

University of Ljubljana Faculty of Electrical Engineering





Cost-effective Potential for PV Generation in SE Europe

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Practical PV potential in SE Europe

I2 Countries and territories covered in the report

Country	ISO code	Country	ISO code
Albania	AL	Moldova	MD
Bosnia and Herzegovina	BH	Montenegro	ME
Bulgaria	BG	Romania	RO
Croatia	HR	Serbia	SR
Kosovo*	XK	Slovenia	SI
FYR of Macedonia	MK	Ukraine	UE

Solar PV On-Grid, suitability >70%









IRENA Global Atlas

- Largest collection of most recent and accurate public maps of RES.
- IRENA Opportunity based approach
 - Outcome is a display of availability for RES projects on land
 - Simple and replicable suitability approach
 - 6 factors are used to estimate suitability in each point of a map
 - Resource intensity, Distance to power grid, Population density, Land cover, Topography and Protected areas.
 - Multiple factors of every area unit (AU) combined
 - Final suitability level of every AU obtained
 - Maps associated with suitability-levels
- Suitability >70% used for SEE area

SSIRENA

INVESTMENT OPPORTUNITIES IN LATIN AMERICA SUITABILITY MAPS FOR GRID CONNECTED AND OFF-GRID SOLAR AND WIND PROJECTS





Cost-effective PV potential





The FiT levels differ among the SEE countries





	Scen. No	Year	<u>Int</u> . <u>Rates</u>	Panel+ inverter price	r <u>loan</u> (%)	r <u>deposit</u> (%)
	1	2016	Initial	Initial	8,84	3,57
	2	2020	Low	Initial	6	2,42
	3	2020	Low	Low	6	2,42
	4	2020	Initial Initial 8,84		8,84	3,57
	5	2020	Initial	Low	8,84	3,57
	6	2020	High	Initial	12	4,85
	7	2020	High	Low	12	4,85
	8	2030	Low	Initial	6	2,42
<u> </u>	9	2030	Low	Low	6	2,42
	10	2030	Initial	Initial	8,84	3,57
	11	2030	Initial	Low	8,84	3,57
	12	2030	High	Initial	12	4,85
-	13	2030	High	Low	12	4,85

		Scen. No	Year	<u>Int</u> . <u>Rates</u>	Panel+ <u>inverter</u> price	r <u>loan</u> (%)	r deposit (%)
		1	2016	Initial	Initial	8,84	3,57
	Results 2010	2	2020	Low	Initial	6	2,42
		3	2020	Low	Low	6	2,42
		4	2020	Initial	Initial	8,84	3,57
10		5	2020	Initial	Low	8,84	3,57
		6	2020	High	Initial	12	4,85
		7	2020	High	Low	12	4,85
	■ Panel price: 0.64 €/W _n	8	2030	Low	Initial	6	2,42
	i i p	9	2030	Low	Low	6	2,42
		10	2030	Initial	Initial	8,84	3,57
		11	2030	Initial	Low	8,84	3,57
		12	2030	High	Initial	12	4,85
	80	13	2030	High	Low	12	4,85
PPV Potential (GW)	60 50 40 30 20 10	—Inst —EE F	alled I Price (:	5 100%)			
	0						
	0,0 10,0 20,0 30,0 40,0 50,0 60,0 LCOE PV (€/MWh)	7	70,0	8	0,0		

		Scen. No	Year	Int. <u>Rates</u>	Panel+ <u>inverter</u> price	r <u>loan</u> (%)	r <u>deposi</u> (%)
	Doculto 2020	1	2016	Initial	Initial	8,84	3,57
	Results 2030	2	2020	Low	Initial	6	2,42
		3	2020	Low	Low	6	2,42
		4	2020	Initial	Initial	8,84	3,57
11		5	2020	Initial	Low	8,84	3,57
		6	2020	High	Initial	12	4,85
		7	2020	High	Low	12	4,85
	Initial: (=8.84%)	8	2030	Low	Initial	6	2,42
	•	9	2030	Low	Low	6	2,42
	• Panel price: $\sigma r = f/M$	10	2030	Initial	Initial	8,84	3,57
	ranciprice. 0.52 e/w _p	11	2030	Initial	Low	8,84	3,57
	·	12	2030	High	Initial	12	4,85
PPV Potential (GW)		EE	stallec Price Price Price	d P [GW] (100%) (125%) (75%)]		
	0,0 10,0 20,0 30,0 40,0 50,0 LCOE PV (€/MWh)		50,0		70,0		

		Scen. No	Year	Int. Rates	Panel+ <u>inverter</u> price	r <u>loan</u> (%)	r <u>deposit</u> (%)
	^{>} Doculto 2020	1	2016	Initial	Initial	8,84	3,57
		2	2020	Low	Initial	6	2,42
		3	2020	Low	Low	6	2,42
		4	2020	Initial	Initial	8,84	3,57
12		5	2020	High	Initial	0,04	1.85
		7	2020	High	Low	12	4 85
	Conservative: r=12%	8	2030	Low	Initial	6	2.42
		9	2030	Low	Low	6	2.42
		10	2030	Initial	Initial	8,84	3,57
	Panel price: 0.52 €/W _n	11	2030	Initial	Low	8,84	3,57
		12	2030	High	Initial	12	4,85
	80 [13	2030	High	Low	12	4,85
PPV Potential (GW)	$ \begin{array}{c} 70 \\ 50 \\ 50 \\ 40 \\ 30 \\ 20 \\ 10 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ $		Install EE Prio EE Prio EE Prio	ed P [G ce (1009 ce (1259 ce (75%	W] %)) 80,0		
	LCOE PV (€/MWh)	-	,.		,-		



		Scen. No	Year	Int. Rates	Panel+ <u>inverter</u> price	r <u>loan</u> (%)	r deposit (%)
	Doculto 2020	1	2016	Initial	Initial	8,84	3,57
	RESULS 2030	2	2020	Low	Initial	6	2,42
		3	2020	Low	Low	6	2,42
		4	2020	Initial	Initial	8,84	3,57
14		5	2020	Initial	Low	8,84	3,57
		6	2020	High	Initial	12	4,85
	Initial & Q Q (04)	7	2020	High	Low	12	4,85
	- IIIIIdi: 1=0.04%	8	2030	Low	Initial	6	2,42
		9	2030	Low	Low	6	2,42
	• Panel price: $0.80 \in NN$	10	2030	Initial	Initial	8,84	3,57
	ranerprice. 0.00 e/ w _p	11	2030	Initial	Low	8,84	3,57
	· · ·	12	2030	High	Initial	12	4,85
		13	2030	High	Low	12	4,85
PV Potential (GW)		—Inst	alled	P [GW]			
μ.			Price (Price (Price (100%) 125%) 75%)			
	o		1				
	0,0 10,0 20,0 30,0 40,0 50,0 60,0 LCOE PV (€/MWh)	-	70,0	8	80,0		

		Scen. No	Year	Int. <u>Rates</u>	Panel+ <u>inverter</u> price	r <u>loan</u> (%)	r deposit (%)
	Doculto 2020	1	2016	Initial	Initial	8,84	3,57
	Results 2030	2	2020	Low	Initial	6	2,42
2		3	2020	Low	Low	6	2,42
		4	2020	Initial	Initial	8,84	3,57
15		5	2020	Initial	Low	8,84	3,57
		6	2020	High	Initial	12	4,85
	Concervative r-120%	/	2020	High	Low	12	4,85
		0	2030	Low	Initial	0	2,42
		9	2030	Low	Low	8.84	2,42
	Panel price: 0.80 €/W,	10	2030	Initial	Low	8 84	3.57
		12	2030	High	Initial	12	4.85
		13	2030	High	Low	12	4,85
PV Potential (GW)		Ins EE EE EE	talled Price (Price (Price (P [GW] 100%) 125%) 75%) 90).0		
	0,0 10,0 20,0 30,0 40,0 50,0 60,0 70,0 LCOE PV (€/MWh)		80,0	90	,0		



- The results presented reflect regional focus
 - In the report, the country-specific approach will also be addressed.
- Suitability >70% map: conservative
 - Only the most promising potential is shown
 - Less conservative data (for >50 and >60%) considerably higher
- Results reflect the riskiness of the investment
 - Interest rate reflects country risk
 - In the study, the decision was to treat it conservatively
 - For non-EU countries, 12% is the reference
 - E.g. Ukraine: 20-30%
 - EU countries have lower IR than EnC countries
 - Currently Bulgaria r = 6-8%



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- Practical potential
 - This is "the technical price"
 - No administrative costs included
 - Shows the possible range of FiT
 - Set high at the beginning
 - Initial overcompensating to stimulate the investors
- Per-country analysis forthcoming
- Questions for discussion
 - What extra costs are not included here, but should be?
 - What other prices influence costs and should be modelled?
 - What could be the cost of admin barriers?