 2019c)
Lebanon	PV	2017	(Bellini, 2017c; Bellini, 2017d; Bellini, 2017e; IRENA, 2020)
Malaysia	Solar	2016	(Tongsopit, 2017)
Saudi Arabia	Wind, PV	2017	(Kruger et al., 2018)
Sri Lanka	Wind, PV	2016, 2017, 2018	(Energy Sector Management Assistance Program, 2017a; Energy Sector Management Assistance Program, 2017b)
Taiwan	Off-shore wind	2018	(Global Wind Energy Council, 2020; Lee, 2019; MOEABOE, 2018; The Maritime Executive, 2018; Tisheva, 2018; Wentworth, 2018)
Thailand	Biomass, biogas	2016	(Kenning, 2017; Tantravanich, 2018; Tongsopit, 2017)
Turkey	PV	2017	(Sarı & Saygın, 2018)
Turkey	Wind on-shore	2018	(Sarı & Saygın, 2018)
Turkey	Wind off-shore	2018	(Sarı & Saygın, 2018)
Oceanía (Australia)(3)			
Australian Capital Territory (ACT)	PV, Wind	2012–2016	(Buckman et al., 2014; Buckman et al., 2019)
South Australia	CSP	2017	(del Río & Mir-Artigues, 2019; Lilliestam & Pitz-Paal, 2018)
Victoria	All RES	2018	(Maisch, 2018; Victoria State Government, 2017; Victoria State Government, 2019)

Source: own elaboration.

relevant category. This avoids the simplification and arbitrariness of choosing only one auction per country when, indeed, the auctions in such country clearly differ between each other. In contrast, only one auction has been considered when the design of several auctions did not differ in a meaningful way.

As it can be observed, auctions from the five continents have been included. Europe has the largest number (35), followed by Asia (23), America (15), Africa (14) and Oceania (3). There might be an overrepresentation of European auctions, since this is the instrument required in the EU since 2017 (with pilot auctions since 2015). According to REN21 (2020), 106 countries had organized RES auctions at least in one year. This means that we cover almost 2/3 of countries with at least one auction being conducted.

The information was organized per country. For each country, the time scope (year the auction was conducted), the technologies eligible to participate and all the design elements of that particular auction were included in a table. The design elements in each auction were classified according to Table 1. For each design element, the data have been added and averages have been calculated per continent (region), technology or year. Then, a simple comparison across those categories has been carried out to identify relevant differences.

Prequalification requirements, whether material or financial, have been adopted virtually everywhere. However, we have not included them in the analysis. Data on these prequalification requirements are in some cases not publicly available. But, even if available, it is difficult to identify a global measure of their stringency which allows comparisons across regions, technologies and overtime. Context conditions in the countries are different, and the same prequalification requirement in two different countries may in fact result in different levels of stringency. Thus, this design element entails qualitative aspects which are difficult to parameterize in a quantitative manner for purposes of comparison of the levels of stringency/leniency across countries.

In order to identify differences between the alternatives over time, not all design elements are deemed equally relevant. The selection of the design elements has taken place in two stages, following two criteria:

1) Only those options which are judged as more important in the design of the auction, based on our own experience, are considered. These include: volume metric, schedule, technological, geographical and size diversity, LCRs, remuneration form (FITs, FIPs), selection criteria, auction format, auction type, pricing rule and existence of ceiling prices.
2) In a second stage, only those categories of design elements for which the different alternatives experience at least slightly distinct trends over time have been considered. This is the case for the following

design elements: volume, size diversity, selection criteria, auction format, auction type, pricing rule and existence of ceiling prices.

Results and discussion

General results

Some design elements are widespread (Fig. 1). These include capacity-based volume with disclosure of volume, absence of an auction schedule (or low frequency), technology-specific auctions, size diverse and actor-neutral auctions, absence of LCRs and information provision, generation-based support, remuneration based on FITs and price-only, multi-item, static PAB auctions with disclosed ceiling prices. The only design element which does not show a dominant choice is geographical diversity, with a similar number of auctions being geographically-neutral and geographically-specific. However, behind these general figures, there are wide regional and technology disparities. In addition, the adoption of those design elements changes over time.

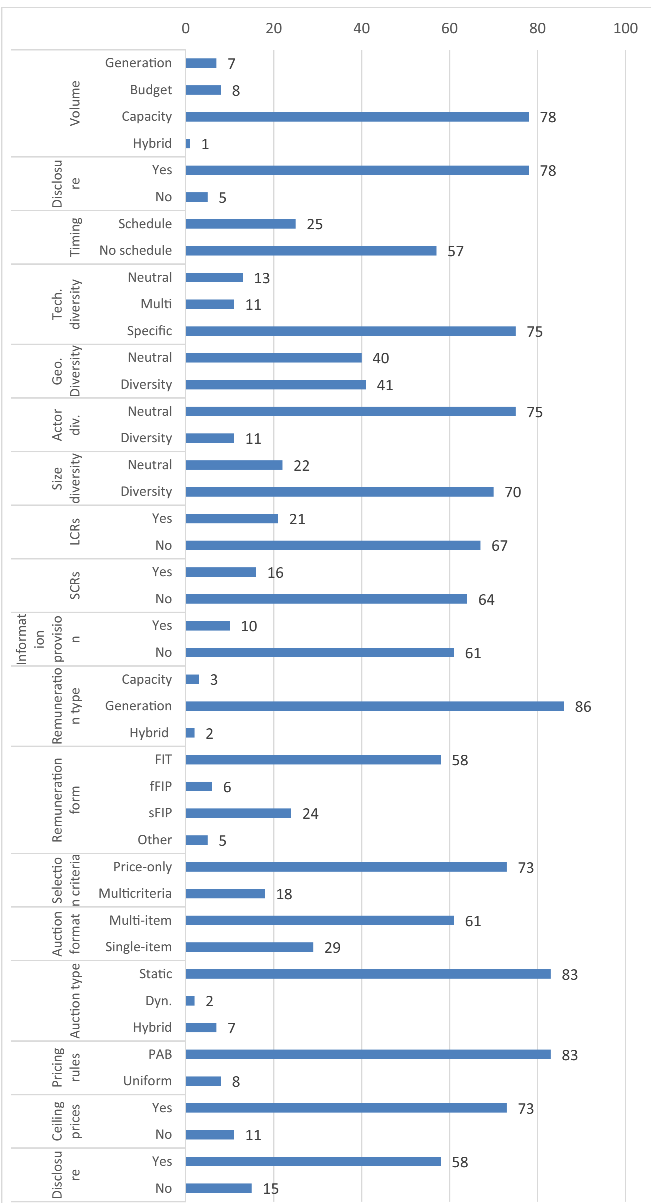

Fig. 1. Adoption of different design elements (n° of auctions). Note: The values indicate the number of auctions which have adopted the respective design element.
Note: The FIT category refers to the full payment received by bidders, which can be a FIT or a PPA (see Table 1).

Results per geographical area

With respect to the general results, some differences across regions can be observed (see Figs. 2 and 3):

- *Volume*. Although capacity-based volumes are widespread and dominate in every region, other metrics have relevant shares in some continents (budget-based volumes in Europe and generation-based volumes in America).
- *Disclosure of volumes.* The data do not show a differential preference across regions with respect to the clearly dominating choice (disclosure).
- *Timing.* The non-existence of a schedule is the dominant choice, especially in Africa. In Europe, auctions with a schedule have a relatively high share (48% of all the auctions in this region).
- *Technological diversity*. Technology-specific auctions dominate across all regions, especially in Africa and Asia. Technology-neutral auctions have some relevance in America and Oceania. Multi-technology auctions are relatively important in Europe (21% of all auctions there) and present (albeit with very low shares) in Asia and America.
- *Geographical diversity*. In this case, none of the two alternatives (geographically-specific or geographical-neutral auctions) prevails with respect to the other in the whole sample. However, clear differences across regions can be observed. In Africa (78%) and Asia (71%), geographically-diverse auctions are more widespread than geographically-neutral ones, whereas the opposite is true in America (geographically-neutral auctions represent 37% of all auctions there) and, especially, in Europe (68%).
- *Actor diversity*. Auctions are overwhelmingly actor-neutral across the world. Actor-diverse auctions are only relevant in Europe (28%).
- *Size diversity*. Most auctions require either a minimum or a maximum size of the projects, i.e., they are not size-neutral. However, size-neutrality has important shares in America (38%) and Europe (27%).
- *LCRs*. Most auctions do not require LCRs. However, auctions with LCRs dominate in Oceania (100%) and are quite relevant in Africa (50%), America (40%) and Asia (40%).
- *SCRs* have only significant shares in Oceania (33%) and Asia (35%).
- *Information provision* is only relatively important in Africa (27%), Oceania (33%) and Asia (23%).
- *Remuneration type.* Remuneration based on generation is overwhelmingly widespread and meaningful differences across regions cannot be observed. Auctions with capacity-based remuneration are a bit more widespread in Europe and America, but with negligible shares.
- *Remuneration form.* FITs clearly dominate in America, Asia and Africa. In contrast, FIPs (particularly sliding FIPs) have a greater share than FITs in Europe (68%). In Oceania, the share of all the alternatives is balanced (33%).
- *Selection criteria.* Most auctions are price-only ones. Multicriteria auctions only have relevant shares in Africa (28%), America (20%) and Europe (25%) although, in this latter continent, this is not true in recent auctions.
- *Auction format.* Multi-item auctions are much more widespread than single-item ones, although large regional differences can be observed. In Africa, single-item auctions are more common (85%), and this is also the case in Asia (52%).
- *Auction type.* Auctions are overwhelmingly static ones. Dynamic auctions have only some share in Europe (5%). Hybrid auctions have relevant shares in Asia (22%) and America (13%).
- *Pricing rules.* PAB auctions are the clearly dominating option in all regions, although there are some experiences with uniform auctions in Europe (16%) and Oceania (33%).

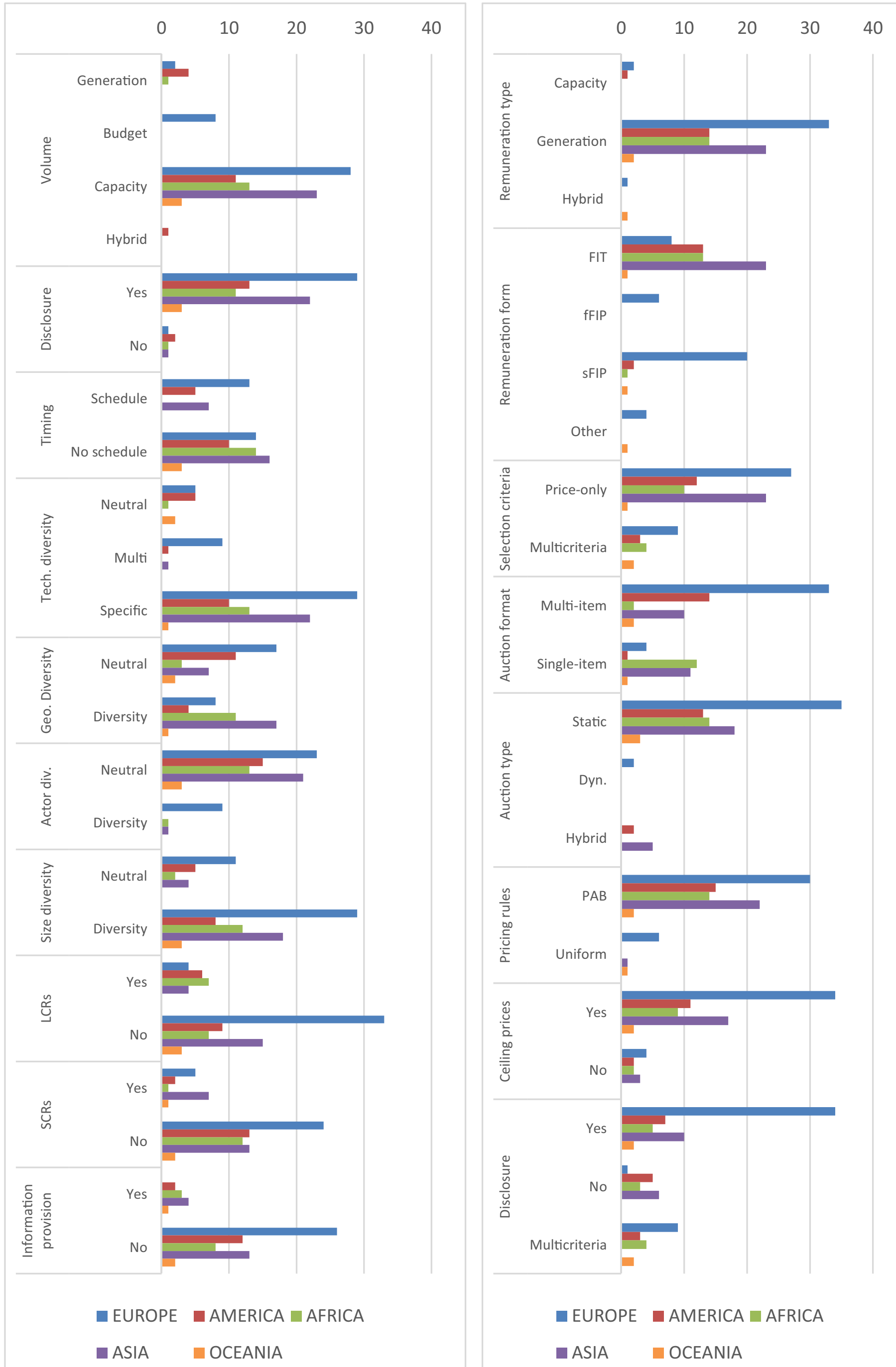

Fig. 2. Adoption of design elements per region (absolute). Note: The values indicate the number of auctions per region which have adopted the respective design element.

- *Ceiling prices.* Most auctions include ceiling prices, and this is the case in all regions. However, the absence of ceiling prices is non-negligible in Africa (18%) and Asia and America (15% each).
- *Disclosure of ceiling prices.* For those countries with ceiling prices, these are published before the auction in all regions, especially in auctions in Europe (97%). However, the non-disclosure of those prices in auctions has a relevant presence in Africa (37%), America (41%) and Asia (37%).

Results per technology

Renewable energy technologies differ in many respects and these differences may influence the design of auctions where they are eligible to participate. Some are variable (e.g., PV and wind on-shore), whereas others are dispatchable (CSP and biomass). Some are now more mature and have lower costs than others (e.g., PV and on-shore wind vs. CSP, off-shore wind and biomass)(see, e.g. IRENA, 2019a). Some are modular and standardized (PV), while others are rather indivisible projects with a higher degree of complexity and tacit knowledge (CSP).

In order to analyze distinct auction design elements for different technologies, we focus on technology-specific auctions for the following technologies: wind on-shore and off-shore, PV, CSP and bioenergy.[5] In other words, we have not considered technology-

[5] However, with only two biomass-specific auctions in our database, the results cannot be deemed representative for this technology.

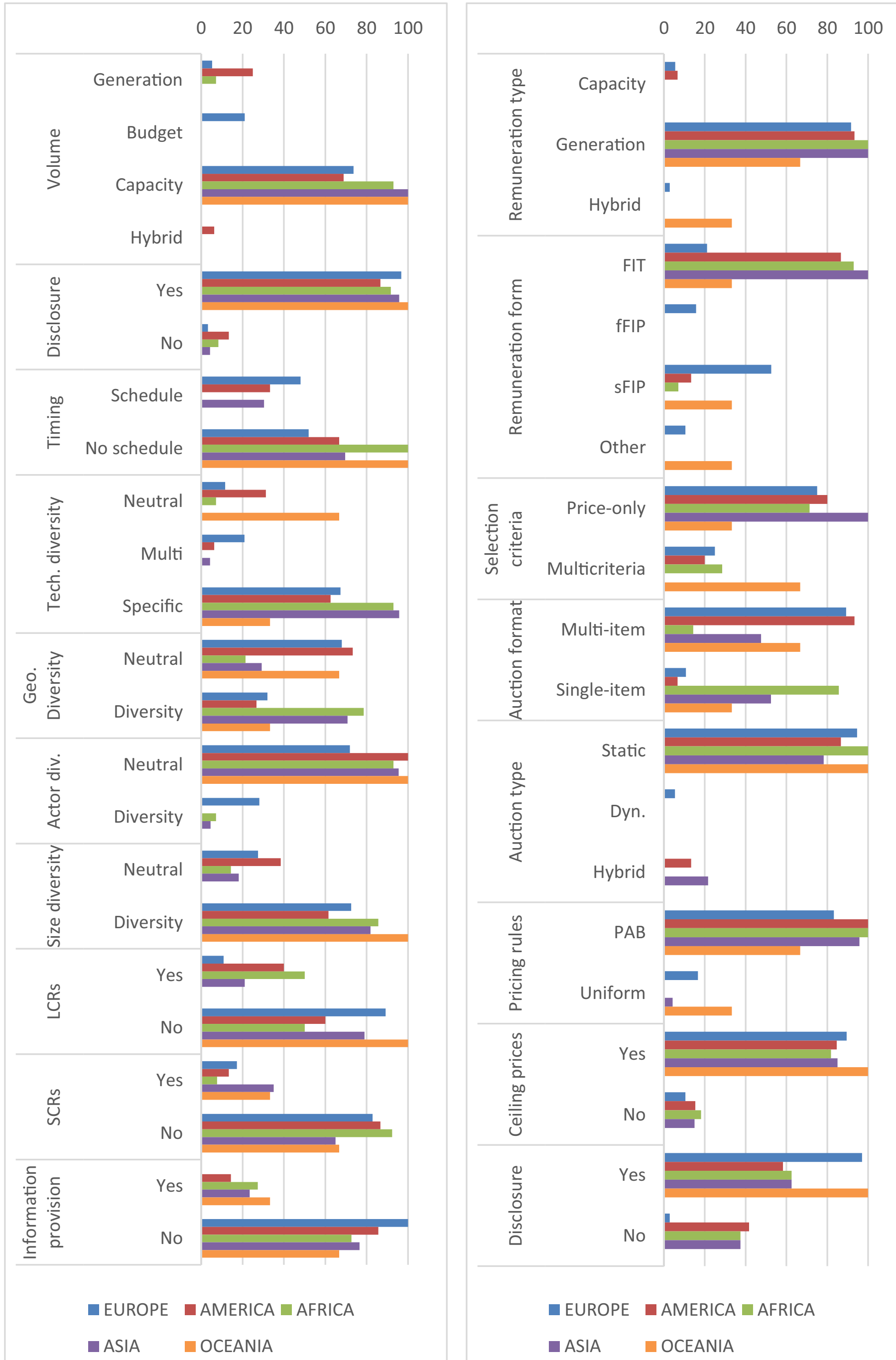

Fig. 3. Adoption of design elements per region (relative). Note: The values indicate the percentage of auctions per region which have adopted the design element.

neutral or multi-technological auctions because this would not allow us to differentiate between the design elements applied to different technologies.

On the other hand, we do not analyze all the design element choices per technology, but only those which are deemed more closely related to the aforementioned features of the technologies, such as geographical and size diversity, auction format and realization periods (deadlines for construction). In addition, we have considered two design elements which are very relevant in general and whose adoption might be influenced by the features of the technologies: volume metric and remuneration form. Figs. 4 and 5 show the results of the analysis. Some differences across technologies can be observed:

– *Volume*. Virtually all the technologies have been auctioned and awarded in auctions in which the volume is set in capacity terms.
– *Geographical neutrality*: Geographically-specific auctions dominate in all technologies, but especially in CSP, wind on-shore and wind off-shore.
– *Size diversity*. No noticeable differences between the distinct technologies can be observed. Size diversity prevails in all technologies. Size-neutral auctions have a relatively large share in

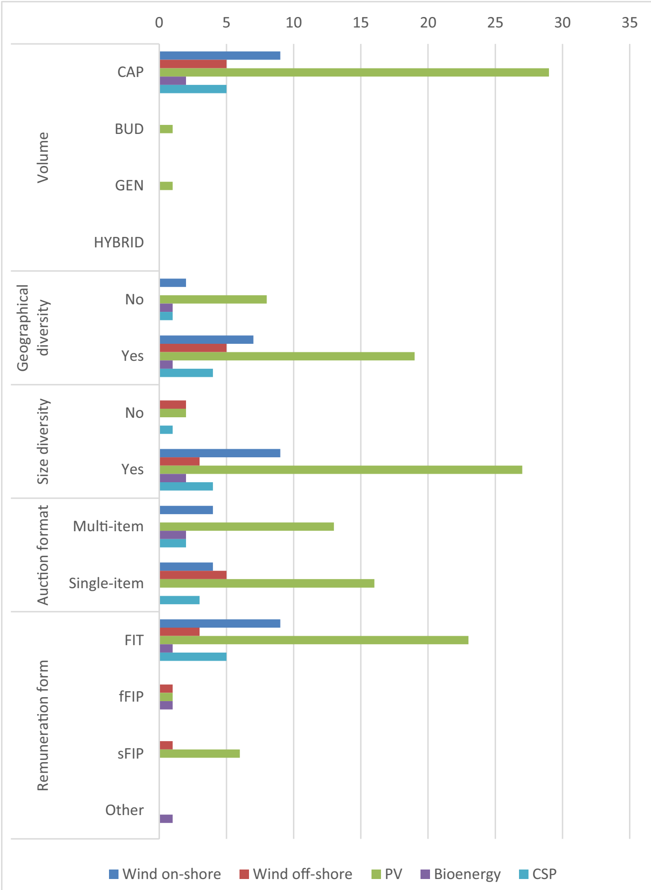

Fig. 4. Adoption of design elements per technology: diversity, volume, auction format and remuneration form (n° of auctions per technology for which the specific design element has been adopted).

wind off-shore (40% of all the auctions in our database for this technology).

– *Auction format*. Single-item auctions clearly dominate in wind off-shore, and biomass has been awarded mostly in multi-item auctions, whereas the relative shares of both options are more balanced in the rest of cases, i.e., in wind on-shore (50% each), CSP (40% being awarded in multi-item auctions) and PV (44%).
– *Remuneration form*. A total amount of support (either as FITs or PPAs) are the most usual remuneration form for all technologies. However, FIPs have been gaining ground in the last years (see next section) and they represent a non-negligible share of auctions in wind off-shore (40%), PV (23%) and bioenergy (50%).
– *Realization periods*. The realization periods for the projects awarded in the auctions are, on average, longest for the wind technologies (especially for off-shore) and CSP, and shortest for PV.

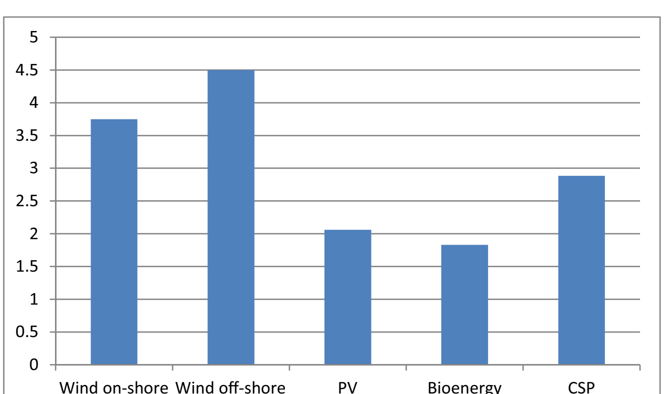

Fig. 5. Adoption of design elements per technology: realization periods (years, average in technology-specific auctions).

Evolution of design elements over time

Some clear differences over time can be observed (Fig. 6). Sometimes the trends are different depending on the region being considered and these regional differences are further analysed in a latter section.

– *Schedule*. There is a trend towards auctions without a schedule. The implementation of auctions has increased in the last years, but those without a schedule have prevailed (3/5 of those conducted since 2011 and 2/3 of those conducted since 2016).
– *Technological diversity*. There is a clear trend towards technologically-specific auctions, although the number of technology-neutral and multi-technology auctions has increased in the last 5 years.
– *Geographical diversity*. The trends show two clearly different periods. Until 2015, a slightly higher share of geographically neutral auctions could be observed. However, auctions have tended to be more geographically-specific in the last five years.
– *LCR*. Similarly to the previous design element, there are two subperiods in this case. Until 2014, auctions with LCRs dominated. Since 2015, most auctions have been conducted without LCRs.
– *Volume*. Capacity-based volumes are overwhelmingly dominant throughout the whole period. The presence of generation-based and budget-based volumes has increased in the last five years, but remains at very low levels.
– *Remuneration form*. Although a total amount of support (PPA or FITs) prevail in the period and they keep being adopted in most auctions conducted around the world, there is an increasing trend towards the use of FIPs.

Evolution of design elements per region

A more disaggregated analysis of the evolution of the choice of design elements per region has been carried out for all the auctions (see Tables 3 and 4).

– *Schedule*. Whereas the general trend is towards auctions without a schedule, most auctions being conducted in Europe do have a schedule. This is clearly not the case in the other regions.
– *Technological neutrality*. The general trend is towards technology-specific auctions, but there is a clearly increasing trend (albeit at low levels) to technologically-neutral auctions in Europe and America and multi-technology auctions in Europe. Technology-specific auctions remain the only choice in Asia and Africa.
– *Geographical-diversity*. Although there is a tendency towards geographically-specific auctions (and this is clearly the case in Asia and Africa), there is a relevant share of geographically-neutral ones (in Europe and America).
– *LCR*. Compared to auctions with LCRs, the share of auctions without LCRs has increased over time. In Europe, auctions with LCRs have not been adopted in the whole period. In contrast, the choice has been more balanced in Africa, although a trend towards the absence of LCRs in the last years can be observed in this region, as well as in Asia and America.
– *Volume*. There has been an overwhelming prevalence of capacity-based volumes in all the regions, with generation-based and budget-based volumes representing a very small share. However,

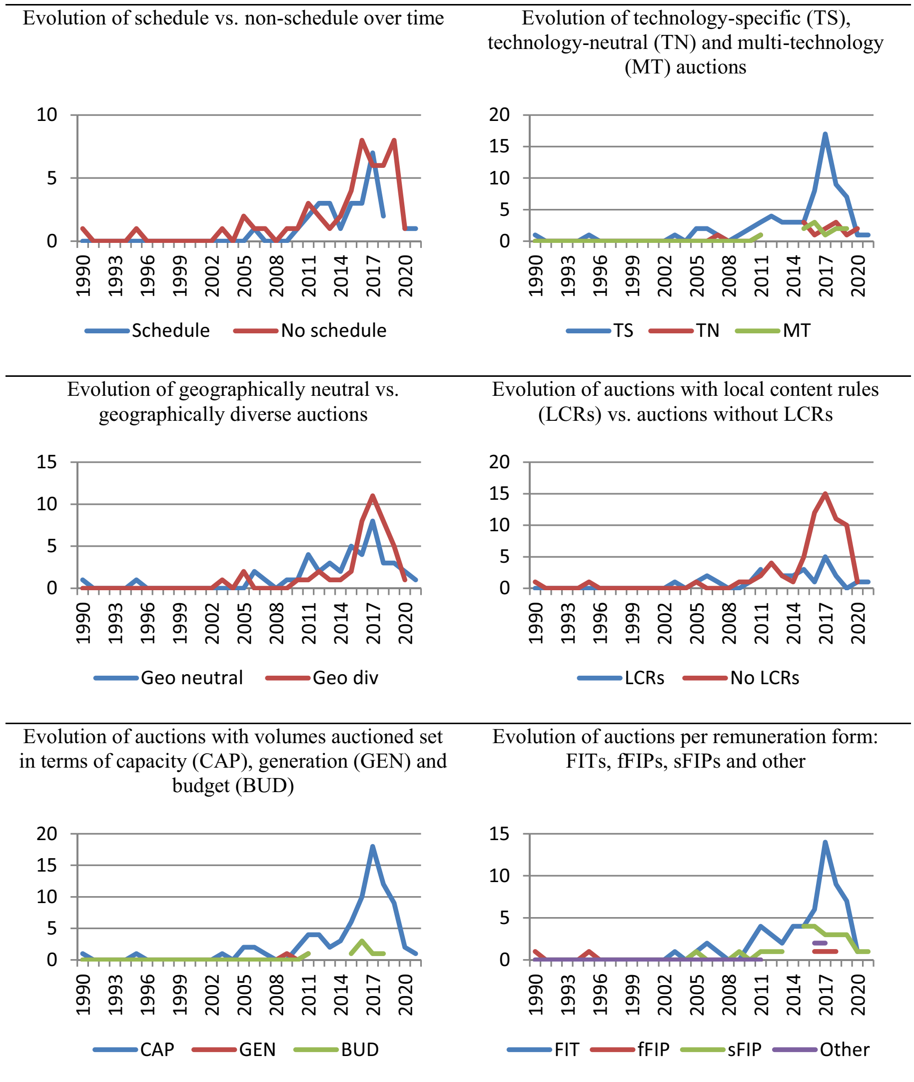

Fig. 6. Evolution of design elements over time (n° of auctions per year with the specific design element).
Note: The displayed values are the numbers of auctions per year with the specific design element.

generation-based volumes have had some presence in America and budget-based volumes have had a non-negligible share in Europe.

– *Remuneration form*. The data show a clear dominance of FITs/PPAs in the period. However, there has been an emergence of FIPs (particularly sFIPS) since 2015, with a small albeit non-negligible share, especially in Europe.

Evolution of design elements per technology

In this section, an analysis of the evolution of the choice of design elements per technology in technology-specific auctions is provided (see Tables 5 and 6).

– *Geographical diversity*. In general, most technologies have been awarded in geographically-specific auctions. This is the case for all technologies. Geographically-neutral auctions are only relevant in PV (although at very low levels) and, to a much lesser extent, wind on-shore.
– *Size diversity*. RETs have been overwhelmingly awarded in auctions with either maximum or minimum limits on project sizes. The data do not reveal a clear difference across technologies when conducting either size-neutral or size-specific auctions.
– *Volume*. All RETs awarded in technology-specific auctions have also been capacity-based auctions. Therefore, differences in this regard across technologies cannot be observed.
– *Auction format*. There has been a slightly higher share of single-item auctions and a timid trend towards single-item auctions. Whereas biomass is awarded only in multi-item auctions and CSP and off-shore wind are awarded only in single-item auctions, the picture is more balanced in on-shore wind and PV.
– *Remuneration form*. There is a clear dominance of FITs during the whole period and a trend towards FIPs cannot be observed for any RET. Non-FIT remuneration forms (e.g., sliding FIPs) have only some relevance in the case of PV, but at very low levels, and a clear trend is not visible in this regard.

Differences in the design elements of auctions per technology and region

Finally, differences in the design elements of auctions per technology and region are assessed, also for technology-specific auctions (see Tables 7 and 8).

Regarding *PV*, there are meaningful regional differences for several design element categories (geographical diversity, auction format and remuneration form). The choice between geographically-specific and

Table 3
Evolution of design elements per region (I).

	Schedule		Tech. neutrality			Geo. Neutrality	
	Y	N	TS	TN	MT	Neutral	Div
1991		x	x			x	
1995		x	x			x	
2003		x	x				x
2005		x x	x x				x x
2006	x	x	x x			x x	
2007		x	x	x		x	
2008							
2009		x	x			x	
2010	x	x	xx			x	x
2011	x x	x xx	x xx	x	x	x x x	x
2012	x xx	x x	xx x x			x x	x x
2013	xx	x	xx x			xx	x
2014	x	x x	xx x			xx	x
2015	x x	x x xx	xx x	xx x	x	x xx xx	x
2016	xx x	xxx x x xx	xx xx x xxx	x	xxx	xxxx	xx xx x xxx
2017	xxx xx	x xxxx xxxxxx xx	xxxxx xxxx xxxxxxx	xx	x	xxx xxxx x	xx xxxx xxxx x
2018		xxx x xx xxxx	xxx xx xxxx	xx x	x	xx x	x xx xxxx
2019	x	xx xx xx xx	xx x xx xx	x	x	x x x x	x x x x

Note: x **Asia** x **Africa** x **America** x **Europe** x **Oceania**

geographically neutral auctions is balanced in the PV auctions conducted in Europe and Asia. However, PV auctions conducted in Africa are mostly geographically-specific. In the case of the auction format, regions show considerable differences. Multi-item auctions dominate in Europe, whereas single item ones are clearly more widespread in Africa and there is a balance between both options in Asia. Regarding the remuneration form, in all regions (except Europe), awarded bids in PV auctions are remunerated with a FIT/PPA. In Europe, sFIPs dominate. Finally, meaningful differences between distinct choices in other design elements (size diversity and volume metric) in PV auctions could not be found: they are size-specific and capacity-based in all regions.

Concerning *wind on-shore*, all regions conduct geographically-specific, size-specific, capacity-based auctions in which the remuneration is provided in the form of a FIT/PPA. Thus, differences across regions could not be found. There doesn't seem to be any clear difference in the choice of multi-item vs. single-item auctions.

The lack of meaningful regional differences is also the case in *wind off-shore, CSP and biomass*. The only exception is the more frequent presence of sliding FIPs as the remuneration form in wind-offshore auctions in Europe, whereas remuneration is provided with a FIT in the rest of regions (although there are few wind off-shore auctions outside Europe).

Discussion

Regarding the regional differences

The findings in Section 4 show that clear differences across regions can be observed for several design elements (geographical diversity, LCRs, remuneration form, auction form and disclosure of ceiling prices). Possible reasons for those differences are discussed in this section and several ideas are proposed. However, a more in-depth analysis of the reasons for those differences should be the focus of future research.

Policy design depends on several factors. Policy goals are obviously one of these factors. Countries are likely to have different policy goals and priorities when designing RES auctions, which usually include the following: effectiveness, support costs, efficiency and local impacts (del Río, Wigan, et al., 2015; IRENA, 2015; Mora et al., 2017):

Table 4
Evolution of design elements per region (II).

	LCR		Volume			Remuneration type			
	Y	N	CAP	GEN	BUD	FIT	fFIP	sFIP	Other
1991		x	x						
1995		x	x				x		
2003	x		x			x			
2005	x	x	x x			x		x	
2006	x x		x x			x x			
2007	x		x			x			
2008									
2009		x		x				x	
2010	x	x	xx			xx			
2011	x xx	x x	xx xx	x	x	xx xx		x	
2012		xx x x	xx x x			xx x		x	
2013	x x	x	x	x	x	x		x	x
2014	x x	x	xx x			xx x			
2015	x x x	xx xx	xx x xx	x	x	xx x	x	xxx	
2016	x	xxxxxxx xx x xx	xxxxx x x xxx		xxx	x x x xxx	x	xxxx	x
2017	xxx xx	xxxxxx x xxxx xx xx	xxxxx x xxxxxxxx xxxx	xx	x	x xxxx xxxxxxxx x	x	xxx	xxx
2018	xx	xxxxx x xx xx	xxxx x xx xxxx		x	x xx xxxx	x	xx x	
2019		xxx xx xx xx	xxx x xx xx	x		xx xx xxx		xx	

Note: x Asia x Africa x America x Europe x Oceania

– *Effectiveness*. Deployment of renewable energy projects within a given period is usually a main goal. This implies that the awarded projects in the auction are built and generate electricity.
– *Minimization of support costs*, which are paid by consumers (in their electricity bill) or taxpayers, is usually also a main policy goal. This means that the awarded bids are as low as possible.
– *Efficiency*. Deploying a given amount of RES-E at the lowest generation costs is a main criterion to assess the results of RES-E auctions. The relevant costs in this context are system costs, which include direct costs (installation, operation and maintenance), as traditionally measured with the LCOE metric, and indirect cost (balancing, profile and grid costs)(see Lucas et al. (2020) for details).
– *Local impacts*. Deployment of RES projects has positive socioeconomic impacts at the national, regional or municipal levels (employment and industry creation). Governments may try to design auctions in a way that those local impacts are maximized.

The design of RES auctions can be expected to reflect those policy goals to some extent (del Río & Mir-Artigues, 2019). In turn, these policy priorities are partly dependent upon national socioeconomic, institutional and energy features, which are also likely to differ across countries.

However, this starting assumption would provide a simplistic view of the relationship between policy goals and the choice of design elements.[6] That policymakers choose the option that will maximize the attainment of their goals is a very rationalistic assumption which may be difficult to assume, given the multitude of possible explanations for real-world policy choices (including the capacity of policy-makers, how well they are trained in auction design, their own interests/preferences or the influence of other countries). This is suggested by the literature on policy diffusion and transfer (see, e.g., Gilardi 2012, Stone 2012, Capano and Lippi 2017, among others), which has devoted substantial efforts in determining why countries adopt certain policies. In addition, even if design was related to policy goals, these may change over time with the change of government and the consequential shift in economic philosophy. Therefore, here we use the findings on the choice of design elements per region to derive some preliminary hypotheses on the drivers of those choices, which should be investigated in future research.

In *Europe*, the relatively higher share of auctions with a schedule suggests a strong commitment to RES in the context of long-term

[6] We are grateful to an anonymous referee for this remark and the following remarks in this paragraph.

Table 5
Evolution of design elements per technology (I).

	Geographical diversity		Size diversity		Volume			
	Neutral	Specific	Neutral	Specific	CAP	BUD	GEN	Hybrid
1991								
1995								
2003		x		x	x			
2005		x	x		x			
2006								
2007								
2008								
2009								
2010		xx		xx	xx			
2011		x	x		x			
2012	x	x		x x	x x			
2013								
2014	x	x		x	x x			
2015	x	x x	x	x x	x x x			
2016	x	x xx x		x xxx x	x xx x	x		
2017	x xx x	x xx xx xxxxxx xxx	x	x xx xxx xxxxxx xxx x	x xx xxx xxxxxxxx xx x			
2018		xx xx	x	x xxxx	xx xxxx			
2019	x x	x x xxx	x	x xx xxx	x xx xxxx			

Note: x off-shore wind x on-shore wind, x CSP x PV x biomass

targets. The preference for FIPs over FITs, encouraged by EU-level regulation, reflects the concern about the integration of further variable RES quantities and their incidence on system costs, in the context of decommissioning of some fossil fuel plants (e.g., coal and nuclear). There is already a large RES-E penetration and the 2030 targets will lead to even greater penetration levels. In addition, the small but higher adoption of budget-based volumes compared to other regions may be explained by the concern about the increase in the costs of support. It should be taken into account that the post-2020 policy framework in

Table 6
Evolution of design elements per technology (II).

	Auction format		Remuneration form			
	Multi-item	Single-item	FIT	fFIP	sFIP	Other
1991						
1995						
2003	x		x			
2005		x			x	
2006						
2007						
2008						
2009						
2010	x	x	xx			
2011		x	x			
2012	x	x	x x			
2013						
2014	x	x	x x			
2015		x x x	x x		x	
2016	xx x	x x	x xx x		x	
2017	xxx xxxx x	x xx xxxxxx	x xx xxx xxxxxxxxxx		x	x
2018	xx	xx xx	xx xx		xx	
2019	xx	x xx xx	x x xxx		x	

Note: X offshore wind x CSP x on-shore wind x PV x biomass

Table 7
Regional differences across technologies (I).

	Geographical diversity		Size diversity		Volume			
	Neutral	Specific	Neutral	Specific	CAP	BUD	GEN	HYBRID
PV	xxx x x xx	xxxxxxx xxxxxxxx x xxx	x xx	xxxxxxx x xxxxxxx xxxxxxx	xxxxxxxx xxxxxxxxx x x xxxxxx	x		
Wind on-shore	x	xxx xx xx x		xxxx xx xx x	xxxx xx xx x			
Wind off-shore		xx xxxx	x xx	x xx	xx xxxx			
CSP		xxx x x	x	xxx x	xxx x x			
Biomass	x	x		x x	x x			

Note: x Asia x Africa x America xEurope x Oceania

the EU specifies that economic support needs to be allocated through technology-neutral, competitive procedures and either fixed or sliding FIPs, unless Member States can demonstrate that a technology-neutral tender would lead to suboptimal results (Essig et al., 2019).[7] There is a concern about the support costs, complying with RES targets (effectiveness) and doing so with low system costs in a context of a relatively high penetration of variable renewable electricity (Essig et al., 2019). However, despite the regulatory guidelines and a timid emerging trend towards technology-neutral auctions, technology-specific auctions dominate over technology-neutral ones in Europe, suggesting that governments highly value the advantages of technology-specific auctions. The absence of LCRs reflects the extreme difficulties to adopt them according to EU regulation, but also suggests that RES-E auctions are not regarded as an industrial policy instrument (in addition to being an energy policy one), which is the case in other regions. In contrast, the importance of actor diversity cannot be observed in other regions of the world. Actor diversity is an explicit goal, at least in some countries (e.g., Germany and Spain) and in the Renewable Energy Directive (see number (17) and article 4.4 in this Directive). Finally, the balanced choice for geographically-neutral vs. geographically-specific auctions might be related to the existence of relatively strong grids. However, this could change towards a higher adoption of geographically-specific auctions in the future, with increasing penetrations of variable RES-E and the increase in congestion costs in specific nodes.

In *America*, we can clearly observe two different models. In some countries (such as Mexico, Chile, Peru and Panama), generation-based volume metrics, technology and size-neutral and price-only auctions have been conducted. This suggests that RES-E is regarded as another, low-cost alternative to cover an increasing electricity demand, on an equal footing with conventional sources, given the excellent renewable resources in many of these countries. This vision may be influenced by three context conditions: a high increase in demand, lack of fossil fuel resources and extraordinary renewable energy sources in middle-income countries with relatively good financing conditions and reliable off-takers (del Río & Mir-Artigues, 2019). Low generation costs and low support costs would be the main or even the only policy goal. However, in some of those countries innovative designs for the integration of renewable electricity have also been adopted, such as the hourly and seasonal profiles in Chile, the regional and hourly adjustment factors in Mexico and the 90%–130% rule in Brazil.[8] This indicates that, in these

[7] In May 2019, the EU adopted a new policy package "Clean Energy for all Europeans" that includes a new EU-wide 2030 target of at least 32% for the share of renewable energies in gross final energy consumption. The Renewable Energy Directive 2018/2001 defines the binding RES target on European level and sets guidelines for renewable energy support.

[8] In Brazil, an annual variation in generation in the range of 90%–130% of the contractual obligation is acceptable, although the energy contracted must be delivered over each four-year period (Rego & de Oliveira Ribeiro, 2018).

Table 8
Regional differences across technologies (II).

	Auction format		Remuneration form			
	Multi-item	Single-item	FIT	fFIP	sFIP	Other
PV	xxxxx x x xxxxxx	xxxxxx xxxxxxxxx x	xxxxxxxxxx xxxxxxxxxx x xx	x	xxxx	
Wind on-shore	xxx x x	xx xx x	xxxx xx xx x			
Wind off-shore		xx xxxx	xx xx		xx	
CSP	x	xx x x	xxx x x			
Biomass	x x		x			x

Note: x Asia xAfrica x America xEurope x Oceania

countries, market integration of variable RES may be an important concern. On the other hand, it is interesting to note that, in other countries (Argentina, Uruguay and Brazil), the concern about direct costs coexists with the relatively high presence of some design elements (LCRs and multicriteria auctions) which are in conflict with such concern, suggesting that secondary goals in terms of local-industry creation may be highly relevant.

In *Africa*, the particular context conditions include a low credibility of the off-taker and weak grids, in low-income countries with difficulties to raise finance for RES-E projects (Pueyo et al., 2015).[9] Low access to energy services by the general population, particularly the rural one, would make RES a particularly attractive option. The relatively low weight of auctions with a schedule suggests that governments in this region conduct auctions on a stand-alone basis (and with rather small volumes), and often as a result of external influences (such as international organizations like the World Bank with its Scaling Solar program) and the involvement of international donors. The lack of a schedule may be related to the aforementioned three context conditions (higher finance costs, low income levels and weaker off-takers), which prevent these countries from committing to the relatively high upfront investments that RES require.[10] The dominance of FITs (or long-term PPAs, sometimes with the guarantees provided by international institutions or donors) can be explained by the emerging character of some of these markets (except South Africa and Morocco) and the rather exploratory stage regarding RES auction implementation. FITs, which entail lower risks for investors than FIPs, are particularly suitable to kick-start the market in a context of low RES-E penetration and difficult access to credit (De Jager et al., 2011; Noothout, De Jager, Tesnière, & Sascha, 2016). FIPs may also be less attractive than FITs in this region due to the low penetration of variable RES, which makes the integration of variable RES a less relevant concern than in Europe. The higher preference for geographically-specific auctions suggests the influence of another context condition (weak grids), which makes it recommendable to set the location of projects awarded in the auction in specific sites (Winkler et al., 2018). Finally, the relative importance of LCRs indicates that RES auctions in this continent, with lower income levels compared to others, are not only regarded as an instrument of energy policy, but also of industrial and local development policy.

The design of RES auctions in *Asia* shares some similarities to those in Africa. First, geographically-diverse auctions have a greater share than in other continents, suggesting that governments prefer to pre-define the projects' locations, possibly due to the absence of strong grids, particularly in South-East Asia (Tongsopit, 2017). Second, LCRs are also relatively important (although much less so than in Africa), which indicates that building a local industrial supply chain is relevant there. Third, the share of FITs with respect to FIPs is overwhelming, as in Africa, suggesting that two context conditions of this region and features of FITs vs. FIPs may have also driven this adoption (emerging markets where FITs entail lower risks for investors and a low share of variable RES which makes RES integration through FIPs a less urgent issue). In contrast, the percentage of RES auctions with a schedule is higher than in Africa, which might indicate a greater long-term commitment to RES. Renewable electricity may be considered an interesting alternative to other electricity generation technologies to provide access to electricity to an increasing population. It should be taken into account that the region shows substantial disparities in income levels, access to credit and development of the electricity system. In particular, some countries (e.g., Japan and South Korea) would have context conditions more similar to the European ones and, thus, a similar choice of design elements.

Finally, only three RES auctions have been launched in *Oceania* (Australia). These auctions do not show meaningful differences with respect to the most common ("average") design elements everywhere. A slightly greater share of technology-neutral but geographically-specific auctions and requirement of dispatch profiles suggests a high weight attached to the goals of minimization of generation costs and support costs. However, LCRs and multicriteria auctions are highly present in Australia (ACT and Victoria), suggesting that creation of a local industry is also a relevant policy goal. The Australian states seem to experience with some innovative designs. For example, the ACT applies seller concentration rules, Victoria adopted a technologically-neutral auction with a hybrid remuneration type combining capacity-based and generation-based remuneration and, in South Australia, the technology-neutral auction includes a requirement of a dispatch profile. Australia has similar development levels and financing conditions as in Europe. However, it has greater solar resources, substantial coal resources and a vast territory with a low population density, which puts pressure on electricity grids. This could be behind the adoption of technology-neutral but geographically-specific auctions.

Regarding differences per technology

Some differences across technologies can be observed, although they are relatively small, and probably smaller than what we could a priori expect. Some regional differences in the design elements across technologies are also worth mentioning.

Technology features may only explain a few choices of design elements in technology-specific auctions. A traditional classification is between more mature and less mature technologies. All the technologies have been auctioned and awarded in auctions in which the volume is set in capacity terms. This suggests that the capacity-based metric is overwhelmingly regarded as attractive, irrespective of the type of renewable energy technology being considered, probably due to its simplicity and its ability to identify compliance with the auction early in the project deployment process.

FITs are the most usual remuneration form for all RETs. FIPs have only some relevant presence in PV and wind off-shore. Two different aspects may play a role here: the variability and the maturity of RETs. On the one hand, wind and PV are variable (whereas CSP and biomass are dispatchable) and, thus, their penetration can create significant challenges for the management of electricity systems (balancing). Their proper system integration would encourage the adoption of remuneration forms which consider "when" or "where" the electricity was produced, i.e. its value (such as FIPs, in contrast to FITs) (European

[9] This led international institutions (e.g., the World Bank) and international aid donor countries to take a central role in the auction procedure and design in some of these countries, and particularly those in Sub-Saharan Africa (see Lucas et al. (2017) for details).
[10] There are possibly two exceptions in this context: Morocco and South Africa. In particular, Morocco has a clear commitment to RES and sees auctions as the main instrument to promote them, as suggested by del Río & Mir-Artigues, (2019).

Commission, 2013; Noothout et al., 2016).[11] Thus, it could be expected that those variable RETs with a large potential to contribute to the electricity mix (PV and wind) would be awarded in auctions designed to encourage their integration in the electricity system, particularly in countries with a currently high penetration of variable RES, such as Europe. Compared to FITs, FIPs would encourage such integration (De Jager et al., 2011). The dispatchable nature of CSP and biomass would allow them to take advantage of FIPs, since these projects could sell their electricity when the electricity price is highest (peak load), allowing them to obtain higher revenues (del Río & Mir-Artigues, 2019; Dowling, Zheng, & Zavala, 2017). Therefore, both the integration of variable RETs and encouraging dispatchable technologies would lead to the adoption of FIPs as the remuneration form in auctions in the future for all RETs.

On the other hand, a FIT would be more appropriate for relatively less mature technologies, with higher investment risks [since FITs mitigate these risks, see (De Jager et al., 2011), especially if these technologies have a low potential to significantly contribute to the power mix.[12] Some of the technologies which are now mature and low-cost (wind on-shore and PV) were not so mature and cheap a decade ago (when some of the auctions were conducted) and the adoption of FITs probably aimed to mitigate the risks of investments in high capital-intensive technologies. Therefore, the use of FITs as the remuneration provided in auctions would make sense in the future for the less mature technologies.[13]

Geographically-specific auctions dominate in all technologies and geographically-neutral ones have only been conducted in a few cases for PV and wind on-shore. A trend towards geographical diversity could have been expected for large-scale installations with large economies of scale, for which the fixed costs are a crucial component of the total costs and for which appropriate locations are scarcer than for other technologies, such as CSP or wind off-shore. However, the trend to geographically-specific auctions occurs for all technologies, not only for those mentioned above. Geographically-neutral auctions have only a relevant share in Europe and in PV. However, it is difficult to see that this will be a future trend in Europe, in so far as there will be more concern about grid costs (congestion and connection costs), which will increase with increasing penetration of variable RES.

CSP, biomass and wind off-shore are mostly awarded in single-item auctions probably due to the fact that they are inherently large projects with strong economies of scale. Therefore, dividing them into several projects would lead to higher costs. In addition to their large size, those projects are often complex and, as it is the case of CSP, non-standardized (Lilliestam, 2018). Therefore, site-specific single-item auctions would be particularly suitable for these projects (Lilliestam, 2018). In contrast, wind on-shore and PV are equally auctioned and awarded in multi-item and single-item auctions. Wind on-shore and PV projects are more modular and standardized and can have different sizes without severely affecting their performance and, thus, they could be expected to be increasingly awarded in multi-item auctions. However, our results do not show that this is being the case. Finally, substantial differences per region can be observed for PV and wind on-shore. Although auctions are equally single-item and multi-item in PV and on-shore in our database, European PV auctions are usually multi-item, whereas the African ones are more often single-item. In the case of on-shore wind, African auctions are most often single-item ones. Therefore, in this case, the choice of the design element is probably more related to the features of the region than to the features of the technology.

Regarding trends

Clear trends can be observed regarding the choice of some design elements, with some regional specificities.

The tendency towards auctions without a schedule (except in Europe) suggests that a policy priority of governments may be to maintain the flexibility in deciding when and how regularly to conduct auctions rather than to reduce investment risks throughout the whole supply chain. This is despite auctions with a schedule being considered a best practice (del Río, 2017a; Wigan et al., 2016).

The high and increasing share of technology-specific auctions indicates that policy-makers value other aspects of electricity production than very low LCOEs. They may be concerned about the "value" of electricity (and not only its direct costs), the diversification of domestic energy sources or the promotion of a local supply chain for different technologies (del Río, 2017a). As renewable electricity technologies are more competitive everywhere, an emerging but timid trend towards technology-neutral or multi-technology auctions can be observed in recent times and could also probably be expected in the future.

The trend towards LCRs in non-European countries suggests that RES-E deployment and LCRs are increasingly regarded as a way to boost a local industry and to create local employment.

The dominance of capacity-based auctions during the whole period suggests that this metric to set auction volumes may still be more attractive for governments, given its advantages in terms of simplicity and easiness to identify target compliance. However, a timid increase in generation-based and budget-based volumes in recent times suggests an increasing concern about the support costs of RES-E which, particularly in regions with a high RES-E penetration (Europe and America), may have led to a preference for these metrics.

The prevalence of FITs during the period indicates the concern of governments about reducing the risks for investors, whereas the increasing adoption of sliding FIPs is a signal that policy-makers are increasingly concerned about the integration of variable RES (see Sections 5.2 and 5.3).

Finally, the trend towards the adoption of geographically-specific auctions, particularly in non-European regions, suggests that this choice may have been driven by the conditions of the electricity systems in those regions, and particularly by the possible existence of a weak grid (as it is the case in Sub-Saharan Africa, see Lucas et al. (2017). However, as shown by the recent auctions in Portugal (in 2019, see del Río (2017a), concern about the saturation in some nodes in countries with a high variable RES penetration may lead to the increasing adoption of geographically diverse auctions, even in Europe (see 5.2 and 5.3).

Conclusions

Based on a self-built database of design choices of auctions, this article has analysed the patterns of adoption of design elements across different regions, renewable electricity technologies and overtime.

Some common patterns in the design of auctions for most design elements can be observed, except for geographical neutrality, for which the choices are balanced. RETs are most often auctioned in capacity-based tenders in which the volume is disclosed but without a schedule, in actor neutral, technology-specific auctions, with maximum or minimum size limits. They usually have no LCRs and no seller concentration rules. The remuneration is generation-based, usually with a FIT/PPA. They are most often price-based, multi-item and static auctions. PAB is the clearly dominant pricing rule and there are often disclosed ceiling prices. However, behind this general picture, some regional, technology and temporal patterns emerge for some design elements.

There are regional differences in the cases of geographical diversity, LCRs, remuneration form, auction form and disclosure of ceiling prices. Some design elements clearly show a distinct pattern over time (volume, size diversity, selection criteria, auction format, auction type, pricing rule and existence of ceiling prices). In contrast, the differences

[11] FIPs include a higher degree of compatibility with electricity markets by promoting the active participation of renewable electricity generation in wholesale markets, providing exposure to price signals (European Commission, 2013).

[12] In this case, market integration should not be a main concern, given their lower potential to massively contribute to the power mix.

[13] Another issue, which is not addressed in this paper, is whether the less mature technologies should be remunerated with administratively-set FITs or FITs set in auctions [see Jacobs et al. (2020) in this regard].

across technologies are less marked and are circumscribed to geographical diversity, auction format and remuneration form.

Based on the assumption that policy goals and context conditions (the socioeconomic, institutional and political features of the countries) substantially affect the choices made in the design of RES auctions, and that, thus, the design of auctions reflects (to a certain extent), those priorities, we have tried to provide a preliminary explanation for the observed differences between regions, technologies and over time. These explanations could be regarded as hypotheses on such causal relationships and should be analysed in detail in future research.

Our findings suggest the existence of some relevant policy goals, as reflected by auction design. These include integrating a large and increasing amount of RES-E in electricity systems with a considerable penetration of RES (as in Europe), minimising the costs of supporting RES and competitive auction prices (Europe and America) or meeting secondary goals such as industrial/local development (Africa and Asia) or actor diversity (Europe). These goals may be influenced by the context conditions of the countries where auctions are conducted. For example, the existence of weak grids in Africa probably encourages the implementation of geographically diverse and site-specific auctions there; excellent renewable resources which make RES a cost-efficient electricity generation alternative to meet the demand of a growing population may increasingly lead to technology-neutral auctions (as in America); low income levels and few local development opportunities may be behind LCRs and multicriteria auctions (as in some countries in Africa, Asia and America); the need to limit investor risks in a context of difficult access to credit in emerging RES-E markets and low penetration of variable RES may have influenced the adoption of FITs/PPAs vs. FIPs (as in Africa); and the need to integrate RES-E in a context with a high share of variable renewables is probably behind the choice of FIPs vs. FITs (as in Europe). Some of those goals and context conditions are contradictory and call for the adoption of opposite design elements. Therefore, the analysis of those conflicts between goals and the way they are reflected in auction design calls for further research on this topic.

However, the literature on policy diffusion and transfer suggests that this link between goals (influenced by context conditions) and design choices is probably too simplistic and other factors could also play a role, which have not been considered in this article. This is why those propositions should be taken with care, and further empirical analysis on that link is needed. This would certainly cover a gap in the literature. As argued by Matsuo & Schmidt (2019), how policy priorities influence policy design has been a topic disregarded in the literature on RES-E auctions. Only a few authors have identified policy goals and national features which can be expected to influence the design of RES-E auctions, using official documents and secondary material for this purpose, e.g. Matsuo & Schmidt (2019) for Mexico and South Africa Lucas et al., (2017), for auctions in Sub-Saharan Africa and del Río & Mir-Artigues (2019) for CSP auctions.

Other limitations of this paper suggest more lines for future research. First, although material and financial prequalification requirements are often argued to be a best practice in the literature (del Río, 2017a; IRENA, 2015; Wigan et al., 2016) and their use is widespread, they have not been included in this article for the reasons explained in Section 3. Therefore, further research should specifically be devoted to this analysis. Second, the analysis has abstracted from other aspects, such as the existence of complementary policies which may have an influence on the design elements being adopted by countries in their auction.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Al Rahahleh, L. (2018). *The current situation of the renewable energy in Jordan*, in *Reports. Publications of Karelia University of Applied Sciences*, 1–37.
Alfa Diallo, A., Dézsi, B., Bartek-Lesi, M., Szabó, L., Mezősi, A. (REKK). 2020. Auctions for the support of renewable energy in Slovakia. Report of the EU-funded AURES II project D2.2-SK, July 2020, http://aures2project.eu/wp-content/uploads/2020/09/AURES_II_case_study_planned_Slovakia.pdf
Anatolitis, V. (2019). *Auctions for the support of renewable energy in Greece, in Report of the EU-funded AURES II project.*
Anatolitis, V., & Grundlach, P. (2020). *Auctions for the support of renewable energy in Ukraine, in Report of the EU-funded AURES II project.*
Anatolitis, V., & Welisch, M. (2017). Putting renewable energy auctions into action – An agent-based model of onshore wind power auctions in Germany. *Energy Policy*, *110*, 394–402.
Asian Development Bank, *ADB-Supported Solar Project in Cambodia Achieves Lowest-Ever Tariff in ASEAN*, in *ADB news release*. 2019.
Azuela, G.E., et al., *Performance of renewable energy auctions: experience in Brazil, China and India*. 2014: The World Bank.
Bajaj, S. (2019). *Cambodia Invites Bids for a 60 MW Solar Project, in Mercom India.*
Batz, T., & Müsgens, F. (2019). *A first analysis of the photovoltaic auction program in Germany*. in *2019 16th International Conference on the European Energy Market (EEM)*. *IEEE*, 1–5.
Bayer, B. (2018). Experience with auctions for wind power in Brazil. *Renewable and Sustainable Energy Reviews*, *81*, 2644–2658.
Bayer, B., Berthold, L., & de Freitas, B. Moreno Rodrigo (2018). The Brazilian experience with auctions for wind power: An assessment of project delays and potential mitigation measures. *Energy Policy*, *122*, 97–117.
Bayer, B., Schäuble, D., & Ferrari, M. (2018). International experiences with tender procedures for renewable energy – a comparison of current developments in Brazil, France, Italy and South Africa. *Renewable and Sustainable Energy Reviews*, *95*, 305–327.
Beetz, B. (2017). *Japan: Disappointing first auction; plans for 200 GW solar by 2050, in PV Magazine.*
Bellini, E. (2017a). *Egypt issues tender for 600 MW of solar, in PV Magazine.*
Bellini, E. (2017b). *Armenia pre-qualifies 10 developers for 55 MW solar tender, in PV Magazine.*
Bellini, E. (2017c). *Lebanon's 180 MW solar tender moves forward, in PV Magazine.*
Bellini, E. (2017d). *Lebanon approves plan to install 180 MW of solar, in PV Magazine.*
Bellini, E. (2017e). *Lebanon issues RfP for 180 MW of solar, in PV Magazine.*
Bellini, E. (2018a). *India Power wins Albania's large-scale solar tender, in PV Magazine.*
Bellini, E. (2018b). *Albania's ERBD-supported 50–100 MW solar auction moves forward, in PV Magazine.*
Bellini, E. (2018c). *Algeria issues 150 MW solar tender, in PV Magazine.*
Bellini, E., *Engie wins Senegal's 60 MW PV tender with bids under €0.040/kWh*, in *PV Magazine*. 2018d.
Bellini, E. (2018e). *Tunisia reveals winners of 70 MW solar tender.*
Bellini, E. (2018f). *Fotowatio wins Armenia's 50 MW solar tender, in PV Magazine.*
Bellini, E. (2019a). *Engie secures financing for 60 MW of solar in Senegal, in PV Magazine.*
Bellini, E., *Japan's fourth solar auction concludes with lowest bid of $0.098/kWh*, in *PV Magazine*. 2019b.
Bellini, E. (2019c). *Another 300 MW solar auction for Japan, in PV Magazine.*
Bellini, E. (2019d). *Another disappointing solar auction for Japan as prices stay high, in PV Magazine.*
Bellini, E., *Albania's 140 MW PV tender concludes with final price of €0.02489/kWh*, in *PV Magazine*. 2020.
Bellini, E. and M. Hall, *China auction allocates subsidies for 22.7 GW of solar with lowest bid of $0.0407/kWh*, in *PV Magazine*. 2019.
Bermudez, V., *Japan, the new "El Dorado" of solar PV?* Journal of Renewable and Sustainable Energy, 2018. 10(2).
Bhambhani, A., *Ecuador's Power Generation Company Celec EP Announces Tender For 200 MW PV & 110 MW Wind Power Projects; Tender Process To Be Launched On Aug. 28*, 2019, in *Taiyang News*. 2019.
Bhambhani, A. (2020). *140 MW Solar Power Capacity Tendered In Albania By Ministry Of Infrastructure & Energy; Tariffs Capped At €55/MWh, in Taiyang News.*
Bose, A. S., & Sarkar, S. (2019). India's e-reverse auctions (2017–2018) for allocating renewable energy capacity: an evaluation. *Renewable and Sustainable Energy Reviews*, *112*, 762–774.
Boute, A. (2012). Promoting renewable energy through capacity markets: An analysis of the Russian support scheme. *Energy Policy*, *46*, 68–77.
Buckman, G., Sibley, J., & Bourne, R. (2014). The large-scale solar feed-in tariff reverse auction in the Australian Capital Territory. *Australia. Energy Policy*, *72*, 14–22.
Buckman, G., Sibley, J., & Ward, M. (2019). The large-scale feed-in tariff reverse auction scheme in the Australian Capital Territory 2012, to 2016. *Renewable Energy*, *132*, 176–185.
CAMMESA. *CAMMESA website*. 2020; Available from: https://portalweb.cammesa.com/pages/renovar.aspx.
Cassetta, E., et al. (2017). Is the answer blowin' in the wind (auctions)? An assessment of the Italian support scheme. *Energy Policy*, *110*, 662–674.

CEER (2018). *Tendering procedures for RES in Europe: State of play and first lessons learnt, in CEER Public Document.*

Chadha, M. (2015). *Jordan Awards 200 MW Capacity In Its First Renewable Energy Tender, in Clean Technica.*

China Energy Portal, *Notice on results of 2019 national government subsidy tender for PV power generation projects*, G.A.D. National Energy Administration, Editor. 2019.

Clean Technica (2017). *Indian Wind Prices Reach Record Low In 1 Gigawatt Auction, in Clean Technica.*

Clifford Change (2019). Opportunities and challenges in "game changing" Tunisian Solar and Wind tenders. *Clifford Change.*

Climatescope, *Algeria PV Tender*, in *Climatescope*. 2018a.

Climatescope, *Egypt Renewables Reverse Auctions*, in *Climatescope*. 2018b.

Clover, I. (2016). *Japan solar auctions approved by cabinet, in PV Magazine.*

Clover, I., *Spain's Alten Renewable Energy wins tender to develop 45.5 MW Namibia solar park*, in *PV Magazine*. 2017.

De Jager, D., et al. (2011). *Financing renewable energy in the European energy market, in Final Report.* Ecofys: Utrecht.

De Lovinfosse, I., L. Janeiro, and M. Gephart, *Lessons for the tendering system for renewable electricity in South Africa from international experience in Brazil, Morocco and Peru*. 2013, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). South African – German Energy Programme (SAGEN).

del Río, P. (2015). *A Methodological Note on the Links Between Components for the Assessment of Design Elements in Auctions for RES, in Report of the EU-funded AURES project.*

del Río, P. (2016a). *Implementation of Auctions for Renewable Energy Support in Portugal: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2016b). *Implementation of Auctions for Renewable Energy Support in South Africa: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2016c). *Implementation of Auctions for Renewable Energy Support in Spain: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2017a). Designing auctions for renewable electricity support. *Best practices from around the world. Energy for Sustainable Development*, *41*, 1–13.

del Río, P. (2017b). *Implementation of Auctions for Renewable Energy Support in Mexico: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2017c). Designing auctions for renewable electricity support: the case of Spain. *Renewable Energy Law & Policy Review*, *8*(2), 23–37.

del Río, P. (2017d). *Implementation of Auctions for Renewable Energy Support in Peru: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2017e). *Implementation of Auctions for Renewable Energy Support in Chile: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2017f). *Implementation of Auctions for Renewable Energy Support in Zambia: A case study, in Report of the EU-funded AURES project.*

del Río, P. (2018). An analysis of the design elements of the third renewable energy auction in Spain. *Renewable Energy Law and Policy Review*, *8*(3), 17–30.

del Río, P. (2019a). *Auctions for the support of renewable energy in Portugal, in Report of the EU-funded AURES II project.*

del Río, P. (2019b). *Auctions for the support of renewable energy in Mexico, in Report of the EU-funded AURES II project.*

del Río, P., & Linares, P. (2014). Back to the future? Rethinking auctions for renewable electricity support. *Renewable and Sustainable Energy Reviews*, *35*, 42–56.

del Río, P., & Mir-Artigues, P. (2019). Designing auctions for concentrating solar power. *Energy for Sustainable Development*, *48*, 67–81.

del Río, P., Wigan, F., & Steinhilber, S. (2015). *Assessment criteria for RES-E Auctions, in Report of the EU-funded AURES project.*

del Río, P., et al. (2015). *Overview of design elements for RES-E auctions, in Report of the EU-funded AURES project.*

del Río, P., et al. (2019). *Auctions for the support of renewable energy in Chile. Main results and lessons learnt*, in *Deliverable 2.1-CL of the EU-funded AURES II project. CSIC*, 1–20.

Diallo, A. (2019). *Polish Renewable Energy Auctions, in Report of the EU-funded AURES II project.*

DMNR, *Alternative Energy Requirement (AER VI* – 2003*)* A competition for Electricity Generation from Biomass, Hydro, and Wind. 2003.

Dobrotkova, Z., Surana, K., & Audinet, P. (2018). The price of solar energy: comparing competitive auctions for utility-scale solar PV in developing countries. *Energy Policy*, *118*, 133–148.

Dodd, J. (2019). *First Tunisia tender rewards European firms, in Windpower Monthly.*

Dowling, A. W., Zheng, T., & Zavala, V. M. (2017). Economic assessment of concentrated solar power technologies: a review. *Renewable and Sustainable Energy Reviews*, *72*, 1019–1032.

Eberhard, A. and W. Kruger, *Renewable Energy Auctions - Improving the design and implementation of renewable energy auctions in Sub-Saharan Africa to accelerate investment in clean energy technologies*. 2019, Energy and Economic Growth Applied Research Programme, University of Capetowwn & UKaid.

Eberhard, A. and R. Naude, *The South African Renewable Energy Independent Power Producer Procurement Programme: A Review and Lessons Learned.* Journal of Energy in Southern Africa, 2016. 27(4).

EDAMA, *Renewable Energy Sector Development in Jordan*. 2019, EDAMA.

EDC, *Invitation for bid. Development of a 60MW solar plant project in Kampong Chhnang Province, Cambodia*, E.d. Cambodge, Editor. 2019.

Edge, G., *A harsh environment: the non-fossil fuel obligation and the UKrenewables industry*, in *Renewable Energy Policy and Politics*. 2006, Routledge. p. 179–200.

ENEL, *Auctions.* Enel experience and key factors. 2018.

Energy Sector Management Assistance Program, *Renewable Energy Projects tendered in Sri Lanka (Yet to be Awarded)*. 2017a.

Energy Sector Management Assistance Program, *Renewable Energy Projects tendered in Sri Lanka up to 31st December 2017*. 2017b, Energy Sector Management Assistance Program.

Essig, S., et al. (2019). *Policies for CSP deployment by renewable energy cooperation in the EU*, in *Deliverable 6.2, MUSTEC project. Fraunhofer ISI*, 1–63.

European Bank for Reconstruction and Development (EBRD), *Competitive Selection and Support for Renewable Energy. Policy Guidelines*. 2018.

European Commission, *guidance for the design of renewable support schemes. Accompanying the document Communication from the Commission. Delivering the internal market in electricity and making the most of public intervention*, in *SWD (*2013*) 439 final*. 2013: Brussels 5.11.2013.

Factor, *Subastas de energía renovable en Latinoamérica y Caribe*. 2017, Factor: Bilbao.

Fenés, G. (2019). *Los pliegos de la subasta de energías renovables que lanzó el Gobierno de Ecuador, in Energía Estratégica.*

Fitch-Roy, O. (2015). *Auctions for Renewable Support in California: Instruments and lessons learnt, in Report of the EU-funded AURES project.*

Förster, S., & Amazo, A. (2016). *Auctions for Renewable Energy Support in Brazil: Instruments and lessons learnt, in Report of the EU-funded AURES project.*

Garzón, M., & Kitzing, L. (2019). *Auctions for the support of renewable energy in Denmark, in Report of the EU-funded AURES II project.*

Gephart, M., Klessmann, C., & Wigand, F. (2017). Renewable energy auctions–When are they (cost-) effective? *Energy & Environment*, *28*(1–2), 145–165.

GIZ, *Renewable energy auctions. Goal-oriented policy design*. 2015, Bonn.

Global Wind Energy Council (2020). *Market to watch: Taiwan Offshore Wind, in Global Wind Energy Council.*

Göß, S., *Renewables in China* 2019*: The mid-year status of generation and subsidy schemes*, in *Energy Brainpool*. 2019.

Government of Albania Ministry of Infrastructures and Energy, *Ankand ndërkombëtar për impiantin më të madh fotovoltaik në Vlorë/Ftesë për Ofertë*. 2018.

Government of Algeria, *Décret exécutif n°17–98 du 29 Joumada El Oula 1438 correspondant au 26 février 2017 définissant la procédure d'appel d'offres pour la production des énergies renouvelables ou de cogénération et leur intégration dans le système national d'approvisionnement en énergie électrique*, in *Journal Officiel de la Republique Algerienne*. 2017.

Government of Colombia, *Long-term power purchase tender specific terms and conditions*. 2019a, Ministry of Energy and Mines, Mining and Energy Planning Unit.

Government of Colombia, *UPME specific terms and conditions of the long-term power purchase auction / CLPE auction*. 2019b, Ministry of Energy and Mines, Mining and Energy Planning Unit.

Government of Japan. *Present Status and Promotion Measures for the introduction of Renewable Energy in Japan*. 2011; Available from: https://www.meti.go.jp/english/policy/energy_environment/renewable/index.html.

Government of Kazakhstan, *On approval of the Rules for organization and conduct of auction bidding, including qualification requirements for auction participants, the content and procedure for submitting an application, types of financial security of an application for participation in the auction and conditions for their submission and return, the procedure for summarizing and determining winners*., in *Order of the Minister of Energy of the Republic of Kazakhstan*. 2018.

Government of Portugal, *National Energy and Climate Plan*. Portugal 2021-2030. 2019a.

Government of Portugal, *Leilões de capacidade renovável em Portugal*. 2019b.

Government of Spain, *Royal Decree 960/2020 (Subastas Renovables)*. 2020.

Grashof, K. (2019). Are auctions likely to deter community wind projects? And would this be problematic? *Energy Policy*, *125*, 20–32.

Grashof, K., et al. (2020). Long on promises, short on delivery? Insights from the first two years of onshore wind auctions in Germany. *Energy Policy*, *140*.

Groenendaal, B. (2018). *2x 125MW Solar Power Projects announced in Ethiopia, in Green Building Africa.*

Hall, M. (2019a). *Scatec Solar secured 300 MW of solar capacity in 500 MW Tunisia auction, in PV Magazine.*

Hall, M. (2019b). *Cambodia tender secures lowest solar power price in Southeast Asia, in PV Magazine.*

Hall, M. (2019c). *China reveals details of first 15 GW of grid parity solar, in PV Magazine.*

Hamed, T. A., & Bressler, L. (2019). Energy security in Israel and Jordan: The role of renewable energy sources. *Renewable Energy*, *135*, 378–389.

Haufe, M. -C., & Ehrhart, K. -M. (2018). Auctions for renewable energy support – Suitability, design, and first lessons learned. *Energy Policy*, *121*, 217–224.

Haugwitz, F. (2019). *Towards a subsidy-free era for China's solar PV market, in Apricum.*

Held, A., et al., Design features of support schemes for renewable electricity. A report within the European project "Cooperation between EU MS under the Renewable Energy Directive and interaction with support schemes". 2014, Ecofys: Utrecht, The Netherlands.

Hochberg, M., & Poudineh, R. (2018). *Renewable Auction Design in Theory and Practice: Lessons from the Experiences of Brazil and Mexico*, in *Oxford Institute for Energy Studies. University of Oxford*, 1–54.

IEA, *Reference Pricelist Record for the calculation of Electrical Energy purchase prices from Renewable Energy Sources* 2013, IEA.

IEA, *Israel solar PV auction*. 2017.

IEA, *Albania First Solar PV Auction (July 2018)*. 2018a.

IEA, *Ethiopia Solar Auctions*. 2018b.

IEA, *Japan Solar PV Auctions*, in *IEA Policy Database*. 2020.

International Finance Corporation (IFC), *Two Scaling Solar Projects in Senegal Advance to Construction with IFC Financing Package*. 2019, International Finance Corporation, World Bank Group: Washington D.C.

IPP Journal (2018). *Kazakhstan awards over 850 MW capacity in 2018 renewables auctions, in IPP Journal.*

IRENA (2013). *Renewable Energy Auctions in developing Countries.*

IRENA, *Renewable Energy Auctions: A Guide to Design*. 2015: Abu Dhabi, United Arab Emirates.

IRENA, *Renewable Energy Auctions. Analysing 2016*. 2017: Abu Dhabi.

IRENA, *Renewable Energy Outlook: Egypt*. 2018a: Abu Dhabi.
IRENA. *Renewable energy auctions. Cases from sub-saharan Africa*. 2018b.
IRENA, *Renewable energy auctions. Status and trends beyond price*. 2019a: Abu Dhabi.
IRENA, *Renewable energy auctions: Status and trends beyond price*. 2019b, International Renewable Energy Agency: Abu Dhabi.
IRENA (2020). *Renewable Energy Outlook Lebanon*.
Jacobs, D., et al., The Case for a Wider Energy Policy Mix in Line with the Objectives of the Paris Agreement. Shortcomings of Renewable Energy Auctions Based on World-wide Empirical Observations. 2020, Energy Watch Group, World Future Council/Global Renewables Congress and Haleakala Stiftung.
Jakob, M. (2019). *Auctions for the support of renewable energy in the Netherlands, in Report of the EU-funded AURES II project.*
Jonuzaj, K. (2018). *Albania completes first renewable energy support auction in Energy Community, in Renewables Now.*
Keating, C. (2019a). *ACWA's "record" bid wins 250MW Scaling Solar duo in Ethiopia, in PV Tech.*
Keating, C. (2019b). *Cambodia's 60MW solar auction draws record-low bid, in PV Tech.*
Kenning, T. (2017). *Time running out to apply for 300MW of Thai hybrid PPAs with 'continuous baseline' requirements, in Energy Storage News.*
Kenning, T. (2018a). *Six developers pre-qualified for 25MW Scaling Solar tender with storage in Madagascar, in PV Tech.*
Kenning, T. (2018b). *Armenia issues LoA for 55MW solar project, in PV Tech.*
Kenning, T. (2019). *Tunisia awards 60MW of solar, in PV Tech.*
Khana, A., & Barroso, L. (2014). *Promoting Renewable Energy through Auctions: The Case of India, in The World Bank.*
Kitzing, L., & Wendring, P. (2015). *Auctions for Renewable Support in Denmark: Instruments and lessons learnt, in Report of the EU-funded AURES project.*
Knaack, J.M., *Enabling PV in the MENA Region. The Emerging PV Market in Jordan*. 2014, giz Deutsche Gesellschaft für Internationale Zusammenarbeit.
KOREM (Kazakhstan electricity and power market operator), *Holding auctions for selection of renewable energy sources projects*. 2019.
KOREM (Kazakhstan electricity and power market operator). *Website of* KOREM. 2020; Available from: https://vie.korem.kz/eng/zakonodatelstvo/.
KOREM and USAID, *Renewable energy auctions in Kazakhstan 2018–2019 results. Report prepared jointly by Kazakhstan Electricity and Power Market Operator JSC (*KOREM *JSC) and the USAID Power the Future Regional Program.* 2020.
Kreiss, J., Ehrhart, K. -M., & Haufe, M. -C. (2017). Appropriate design of auctions for renewable energy support – Prequalifications and penalties. *Energy Policy*, *101*, 512–520.
Kruger, W. and A. Eberhard, *Renewable energy auctions in sub-Saharan Africa: Comparing the South African, Ugandan, and Zambian Programs.* Wiley Interdisciplinary Reviews: Energy and Environment, 2018. 7(4).
Kruger, W., A. Eberhard, and K. Swartz, *Renewable energy auctions: A global overview*. 2018, Graduate School of Business. University of Cape Town.
Kruger, W., Stritzke, S., & Trotter, P. A. (2019). De-risking solar auctions in sub-Saharan Africa – A comparison of site selection strategies in South Africa and Zambia. *Renewable and Sustainable Energy Reviews*, *104*, 429–438.
Lawrence, H. C. M. (2018). *Senegal Scaling Solar tender produces one of the lowest electricity costs in Africa*, in *International Finance Corporation. World Bank Group.*
Lee, C. -L. (2019). *Policy of Offshore Wind in Taiwan.* Bureau of Energy, Editor: M.o.E.A.
Lilliestam, J. (2018). Whither CSP ? Taking stock of a decade of concentrating solar power expansion and development. Deliverable 4.2 of the MUSTEC project, funded by the European Commision under the H2020 programme. *Zürich*, 1–57.
Lilliestam, J., & Pitz-Paal, R. (2018). Concentrating solar power for less than USD 0.07 per kWh: finally the breakthrough? *Renewable Energy Focus*, *26*, 17–21.
Lucas, H., del Río, P., & Cabeza, L. F. (2020). Stand-alone renewable energy auctions: The case of Peru. *Energy for Sustainable Development*, *55*, 151–160.
Lucas, H., P. del Río, and M.Y. Sokona, *Design and assessment of renewable electricity auctions in sub-saharan Africa.* IDS Bulletin, 2017. 48(5–6).
Lundberg, L. (2019). Auctions for all? Reviewing the German wind power auctions in 2017. *Energy Policy*, *128*, 449–458.
Maisch, M. (2018). *Victoria announces first RE auction winners, pledges battery subsidy scheme, in PV Magazine.*
Matsuda, D., Umino, K., & Morita, T. (2018). *Japan Renewable Energy Update, in DLA Piper.*
Matsuo, T., & Schmidt, T. S. (2019). Managing tradeoffs in green industrial policies: The role of renewable energy policy design. *World Development*, *122*, 11–26.
Maurer, L., & Barroso, L. (2011). Electricity auctions: an overview of efficient practices. *The World Bank: Washington*, 1–155.
MEDREG, *Analysis of auction mechanisms to promote RES*, in *Final Report*. 2019, MEDREG.
Menzies, C., & Marquardt, M. (2019). *Renewable electricity auctions in Alberta (Canda), in Report of the EU-funded AURES II project.*
Menzies, C., Marquardt, M., & Spieler, N. (2019). *Auctions for the support of renewable energy in Argentina, in Report of the EU-funded AURES II project.*
Meyer, R., Tenenbaum, B., & Hosier, R. (2015). Promoting solar energy through auctions: the case of Uganda. *The World Bank*, 1–8.
Mir-Artigues, P., Del Río, P., & Caldés Gómez, N. (2019). The Economics and Policy of Concentrating Solar Power Generation. *Switzerland: Springer*.
Mitchell, C. (2000). The England and Wales non-fossil fuel obligations: History and lessons. *Annual Review of Energy and the Environment*, *25*, 285–312.
Mitchell, C., & Connor, P. (2004). Renewable energy policy in the UK 1990–2003. *Energy Policy*, *32*(17), 1935–1947.
MOEABOE, *Directions for Allocating Installed Capacity of Offshore Wind Potential Zones Taiwan, R.O.C. Entry into Force since 18th, January 2018*. 2018.
Molina, J., Scharen-Guivel, N., & Hyman, E. (2018). Analysis of Renewable Energy Auctions in Six Countries. *U.S. Agency for International Development: Washington*, 1–39.
Montmasson-Clair, G., & Ryan, G. (2014). Lessons from South Africa's renewable energy regulatory and procurement experience. *Journal of Economic and Financial Sciences*, *7*(S), 507–526.
Mora, D., et al. (2017). *Auctions for renewable energy support - Taming the beast of competitive bidding, in Final report of the EU-funded AURES project.*
Nasirov, S., et al. (2019). Policy makers' perspectives on the expansion of renewable energy sources in chile's electricity auctions. *Energies*, *12*.
Noothout, P., D. De Jager, and L. Tesnière, Van Rooijen Sascha. *The impact of risks in renewable energy investments and the role of smart policies*. in *DiaCore*. 2016.
O&G Links, *Alten Energy wins NamPower solar tender* in *O&G Links*. 2017.
OLADE (Organización Latinoamericana de Energía), *Procesos competitivos para el financiamiento de proyectos de energías renovables*. 2020.
Petrova, V. (2018a). *Madagascar pre-qualifies bidders for 25-MW solar tender, in Renewables Now.*
Petrova, V. (2018b). *Armenia awards LoA to 55-MW solar tender winner, in Renewables Now.*
Petrova, V. (2019a). *World Bank guarantees 60 MW of solar projects in Senegal, in Renewables Now.*
Petrova, V. (2019b). *Tunisia grants licences to 120 MW of wind projects, in Renewables Now.*
Power Technology, *Japan to slash solar subsidies as feed-in tariff costs mount*, (in *Power Technology* 2019).
Publicover, B. (2017). *Japan's METI awards 140 MW in first PV auction - Report, in PV Magazine.*
Publicover, B. (2018). *Japan auctions 197 MW in second PV tender, in PV Magazine.*
Pueyo, A., et al. (2015). *Green growth diagnostics for Africa: Literature review and scoping study.*
PV Magazine, *Jordan Round 3 PV auction attracts lowest bid of $0.02488/kWh*, in *PV Magazine*. 2018a.
PV Magazine (2018b). *Jordan delays announcement of Round 3 PV tender winners, in PV Magazine.*
PWC, *Power in Indonesia. Investment and taxation guide. 6th edition*. 2018.
Rani, K. S. A. (2019). *IFC approves financing for two Scaling Solar projects in Senegal, in NS Energy.*
Rego, E. E. (2013). Reserve price: Lessons learned from Brazilian electricity procurement auctions. *Energy Policy*, *60*, 217–223.
Rego, E. E., & de Oliveira Ribeiro, C. (2018). Successful Brazilian experience for promoting wind energy generation. *The Electricity Journal*, *31*(2), 13–17.
REN21, *Renewables* 2020. *Global Status Report*. 2020: Paris. p. 104.
ReNews.biz, *PV high five for EDF in Israel*, in ReNews.biz. 2018.
RES4MED, *Algerian case study. Mechanisms and main factors of a RES auction*. 2018.
RES4MED, *Scaling-up renewable energy deployment in Jordan*, in *Position paper*. 2019, RES4MED.
Resources, Government of Ecuador Ministry of Energy and Natural Nonrenewable Resources, *Proceso público de selección para la concesión de El Aromo - Proyecto fotovoltaico*. 2019.
Reuters, *Jordan PV tariffs drop 50% in second tender round*, in *Reuters*. 2015.
Rice, W. (2014). *Russia's Second Renewable Energy Auction Gives Both Glimmer of Hope and Cause for Concern, in King & Spalding Energy Newsletter.*
Richter, A. (2019). *Geothermal to keep FIT in Japan, while auction system is introduced for solar and wind, in Think Geonenergy.*
Rojo Martín, J. (2019). *ENGIE's 60MW Scaling Solar duo hits financial close in Senegal, in PV Tech.*
Rojo Martín, J. (2020). *Albania's new 140MW solar auction to pave way for future growth, in PV Tech.*
Romeiro, D.L., E.L.F.d. Almeida, and L. Losekann, *Systemic value of electricity sources – What we can learn from the Brazilian experience?* Energy Policy, 2020. 138.
Sach, T. (2019). *Auctions for the support of renewable energy in Germany, in Report of the EU-funded AURES II project.*
Sánchez Molina, P. (2020). *Solarpack y Cobra Zero-E resultan ganadoras de la subasta renovable de Ecuador, in PV Magazine.*
Sarı, A.e.C. and D.e. Saygın, *On the way to efficiently supplying more than half of Turkey's electricity from renewables: Opportunities to strengthen the YEKA auction model for enhancing the regulatory framework of Turkey's power system transformation*. 2018.
Scaling Solar (2018a). *Madagascar launches RQF for latest scaling solar tender, in Scaling Solar.*
Scaling Solar (2018b). *Pre-qualified bidders for scaling solar tender in Madagascar announced, in Saling Solar.*
Scaling Solar (2021). *Ethiopia*, in *Scaling Solar*. *World Bank Group*.
Schenuit, C., *The economies of support policies for renewables. Money well spent. Effective allocation of financial support and enhancement of system integration of renewable energies.* 2018, German Energy Agency (DENA): Berlin.
Shrimali, G., Konda, C., & Farooquee, A. A. (2016). Designing renewable energy auctions for India: Managing risks to maximize deployment and cost-effectiveness. *Renewable Energy*, *97*, 656–670.
Shumkov, I. (2018). *Tunisia extends 130-MW wind tender deadline, in Renewables Now.*
Singh, S. (2016). *MNRE issues bidding guidelines for setting up 1,000 Mw wind power capacity, in Energy World.*
Smeets, N. (2017). Similar goals, divergent motives. The enabling and constraining factors of Russia's capacity-based renewable energy support scheme. *Energy Policy*, *101*, 138–149.
Steinhilber, S. (2016). *Onshore wind concessions in China: Instruments and lessons learnt, in Report of the EU-funded AURES project.*
Stuurman, F., O. Alao, and W. Kruger, *Ethiopia Country Report*. 2019, Energy and Economic Growth Applied Research Programme, UKaid.
Tantravanich, K., *Competitive Biddings Renewable Energy Projects in Thailand* in *SPP Hybrid-Firm Asian Clean Energy Forum* 2018 Manila, Philippines. 2018.

Tazmakina, B. (2019). *Renewable Energy Auctions in Kazakhstan.*
Thapar, S., Sharma, S., & Verma, A. (2018). Analyzing solar auctions in India: Identifying key determinants. *Energy for Sustainable Development*, *45*, 66–78.
The Maritime Executive, *Taiwan Holds First Major Offshore Wind Auction*, in *The Maritime Executive*. 2018.
Tisheva, P., *Taiwan awards 1.66 GW offshore wind at as low as USD 73/MWh*, in *Renewables Now*. 2018.
Tongsopit, S. (2017). Designing Renewable Energy Incentives and Auctions: Lessons for ASEAN. *United States Agency for International Development*, 1–166.
Tsagas, I. (2015a). *Jordan's solar PV spring, in PV Magazine.*
Tsagas, I. (2015b). *Jordan's second PV tender leads to record low tariffs, in PV Magazine.*
Tsagas, I. (2015c). *Jordan's solar tender bears fruit, in PV Magazine.*
U.S. International Trade Administration, *Japan - Renewable Energy*. 2019.
USAID, *Designing renewable energy auctions: a policymaker's guide.* Scaling up renewable energy project - July 2019a. 2019.
USAID (2019b). *Snapshot of Colombia's first long-term energy auction.*
USAID (2019c). *Investor's guide to renewable energy projects in Kazakhstan.*
Viana, A. G., & Ramos, D. S. (2018). Outcomes from the first large-scale solar PV auction in Brazil. *Renewable and Sustainable Energy Reviews*, *91*, 219–228.
Victoria State Government, *Victorian Renewable Energy Targets (VRET)* 2017 Reverse Auction Questions and Answers. 2017.
Victoria State Government, *Victorian Renewable Energy Target 2018–19 Progress Report*. 2019.
Viscidi, L., & Yepez, A. (2019). Clean energy auctions in Latin America. *Inter-American Development Bank*, 1–59.
Wang, Q. (2010). Effective policies for renewable energy—the example of China's wind power—lessons for China's photovoltaic power. *Renewable and Sustainable Energy Reviews*, *14*(2), 702–712.
Welisch, M. (2019). Multi-unit renewables auctions for small markets - Designing the Danish multi-technology auction scheme. *Renewable Energy*, *131*, 372–380.
Wentworth, A., *Taiwan orders 1.6 gigawatts of new offshore wind power*, in *Climate Action*. 2018.
Wigan, F., et al. (2016). *Auctions for renewable energy support: lessons learnt from international experiences, in Report of the EU-funded AURES project.*
Winkler, J., Magosch, M., & Ragwitz, M. (2018). Effectiveness and efficiency of auctions for supporting renewable electricity – what can we learn from recent experiences? *Renewable Energy*, *119*, 473–489.
Woodman, B. and O. Fitch-Roy, *Auctions for the support of renewable energy in the U.K.*, in *Report of the EU-funded AURES II project*. 2019.
World Bank (2018). Time to Shine: Introducing Armenia's Solar Industry. *World Bank*.
Yu, J., et al. (2009). An over painted oriental arts: Evaluation of the development of the Chinese renewable energy market using the wind power market as a model. *Energy Policy*, *37*, 5221–5225.