



# **ECONOMICS OF LARGE-SCALE RENEWABLE ENERGY PROJECTS IN EUROPE AND THE WESTERN BALKANS**

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## Overview

1. Photovoltaic (PV)-generated electricity prices and investment costs
2. Auctions for subsidies for PV electricity generation
3. Successful public-private partnership (PPP) models for large-scale renewable energy source (RES) power plants
4. Economics of large-scale RES projects to be subsidized in Kosovo

# **PV-Generated Electricity Prices and Investment Costs**

# Trends in power exchange prices for RES electricity

The average realized annual price of HUPX and calculated prices for each technology:

|                                      | <b>Average<br/>(€/MWh)</b> | <b>2011<br/>€/MWh</b> | <b>2012<br/>€/MWh</b> | <b>2013<br/>€/MWh</b> | <b>2014<br/>€/MWh</b> | <b>2015<br/>€/MWh</b> | <b>2016<br/>€/MWh</b> | <b>2017<br/>€/MWh</b> | <b>2018<br/>€/MWh</b> | <b>2019<br/>€/MWh</b> | <b>2020<br/>€/MWh</b> | <b>2021<br/>€/MWh</b> |
|--------------------------------------|----------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <b>HUPX+SEEPEX<br/>average price</b> | <b>51.4</b>                | 56.0                  | 50.6                  | 42.4                  | 40.5                  | 40.6                  | 35.4                  | 47.6                  | 51.2                  | 48.6                  | 39.2                  | 113.9                 |
| <b>PV</b>                            | <b>54.1</b>                | 63.4                  | 60.3                  | 46.5                  | 43.9                  | 44.6                  | 36.6                  | 55.9                  | 53.5                  | 54.4                  | 35.6                  | 100.3                 |
| <b>Wind</b>                          | <b>51.8</b>                | 54.4                  | 51.1                  | 41.7                  | 39.3                  | 39.7                  | 35.8                  | 48.3                  | 50.5                  | 49.5                  | 40.6                  | 119.4                 |

# Investment costs for PV power plants

The U.S. National RES Laboratory (NREL) overview of investment costs for the first quarter of 2020 shows significantly reduced PV investment costs from 2010 to 2020

|  | <b>2010</b><br><b>US\$ per watt</b> | <b>2015</b><br><b>US\$ per watt</b> | <b>2020</b><br><b>US\$ per watt</b> |
|--|-------------------------------------|-------------------------------------|-------------------------------------|
| Residential PV (5.7 kW)                    | 7.53                                | 3.36                                | 2.71                                |
| Commercial - rooftop<br>(200 kW)           | 5.57                                | 2.40                                | 1.72                                |
| Utility scale – network<br>supply (100 MW) | 4.75                                | 1.93                                | 0.94                                |

Source: NREL, U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020

## Investment costs for PV power plants (cont.)

The price was further reduced in the first half of 2021

| <b>Installed capacity</b> | <b>Fixed-tilt –<br/>US\$ per watt</b> | <b>One-axis tracker –<br/>US\$ per watt</b> |
|---------------------------|---------------------------------------|---|
| 5 MW                      | 1.13                                  | 1.22  |
| 10 MW                     | 1.03                                  | 1.13  |
| 50 MW                     | 0.91                                  | 0.98  |
| 100 MW                    | 0.83                                  | 0.89  |

However, the global energy crisis that started in the second half of 2021 impacted investment costs, which increased

## Investment costs for PV power plants (cont.)

- According to the IRENA report on renewable power generation costs in 2020, the average investment (total installed) costs are:
  - PV power plants = 883 US\$/kW
  - Wind farms = 1,355 US\$/kW, a 31% decrease compared to 2010
- Important factors for decreasing investment costs:
  - Decrease of interest rates (from 5.5% to 4%)
  - Increase of debt fraction
  - Lower cost of equity (around 10%)
  - Annual degradation rate of PV panels (0.7%)

Estimation for 2022 - the overall investment costs of new utility-scale PV and onshore wind plants will be higher by between 15% and 25%, while the prices in 2023 will be on the 2020 level

# **Auctions for Subsidies for PV Electricity Generation**



# North Macedonia

- Inverse proportion trend - premiums for PVs on private land fell drastically as electricity prices rose dramatically
- Tender for PVs on public land - for higher installed capacity, no premium was requested by investors

|  | e-auction 1<br>November 2019<br>public land |         | e-auction 2<br>January 2020<br>private land | e-auction 3<br>February 2022<br>private land |                 |             |
|--|---|---------|---|--|-----------------|-------------|
| Installed capacity per power plant               | ≥1 MW                                       | 1-10 MW | 0-3 MW                                      | 0.2-1 MW                                     | 1-5 MW          | 5-10 MW     |
| Awarded premium amount range                     | 3,78 – 5,87 €/MWh                           | 0.00    | 12 – 14,9 €/MWh                             | 0.01-7.55 €/MWh                              | 0.42-3.40 €/MWh | 14.62 €/MWh |
| HUPX average price in the month of the e-auction | 43.93 €/MWh                                 |         | 52.96 €/MWh                                 | 194.27 €/MWh                                 |                 |             |

# Croatia

The only completed tender for premiums in Croatia was intended for small-scale PVs when the electricity price on the market was still low, therefore the average price awarded was only slightly lower than the maximum reference price.

|   | e-auction 1<br>November 2020<br>private land   | e-auction 2<br>July 2022<br>private land           |
|---|--|--|
| Installed capacity per power plant                  | 50-500 kW  | ≥500 kW  |
| Awarded premium amount range                        | 61.9 – 83.1 €/MWh<br>average = 77.4 €/MWh<br>Maximum reference price =<br>83.1 €/MWh | Ongoing<br>Maximum reference price =<br>65.8 €/MWh |
| HUPX average price in the month<br>of the e-auction | 48.88 €/MWh  | 197.95 €/MWh                                       |

# Greece

Trend of declining prices for PV support, reaching 32.9 €/MWh as the lowest requested price for electricity, which will be generated from a 1 MW installed capacity PV power plant; average price is 37.6 €/MWh.

|  | e-auction 1<br>August 2020<br>private land                                      | e-auction 2<br>May 2021<br>private land  |
|--|---|--|
| Installed capacity per power plant               | ≤20MW   | ≤20MW  |
| Awarded premium amount range                     | 45.8 – 62.4 €/MWh<br>Average = 49.8 €/MWh<br>Maximum reference price = 63 €/MWh | 32.9 – 51.2 €/MWh<br>Average = 37.6 €/MWh<br>Maximum reference price = 53.86 €/MWh |
| HUPX average price in the month of the e-auction | 37.60 €/MWh   | 59.94 €/MWh  |

# Germany

- Average price in the 2022 auction for ground-mounted PVs increased slightly, from 50 €/MWh to 51.9 €/MWh
- Prices achieved in Germany's tenders for innovative installations, off-shore wind projects, and PVs on buildings and noise barriers are higher and not comparable with prices for ground-mounted PVs

|  | e-auction for ground-mounted PVs<br>April 2022 | e-auction for innovative installation<br>April 2022 | e-auction for PV on buildings and noise barriers<br>April 2022 |
|--|--|---|--|
| Installed capacity per power plant               | ≥751 kW  | ≥751 kW   | N/A  |
| Awarded premium amount range                     | 40 - 55 €/MWh<br>average = 51,9 €/MWh          | 3.95 - 7.43 ct/kWh.<br>average = 5.42 ct/kWh        | 7 - 8.91 ct/kWh<br>average = 8.53 ct/kWh                       |
| HUPX average price in the month of the e-auction | 109.02 €/MWh                                   | 189.18 €/MWh  |  |

# **Successful PPP Models for Large-Scale RES Power Plants**

# PPP for Wind Power Plan in Montenegro

## Krnovo 72 MW Wind Farm Project (2015)

- PPP awarded on the basis of a direct negotiation with the public partner, following the presentation of an unsolicited proposal
- Public partner is the Ministry of Economy, which assumed responsibility of finalizing the lease of the land
- Investment value = €120 million; EBRD and KfW were financiers
- Guaranteed feed-in tariff for a period of 12 years
- PPP contract duration = 20 years

# PPP for PVs in North Macedonia

## Construction and operation of 2 PV power plants (50 MW each) on old mines of the Oslomej mining and energy facility (2021)

- Oslomej is owned and operated by state-owned ESM, the biggest power producer in North Macedonia
- The PPP model:
  - 1) ESM remains owner of the land but transfers to the private partner the right to use the construction land on which the PV power plant is to be built
  - 2) ESM, at its own expense, initiated and completed the procedure for urban planning documentation for the plant
  - 3) Private partner will design, build, and operate the PV power plant
  - 4) Private partner will pay a monthly fee (portion of the generated electricity) to ESM

# **Economics of Large-scale RES Projects to be Subsidized in Kosovo**



## Possible reference prices for the first tender - auction for PV-generated electricity

|   | Capacity (MW) |          |          |           |
|---|---------------|----------|----------|-----------|
| Initial bidding price - support duration period | 1-3           | Up to 10 | Up to 50 | Up to 100 |
| Initial bidding price (€/MWh)<br>15 years       | 73            | 67       | 60       | 56        |
| Initial bidding price (€/MWh)<br>12 years       | 80            | 69       | 64       | 59        |
| Initial bidding price (€/MWh)<br>10 years       | 88            | 77       | 72       | 67        |

## Possible division of lots in the first tender

- Preferred option: three lots (15 MW, 35 MW, and 50MW), which offers opportunities for different investors. Smaller investors would compete in Lot 1, while larger investors would compete in Lots 2 and 3 at competitive prices.
- With such division, the likelihood of lack of competition in any of the lots is reduced.

|                             | Potential Division of Lots in First Tender |              |              |
|-----------------------------|--|--------------|--------------|
| Lot                         | Lot 1: 15 MW                               | Lot 2: 35 MW | Lot 3: 50 MW |
| Installed capacity of plant | 3–4 MW                                     | 32–38 MW     | 45–55 MW     |
| Max number of plants        | 5  | 1            | 1            |
| <b>Total</b>                | <b>100 MW, 7 plants</b>                    |              |              |

## Ensuring competition in the first tender

- **Set rules to minimize possibility of collusion among bidders**
- **Divide the tenders into lots** – limit the number of bids per bidder per lot and/or the number of power plants/total installed capacity that can be awarded to a single bidder
- **Set the tender's subscription rule at a certain percentage** - minimum total capacity offered by all bidders expressed in a percentage that will significantly exceed the total tendered capacity (e.g., 80% subscription rule for total tendered 100 MW of PV capacity means there must be minimum of 180 MW offered by all bidders)
- **Minimum two bids** per lot and/or at least one decrease of the e-auction starting (reference) price by each bidder



# Thank You!

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