

D2.1-HR, April 2022

Auctions for the support of renewable energy in Croatia

Main results and lessons learnt





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Contents

1	Introduction.....	4
2	Renewables in the Croatian electricity sector	5
3	Renewable electricity support schemes in Croatia	7
4	Characteristics of RES auctions in the country.....	9
5	Evaluation of results.....	13
6	Conclusions	15

1 Introduction

Croatia is one of the latest EU member states to introduce auctions for the support of renewable energy sources (RES). Although renewable energy utilisation is high, surpassing the 2020 target for the electricity sector, support schemes were not available consistently over the past decade probably because there were few incentives to invest further in RES expansion in this situation.

Despite the envious position, the official plans and strategies can do more to develop significant renewable electricity capacities in Croatia. The country has strong potential for photovoltaic and wind plants (both on-shore and offshore) which can be supplemented with flexible hydro capacities to ease system integration. To do so, there will need to be improvement from the first auction that concluded with low participation and high prices.

The case study is structured as follows. Chapter 2 provides a brief overview of the composition of the Croatian electricity generation and the development of renewable electricity capacities. Chapter 3 describes the main stages for the evolution of the renewable electricity support system and sectoral targets in the national strategies. The main characteristics of the renewable energy auction design are described in Chapter 4. Chapter 5 provides an analysis of the first auction round. The report ends with conclusions in Chapter 6.



2 Renewables in the Croatian electricity sector

Utilisation of renewables in the energy sector is in a well-advanced phase in Croatia. The binding target for Croatia was to achieve a renewable share of 20% until 2020, which was exceeded by a great margin reaching an actual share 31.02% according to Eurostat¹. The long-term policy goals articulated in the NECP (2019)² and the new Energy Strategy (2020)³ aim to achieve 36.4% and 37% shares by 2030, respectively. The Energy Strategy goes further by establishing a 2050 RES share target of 53.2% - 65.6%.

Figure 1 shows the electricity mix of the country in 2020.

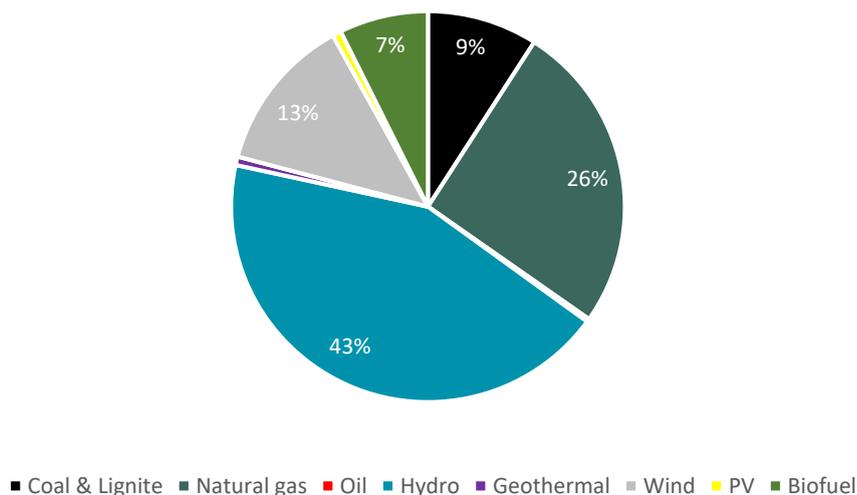


Figure 1: Electricity mix of Croatia in 2020, Source: Eurostat

In 2020 65% of the total electricity generated in Croatia was from RES. Of the RES, the largest share in the total electricity generation has hydro power which provides 40% of the electricity, followed by onshore wind (13%) and bioenergy (7%). The contribution of solar PV and geothermal electricity is marginal. In 2020, the renewable electricity share relative to gross electricity consumption was more than 53%.

Figure 2 shows the historic evolution of renewable electricity capacities in Croatia and the share of RES based capacities relative to all power plants.

¹ https://ec.europa.eu/eurostat/databrowser/view/t2020_31/default/table?lang=en

² https://energy.ec.europa.eu/system/files/2020-01/hr_final_necp_main_en_0.pdf

³ https://narodne-novine.nn.hr/clanci/sluzbeni/2020_03_25_602.html

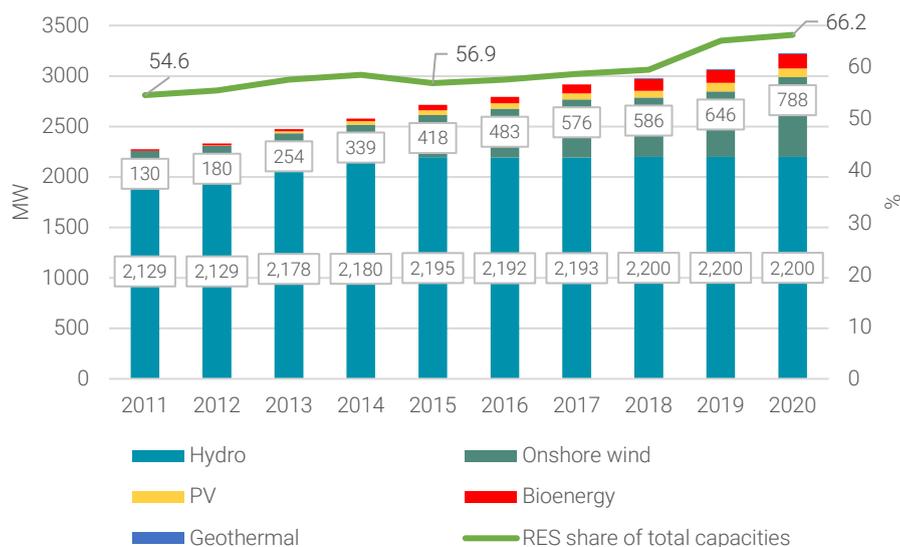


Figure 2: RES capacity share in Croatia, 2011-2020, Source: Irena Renewable Capacity statistics 2021 (2021)⁴

Since 2011, hydro has been relatively stable with 9 water reservoir power plants (1.5 GW), 7 run of river plants (400 MW), and small-scale facilities (45 MW). Onshore wind increased from 130 MW in 2011 to 788 MW in 2020. The share of RES increased from 54.6% in 2011 to 66.2% in 2020.

Croatia's planned capacity expansions are summarised in Figure 3⁵ based on NECP (2019).

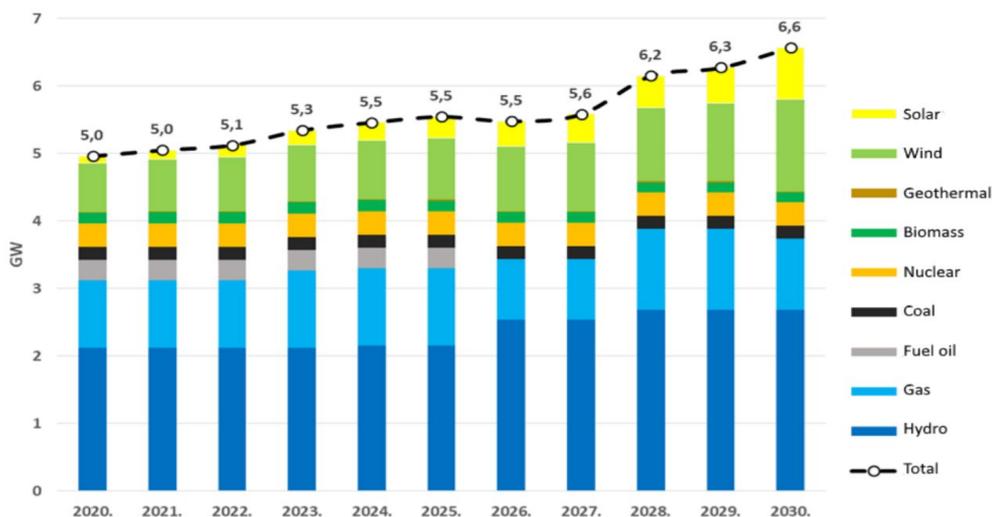


Figure 3: Projected capacity of power plants, Source: NECP (2019)

The figure above shows that considerable capacity growth is expected in hydro, onshore wind and solar. By 2030, hydro capacity will grow by 500 MW, onshore wind by 630 MW, and PV by 680 MW.

⁴ <https://www.irena.org/publications/2021/March/Renewable-Capacity-Statistics-2021>

⁵ Note: Nuclear refers to the Krško NPP located on the territory of the Republic of Slovenia, of which the Republic of Croatia holds 50% ownership and uses 50% of available power and energy. In the Eurostat data power produced by this nuclear power plant is not considered as domestic electricity.

3 Renewable electricity support schemes in Croatia

Croatia introduced its first administratively set feed-in tariff (FiT) system in 2007⁶. Small (below 1 MW) and large installations (above 1 MW) were separated and even further differentiated for some technologies. Only small PV installations, with capacity less than 1 MW were eligible to receive support, to the detriment of utility scale PV in Croatia.

This scheme largely remained in place until 2012⁷, when a new regulation nearly halved tariffs for small PVs from more than 285 EUR/MWh to less than 150 EUR/MWh. Meanwhile, tariffs for most other technologies were slightly raised. The last major legislative revision came in 2014⁸, introducing two major changes. First, the upper boundary for small projects was raised to 5 MW, which was a boom for solar PV installations. Second, for larger power plants the FiT was linked directly with the end user supply tariff defined as “the amount of the valid tariff item for energy at the single daily tariff for electricity supply within the universal service, tariff model Blue”, also called as reference price (Article 3, 16 and Article 4).⁹ Table 1 summarises the evolution of tariffs in the Croatian feed-in tariff scheme:

Table 1: Administratively set tariff levels before the introduction of Auctions

Technology	Size	Tariff 2007 (EUR/MWh)	Tariff 2012 (EUR/MWh)	Tariff 2014 (EUR/MWh)
PV	30 kW to 1 or 5 MW	286.23	146.3	201.74 ¹⁰
not integrated PV ¹¹	30 KW to 5 MW	-	-	Reference price
Wind	at most 1 MW	87.23	95.76	Reference price
Wind	more than 1 MW	88.60	94.43	Reference price
Hydro	at most 1 MW	94.05	79.8-159.6 ¹²	121.83
Hydro	more than 15 000 MWh in a year	57.24	75.81	Reference price
Solid Biomass (wood processing)	at most 1 MW	129.49	159.6-176.89 ¹³	163.75-170.3
more than 1 MW	more than 1 MW	113.13	119.7-159.6 ¹⁴	Reference price

Source: Decree on Tariff system for production of electricity from renewable sources and cogeneration (2007, 2012, 2014)

Then in 2016 the system was abolished by the new Law on Renewable Energy Sources and High-Efficiency Cogeneration¹⁵. This set the minimum limit for RES installations to 30 kW to participate in auctions. Projects

⁶ https://narodne-novine.nn.hr/clanci/sluzbeni/2007_03_33_1082.html

⁷ https://narodne-novine.nn.hr/clanci/sluzbeni/2012_06_63_1508.html

⁸ https://narodne-novine.nn.hr/clanci/sluzbeni/2013_11_133_2888.html

⁹ https://narodne-novine.nn.hr/clanci/sluzbeni/2013_11_133_2888.html

¹⁰ Only for integrated PV.

¹¹ PV which is installed separately on rooftops not integrated into the original design.

¹² Further size segmentation was introduced.

¹³ Further size segmentation was introduced.

¹⁴ Further size segmentation was introduced.

¹⁵ https://narodne-novine.nn.hr/clanci/sluzbeni/2015_09_100_1937.html

under 0.5 MW are entitled to feed-in tariffs and those above 0.5 MW enter a one-sided sliding feed-in premium scheme. The exact design and requirements were not specified in the law, only the general framework of tenders.

Since the introduction of the new law, a relatively long time has passed, until the detailed regulation of the auctions came into force at the beginning of 2019¹⁶. This delay is attributable to the relatively advanced state of Croatia's RES in the power sector ahead of binding EU targets and a shortage of available funding during the period (Musec & Kanceljak (2020))¹⁷. According to Musec & Kanceljak (2020), the Croatian government increased the consumer levy to address funding issues. Nevertheless, the new support scheme would also be needed to achieve new RES pathways articulated in the NECP and Energy Strategy.

A 2020 decree¹⁸ specified capacity quotas per technology for 2030, summarised in Table 2. The government expects the biggest contribution from large solar PV above 10 MW (625 MW) and onshore wind over 3 MW (1.05 GW). The document also stresses the need for a renewable support regulation to be approved by the European Commission as soon as possible. Once the targets have been set, the first auction in Croatia took place in the second half of 2020¹⁹, which is the focus of this report.

Table 2: Eligible quotas for support by technology and size

Group	Classification of production plants depending on the primary energy source and installed capacity	quota (kW)
a.2	Solar power plants with an installed capacity of more than 50 kW up to and including 500 kW	210,000
a.3	Solar power plants with an installed capacity of more than 500 kW up to and including 10 MW	240,000
a.4	Solar power plants with an installed capacity of more than 10 MW	625,000
b.1	Hydropower plants with an installed capacity of up to and including 50 kW	4,000
b.2	Hydropower plants with an installed capacity of more than 50 kW up to and including 500 kW	10,000
b.3	Hydropower plants with an installed capacity of more than 500 kW up to and including 10 MW	10,000
c.4	Wind farms with an installed capacity of more than 3 MW	1,050,000
d.2	Biomass power plants with an installed capacity of more than 50 kW up to and including 500 kW	6,000
d.3	Biomass power plants with an installed capacity of more than 500 kW up to and including 2 MW	20,000
d.4	Biomass power plants with an installed capacity of more than 2 MW to 5 MW	15,000
e.2	Geothermal power plants with an installed capacity of more than 500 kW	20,000
f.2	Biogas power plants with an installed capacity of more than 50 kW up to and including 500 kW	15,000
f.3	Biogas power plants with an installed capacity of more than 500 kW up to and including 2 MW	30,000
	Innovative technologies, according to the classification of production plants from the energy approval, which have received support for development within the European Union	10,000

Source: Decree 2020/57 NN, Regulation on quotas for electricity production from renewable energy and high-efficiency cogeneration, Article 4

As a final point, the European Commission approved²⁰ a new scheme which paved the way for the new Law on Renewable Energy Sources and High-Efficiency Cogeneration²¹ in 2021. This increased the lower limit for small projects to 50 kW, introduced a two-sided sliding premium scheme (also called CfD), and also removed size differentiation within the different categories. However, auctions under the new framework have not been organised yet.

¹⁶ https://narodne-novine.nn.hr/clanci/sluzbeni/2018_12_116_2300.html

¹⁷ <https://cms.law/en/int/expert-guides/cms-expert-guide-to-renewable-energy/croatia>

¹⁸ https://narodne-novine.nn.hr/clanci/sluzbeni/2020_05_57_1141.html

¹⁹ http://files.hrote.hr/files/OIEIK_Premije/JAVNI%20NATJE%C4%8CAJ%2012.11.2020..pdf

²⁰ https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6422

²¹ https://narodne-novine.nn.hr/clanci/sluzbeni/2021_12_138_2272.html

4 Characteristics of RES auctions in the country

The following tables summarise the most important characteristics of Croatia's first auction round in 2020. Transferring the support scheme into auctions was defined in detail by a government decree in 2018²², which specified a comprehensive set of definitions and auction design elements. Although the decree defines 36 different size categories for solar PV, hydro, wind, biomass, geothermal, biogas, liquid biofuel, cogeneration plants, hybrid production plants and other technologies, only 7 were open in this first round.²³ This detailedness of technological and size differentiation was used in early phases when RES support was introduced in Croatia and was kept in the new scheme too to foster smaller RES projects to participate in the scheme and to help more efficiently targeted RES expansion. The European Commission has come out against such detailed size categories, so technological differentiation will be applied in the forthcoming rounds only.

Table 3: Characteristics of the first concluded auction round in Croatia

Characteristics	Description of the auction
Characteristics of the national electricity market	Main source of electricity is hydro accounting for almost 50% of the generated electricity followed by natural gas with more than 25% share. Bioenergy (solid biomass and biogas) and onshore wind contribute significantly to renewable based electricity generation.
Name of auction scheme	Support Program for the Electricity Generation Incentive System from renewable energy sources and high-efficiency cogeneration
Contractual counterparty	Croatian Energy Market Operator (HROTE)
Main features	Technology-specific auction awarding FiT or FiP for different baskets, targeting relatively small installations and/or less established technologies
Technology focus and differentiation (eligible technologies)	PV, biomass, biogas, hydropower
Lead time before auction	Two months from the date of publication of the Public Invitation
Min./max. size of project	Size categories for FiT: <ul style="list-style-type: none"> - PV: 50-500 kW (a.1.) - Hydropower: up to 50 kW and 50-500 kW (b.1. and b.2.) - Biomass: 50-500 kW (d.2.) - Biogas: 50-500 kW (f.2.) Size categories for FiP: <ul style="list-style-type: none"> - Biomass: 500-2.000 kW (d.3.) - Biogas: 500-2.000 kW (f.3.)
What is auctioned?	Capacity

²² https://narodne-novine.nn.hr/clanci/sluzbeni/2018_12_116_2300.html

²³ http://files.hrote.hr/files/OIEIK_Premije/JAVNI%20NATJE%20C4%8CAJ%2012.11.2020..pdf



Budgetary expenditures per auction and per year	783 million EUR was approved for the period 2021-2023
Frequency of auctions	At least one round per year is planned
Volume of the tender	88 MW Volume cap for categories for FiT support <ul style="list-style-type: none"> - PV: 50 MW (a.1.) - Small hydropower: 4 MW (b.1.) - Big hydropower: 5 MW (b.2.) - Biomass: 6 MW (d.2.) - Biogas: 7 MW (f.2.) Volume cap for categories for FiP support <ul style="list-style-type: none"> - Biomass: 8 MW (d.3.) - Biogas: 8 MW (f.3.)
Costs related to grid connection/access	Costs are determined individually for each project as the subject of a grid connection contract
Balancing and profile costs	Balancing costs are 0.003 HRK/kWh (0.04 ct/kWh) for all categories except ²⁴ : <ul style="list-style-type: none"> - 0.01 HRK/kWh (0.13 ct/kWh) for solar - 0.015 HRK/kWh (0.20 ct/kWh) for wind

Table 4: Design elements of auctions in Croatia

Design elements	Description
Auction format	Multi-unit auction
Auction procedure	Selection of bidders must be conducted within 30 days after the bid submission deadline expires Price only selection criterion (after meeting all conditions of the tendering procedure) When valid bids exceed the quota of the specific round, they are sorted from lowest to highest. In case of equal bids projects are sorted by capacity from smallest to the biggest. If undersubscribed, all valid bids win.
Pre-qualification requirements - Financial	Bid bond in a form of a bank guarantee or a proof of payment for cash deposit for 50 HRK/kW (6.6 EUR/kW) If the bid loses or is invalid, the bond is returned to the bidder Winning projects have to deposit 300 HRK/kW (39.8 EUR/kW) performance bond in addition.
Pre-qualification requirements - Material	Location permit (ownership is not required at the time of bidding) Building permit

²⁴ https://narodne-novine.nn.hr/clanci/sluzbeni/2018_12_116_2300.html

Pricing rule	Pay-as-bid
Price limits (ct/kWh)	<p>Maximum reference price for FiT support (ct/kWh)</p> <ul style="list-style-type: none"> - PV: 8.36 (a.1.) - Small hydropower: 16.84 (b.1.) - Large hydropower: 13.93 (b.2.) - Biomass: 17.64 (d.2.) - Biogas: 14.99 (f.2.) <p>Maximum reference price for FiP support (ct/kWh)</p> <ul style="list-style-type: none"> - Biomass: 14.85 (d.3.) - Biogas: 14.32 (f.3.)
Support period	12 years
Favourable treatment of specific actors	Not specified
Realisation time limit	<p>4 years for all technologies and size baskets from the date of the guaranteed purchase price or market premium contract.</p> <p>This deadline is generally applicable for all technologies and size baskets and delaying production is not possible.</p>
Penalties	<p>If a project owner wins but fails to sign a support contract, the bid bond is forfeited.</p> <p>If a project owner fails to start production within four years of signing the support contract, both bid and performance bonds, and the right to the support are forfeited.</p> <p>Incorrect data submitted to the support contract results in its termination.</p>
Form of support auctioned	FiT for plants in the small size baskets, one-sided sliding FiP for larger categories
The method of reference wholesale price calculation	<p>Reference price is calculated monthly as the ratio of the sum of hourly reference electricity prices for each billing interval (CROPEX hourly price) and the number of billing intervals in the month.</p> <p>For wind and solar, the weighted average of hourly reference electricity prices for each billing interval is calculated based on the net delivered electricity by wind/solar capacities.</p>
Support level adjustments	Prices are adjusted every year according to the previous year's consumer price index.
Transferability of support right	Possible
Other	<p>There must be at least 3 bids in each basket for the auction to be valid.</p> <p>In biomass categories the bidder must enclose a technical description of the production plant to confirm that at least 30% of the biomass is wood residue from primary wood processing of the legal entity or related parties.</p>

The first auction set a relatively small volume cap. There was no room for all technologies, e.g., onshore wind. Several small (up to 50kW) and larger categories were not open this time. Highest emphasis was given to solar PV, accounting for more than half of the auctioned capacity.

Capacity is auctioned without other specific caps (e. g. on budget) defined. Yearly frequency is determined by the regulation, but this did not mean any certainty for the investors as a lot of different baskets are defined without knowing which ones will be open in the next round and which not. As mentioned earlier, the size baskets will be merged and only the technology-based distinction will remain in the next auctions. Since the auctions were introduced, one round was completed in 2020 and the second was scheduled for 2021, but was postponed to 2022, with very different characteristics, giving the opportunity to large-scale solar and wind installations to be awarded.

Ceiling prices for each basket are calculated based on historical cost data from completed projects and inputs from experts and set at a level to attract the most competitive projects while meeting quantitative quotas. Feedstock market volatility creates more uncertainty for biogas and biomass fuelled plants and will be included in the development of the ceiling price methodology.

Projects are eligible to apply for support in the early planning phases. Any changes made to the construction or to the location of the plant must be reported within 30 days, but it cannot increase the voltage of the grid connection.

At the time of bidding, location and building permits are required of which the first one is more difficult to obtain. For larger projects, the competent authority is the ministry, for smaller projects it is the local authorities that issue the location permits. There are some new regulations that have not yet been introduced into secondary legislation. Until this process is completed, it is quite difficult for new projects to get access to the grid and to get new permits. The reason for this is that there are many projects that are already in the development stage and have all the permits and even if they have not started construction yet, the grid connection capacity is reserved for them. All new projects come after them, and as the total volume of the projects in development is very large, this creates a real barrier for new project developers to obtain permits and participate in auctions. The new project developers are less likely to participate in the upcoming auctions, as there are many projects already in the development phase ("in-pipeline effect").



5 Evaluation of results

The first Croatian auction was differentiated by technology and size. As smaller projects were allowed to participate, a high number of bids were required to ensure sufficient competition.

Only the large biogas category was competitive, surpassing the total offered volume in the basket by 21%. This is the only basket where almost the full volume was awarded. However, the smaller biogas basket was invalid, along with small hydro.

This round focused mostly on PV installations as more than half of the total auctioned capacity was dedicated to this basket. 75 bids were submitted in this category with an average size of 250 kW applying for a capacity of 19.3 MW, less than half of the total offered amount. Eventually only 57 projects – with a total capacity of 13.4 MW – won, due to the high number of non-valid bids.

In the larger hydro basket 4 out of 10 bids won, accounting for 18% of total offered capacities. Being more competitive, 85% of auctioned capacity in the large biomass basket was bid for but only 26% was awarded, quite close to the results in the small biomass basket (22%).

Table 5: Auction results: number of bids and volumes

	PV 50-500 kW (a.1.)	Hydro up to 50 kW (b.1.)	Hydro 50-500 kW (b.2.)	Biomass 50-500 kW (d.2.)	Biomass 500-2.000 kW (d.3.)	Biogas 50-500 kW (f.2.)	Biogas 500-2.000 kW (f.3.)	Total
Total number of bids received	75	0	10	8	5	2	7	107
Total capacity of received bids, MW	19.3	0	1.9	3	6.8	0.7	9.7	41.5
% of basket volume cap	39%	n/a	38%	50%	85%	n/a	121%	47%
Number of winning bids	57	n/a	4	3	2	n/a	5	71
Total capacity of winning offers	13.4	n/a	0.9	1.3	2.1	n/a	7.7	25.5
% of basket volume cap	27%	n/a	18%	22%	26%	n/a	96%	29%

Source: HROTE²⁵

As we can see, competition was very low in all baskets except for the larger biogas category, but this does not mean that prices were more competitive in this basket. In fact, almost all winning bids were very close to the maximum reference price defined by the auctioneer. The PV basket was price competitive despite a complete lack of support over the preceding five years, with the lowest bid coming in at 74% of the set reference price. Since PV was undersubscribed, the only explanation for lower prices are market players having expected a higher competition. 21 out of 75 projects were over 470 kW, indicating that investors would probably be interested in support for larger projects.

In other baskets even the lowest bids approached the reference price because the baskets were so narrowly defined. Also, based on other countries' experience in the first auction, investors are generally more cautious with their bids compared to later rounds.

²⁵ <https://files.hrote.hr/files/PDF/OIEIK/2020/2020-12-30%20Javna%20objava%20rezultata%20natje%C4%8Daja.pdf>

Table 6: Auction results – prices (ct/kWh)

	PV 50-500 kW (a.1.)	Hydro up to 50 kW (b.1.)	Hydro 50-500 kW (b.2.)	Biomass 50-500 kW (d.2.)	Biomass 500-2.000 kW (d.3.)	Biogas 50-500 kW (f.2.)	Biogas 500-2,000 kW (f.3.)
Lowest awarded price	6.22	-	13.79	17.51	14.85	-	13.93
Highest awarded price	8.36	-	13.93	17.64	14.85	-	14.32
Average awarded price	7.77	-	13.86	17.59	14.85	-	14.16
Reference price	8.36	16.84	13.93	17.64	14.99	14.85	14.32
% of average awarded price to max. ref. price	93%	-	99.5%	99.7%	100%	-	98.9%

Source: based on HROTE²⁶, currency converted using 2020 average exchange rate

The effectiveness of the auction round cannot be assessed based on the realisation rate, as the time elapsed was short while the deadlines for completion were exceptionally generous. However, only 29% of the total auction capacity was awarded, which is a rather low proportion resulting in a much lower RES expansion rate than expected.

The introduction of the tendering procedure for RES support is intended to reduce costs compared to the administratively set prices of the previous system, but as can be seen, the ceiling prices have attracted fewer bids than expected, indicating that prices are unlikely to decrease in the near future. The photovoltaic category had the lowest winning bid compared to the ceiling.

With such small and strictly defined baskets bidders will have very similar capabilities. Smaller project developers were able to compete and even submit bids for more than one project. While foreign companies were permitted to participate, none did.

About one in three bids were invalid despite a very thorough public process, reflecting the high number of inexperienced smaller developers²⁷.

²⁶ <https://files.hrote.hr/files/PDF/OIEIK/2020/2020-12-30%20Javna%20objava%20rezultata%20natije%20C4%8Daja.pdf>

²⁷ <https://balkangreenenergynews.com/croatia-grants-renewables-incentives-for-25-5-mw-in-first-ever-auction/>

6 Conclusions

Croatia is a relative latecomer to RES auctions because it met and surpassed its targets without utilising auctions well before 2020. The first RES auction round announced at the end of 2020 can be considered as a pilot, focusing on very specific and relatively small projects, so it is not possible to draw general conclusions which are valid for the whole scheme, as several important characteristics will be modified in the forthcoming rounds.

With low participation/competition, high prices, and high ratio of invalid bids, the auction was not a good showing – solar PV was the only technology basket to achieve a significant price reduction relative to the ceiling price. Even if it is not unusual that the first round did not bring very competitive prices, no price reductions were realised for other baskets than PV. Effectiveness of the auction was very low, which can be the result of opening baskets which were not popular among the investors who decided to wait for later rounds.

More efficient large-scale projects expected to participate in later rounds should improve overall competition and reduce prices. With a high volume of projects in the pipeline, permitting is already underway for several projects that will participate in the forthcoming rounds.



AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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