iFOREST | INTERNATIONAL FORUM FOR ENVIRONMENT, SUSTAINABILITY & TECHNOLOGY

Odisha Renewable Energy Potential Reassessment

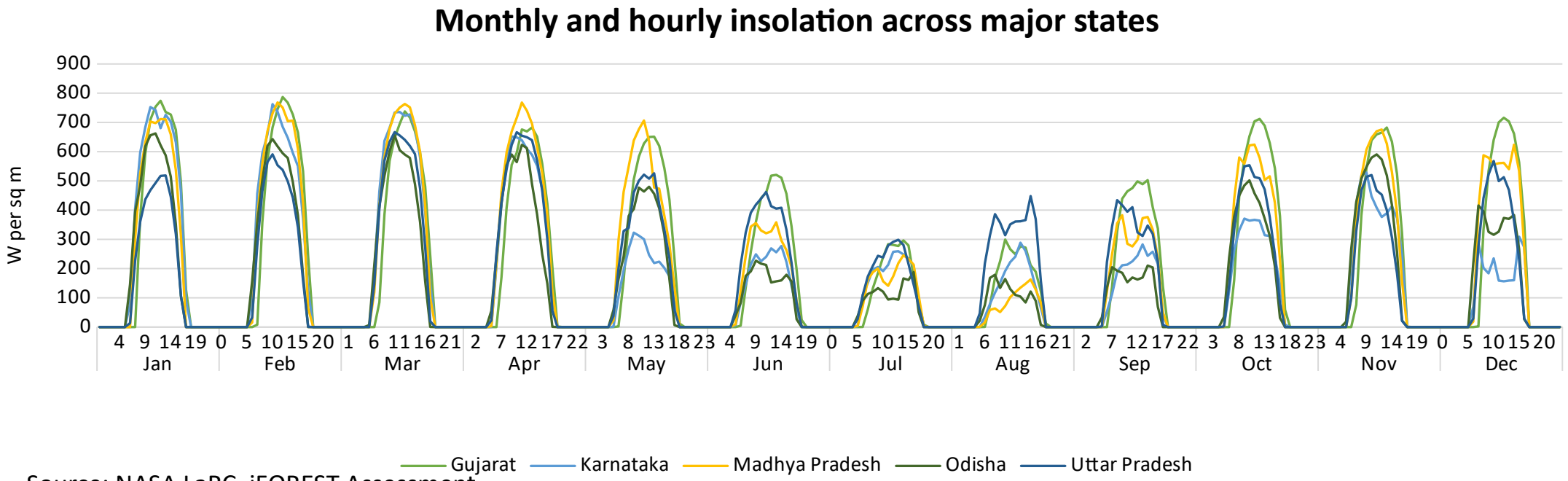
02/10/2025

Solar Energy

02/10/2025

Average Solar Insolation Across Key States

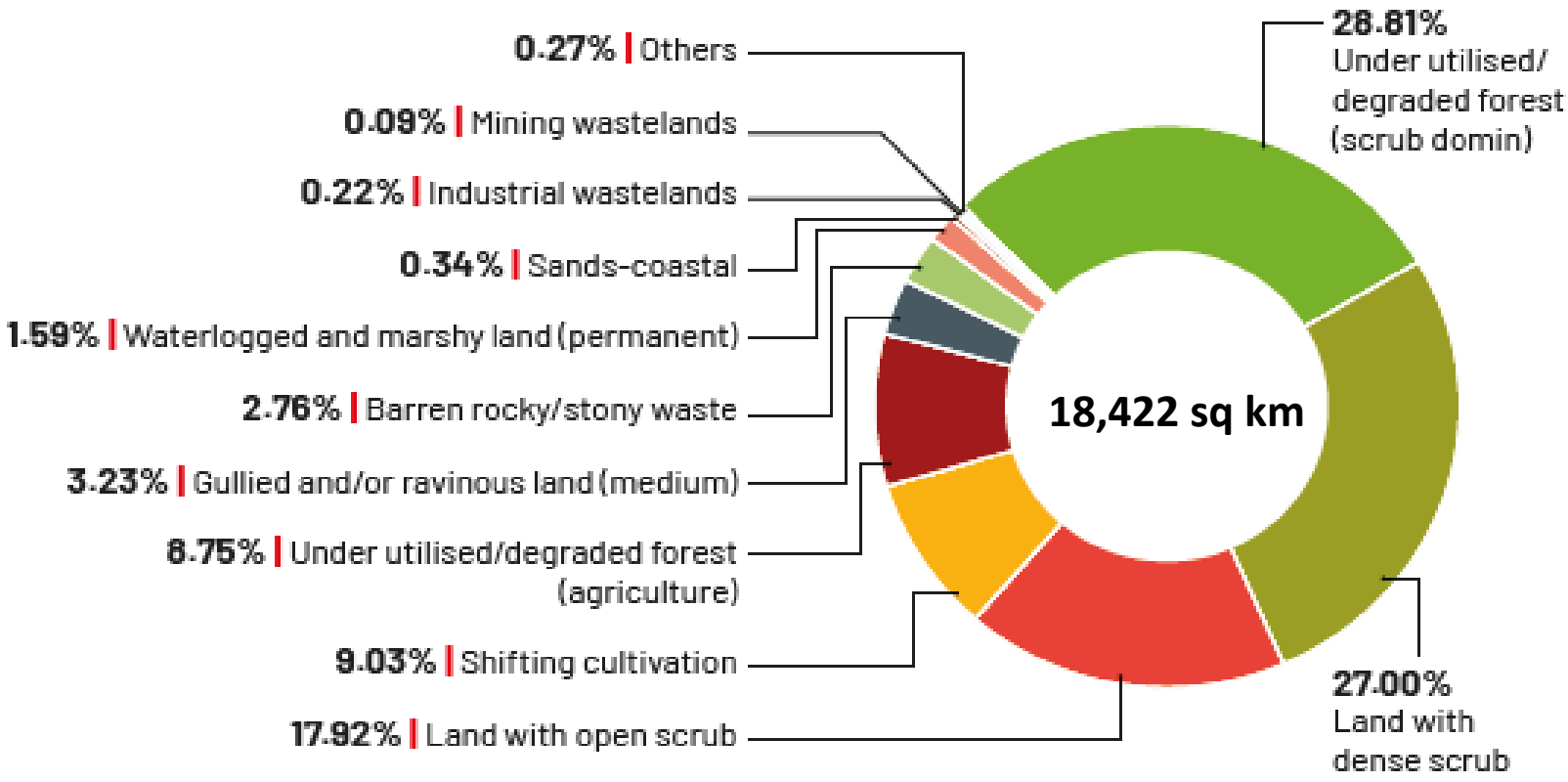
- Over 300 sunny days; average solar radiation of 5.5 kWh per sq m
- Peak insolation is about 900 W per sq m, comparable to states like Gujarat and Uttar Pradesh
- Average insolation of about 390 W per sq m, comparable to Karnataka



Source: NASA LaRC, iFOREST Assessment

Wasteland Availability in Odisha

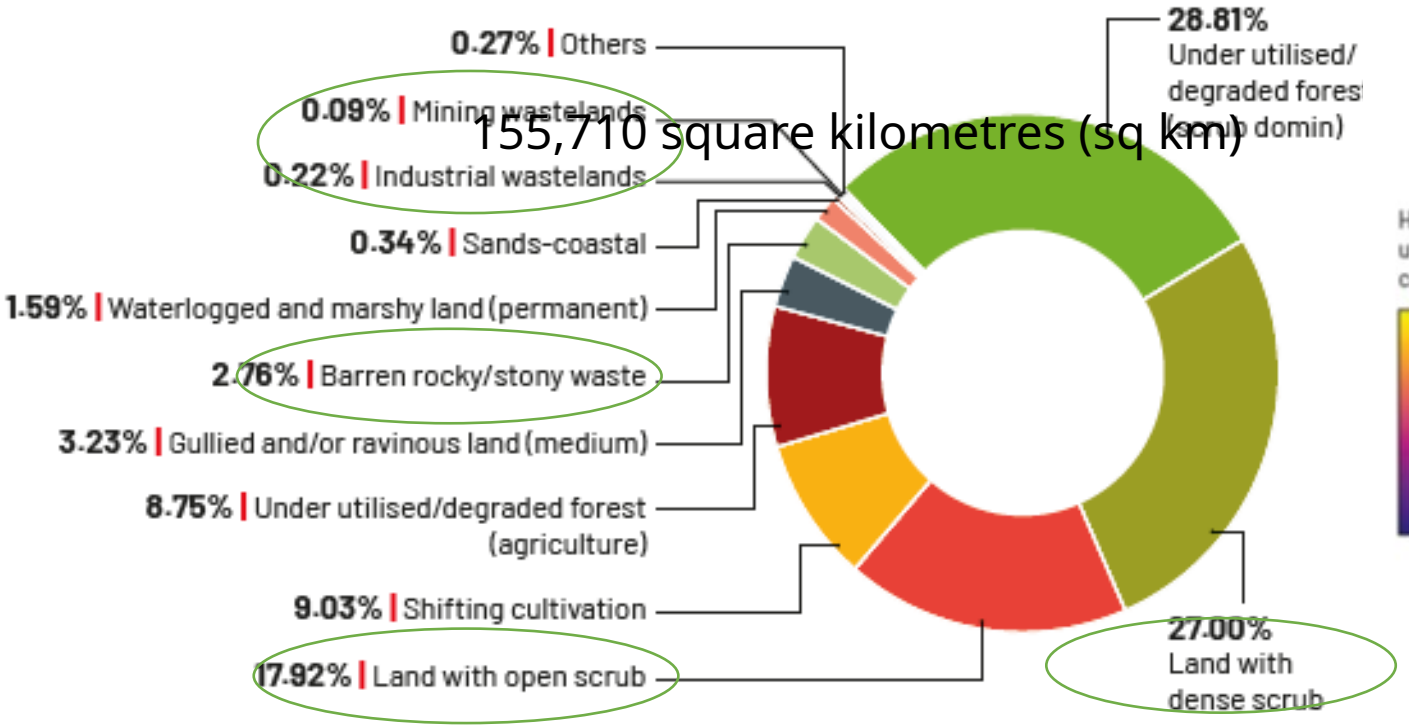
16% of the land area of 155,710 sq km includes wasteland of 18 sub-categories

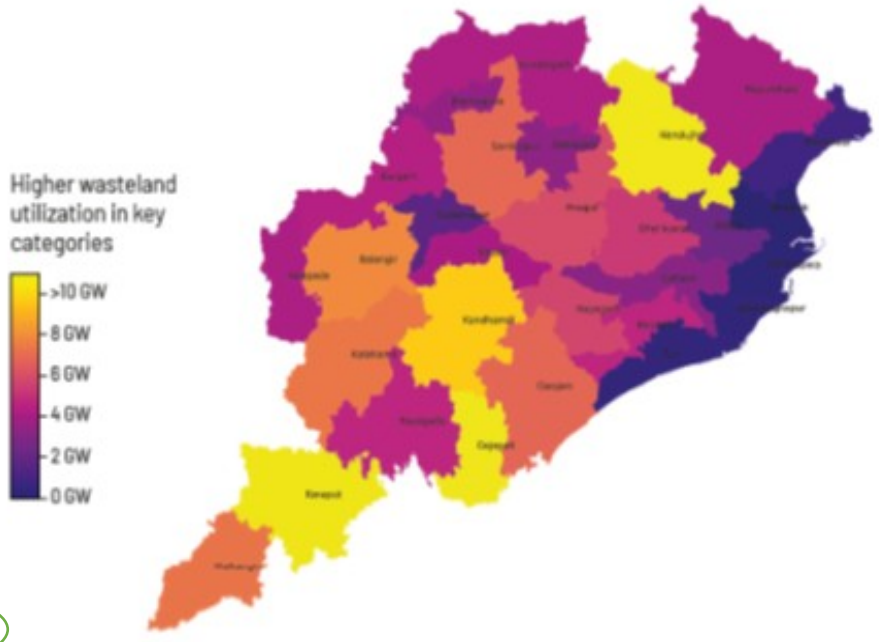


Source: Wasteland Atlas, 2019, Department of Land Resources, GoI

Broad-based Assessment

- Considering high utilization of 50%-10% in key wasteland categories, with lower ecological significance, leads to solar potential of 149 MW across 2,973 sq km of land.
- 68% of the potential is in 13 southern and eastern districts
- Angul, Bolangir, Keonjhar, Koraput and Malkangiri are key due to higher concentration of large land patches with lower socio-ecological conflict and higher insolation





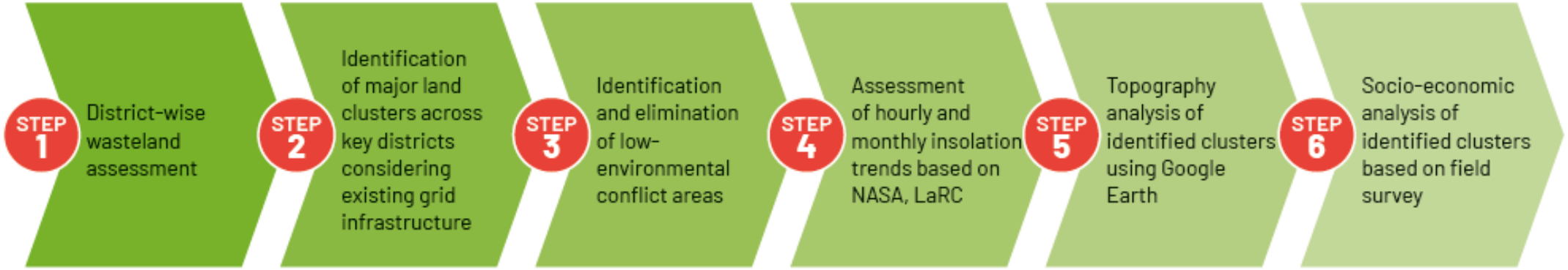
Utilizing Agriculture Land

- Agricultural land frequently utilised for solar - about 68% of existing projects in India.
- Nearly three-fourths of the agricultural land in Odisha is mono-cropped, which can be utilized through agro-PV implementation.
- 5% utilisation of mono-copped agricultural land can support 8.14 GW of solar capacity.

Cropping patter on agricultural lands in Odisha (hectare)

	Cropped once	Cropped twice	Cropped more than twice	Total (net)
Irrigated area	575,724	664,413	46,508	1,286,645
Unirrigated area	2,681,201	220,483	-	2,901,684
Total	3,256,925	884,896	46,508	4,188,329

Large Wasteland Clusters for Solar Methodology



Data/Parameter	Source/Tool
District-wise wasteland LULC Data, 2015-16	Wasteland Atlas, 2019 by Department of Land Resources, GoI
Low-environmental conflict zone mapping	Site Right Tool of The Nature Conservancy
Transmission network availability mapping	DARPAN portal by CSTEP
Solar insolation	NASA's LaRC portal
Topography mapping	Google Earth

Large Wasteland Clusters for Solar

13 clusters identified across 9 districts, comprising 160 small sites aggregating 460 sq km of area and an aggregate potential of 23 GW,

District-wise identified clusters

District	No. of clusters	Potential (GW)
Angul	3	5.3
Balangir	2	4.5
Jharsaguda	2	1.8
Keonjhar	1	5.2
Koraput	1	3.3
Malkangiri	1	1
Mayurbhanj	1	0.7
Nabarangpur	1	1.3
Sundargarh	1	3

Capacity-wise analysis of potential sites across clusters

Project Size (MW)	No. of sites	Area (Sq km)	Potential (MW)
15 - 50	80	51.87	2,615.27
50 -100	26	39.6	1,994.82
100 - 150	14	35.17	1,775.12
150 - 200	13	44.32	2,235.38
200 - 250	3	13.28	671.12
250 - 300	8	44.36	2,224.14
300 - 350	3	18.7	941.26
350 - 400	2	13.97	711.02
400 - 450	4	33.99	1,676.91
>450	7	164.39	8,244.02
Total	160	459.65	23,089.06

Source: iFOREST Assessment

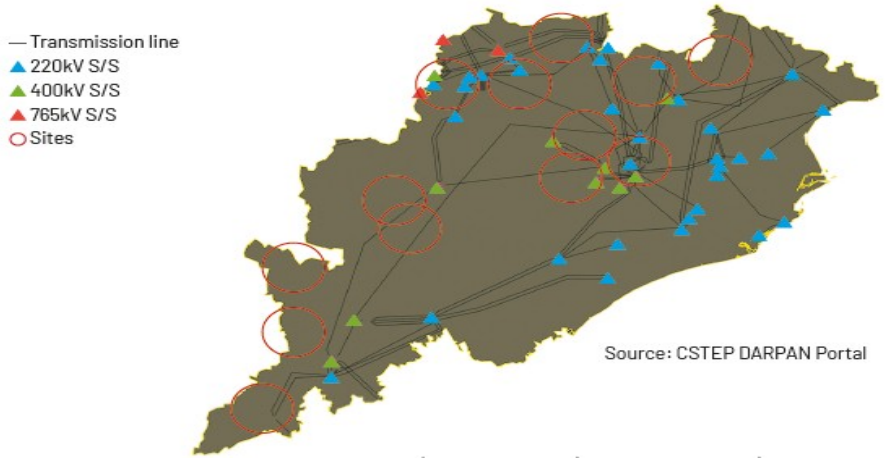
Cluster-wise calculated LCoE

Cluster	Peak insolation (W per sq km)	Average insolation
Angul Cluster 1	954	400
Angul Cluster 2	958	386
Angul Cluster 3	950	411
Bolangir Cluster 1	937	408
Bolangir Cluster 2	940	421
Jharsaguda Cluster 1	972	415
Jharsaguda Cluster 2	972	415
Keonjhar Cluster 1	1,037	397
Koraput Cluster 1	1,004	441
Malkangiri Cluster 1	952	409
Mayurbhanj Cluster 1	902	367
Nabrangpur Cluster 1	991	407
Sundargarh Cluster 1	969	419

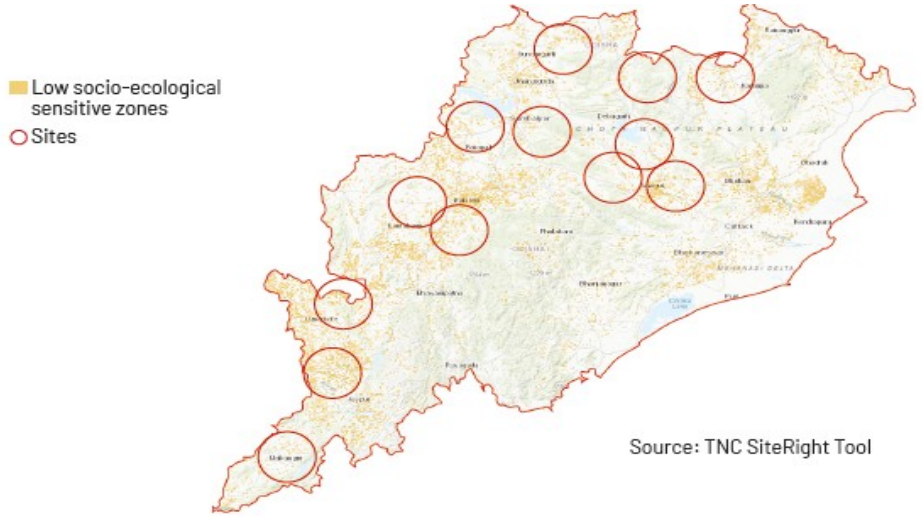
Survey evaluating basic requirements of land condition, land ownership, current land use, water availability, grid availability, transport availability etc., revealed most sites to be feasible for development

Source: iFOREST Assessment

Identified clusters against existing transmission infrastructure



Identified clusters against low socio-ecological sensitive zones

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Longitude: 82.326115
Elevation: 581.54±14 m
Accuracy: 3.9 m
Time: 11-28-2022 15:27
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Latitude: 17.902207
Longitude: 81.534255
Elevation: 102.04±5 m
Accuracy: 3.9 m
Time: 11-27-2022 14:52
Powered by NoteCam


GPS Map Camera
Lat 20.824076° Long 85.070207°
27/10/22 02:43 PM GMT +05:30
5.54 km/h
37%
8.13 m
30.13° C
260° W
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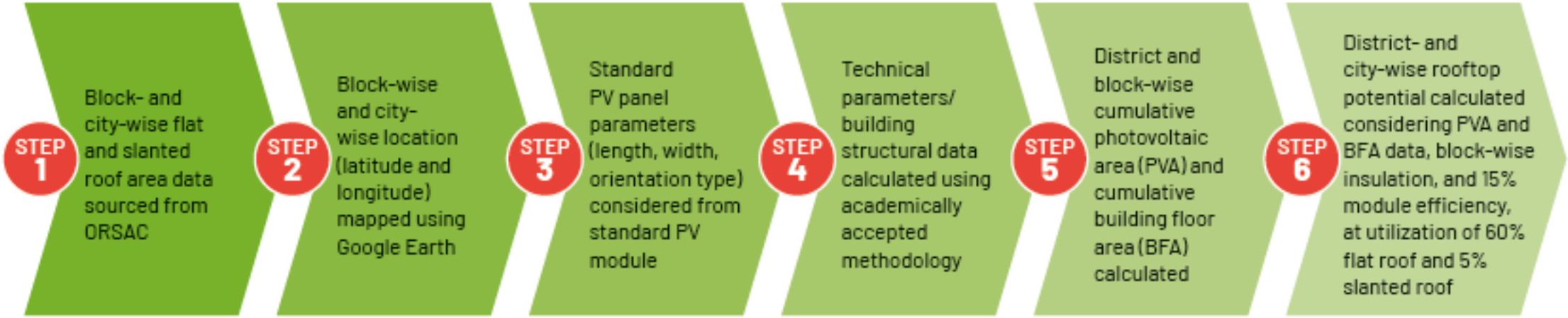
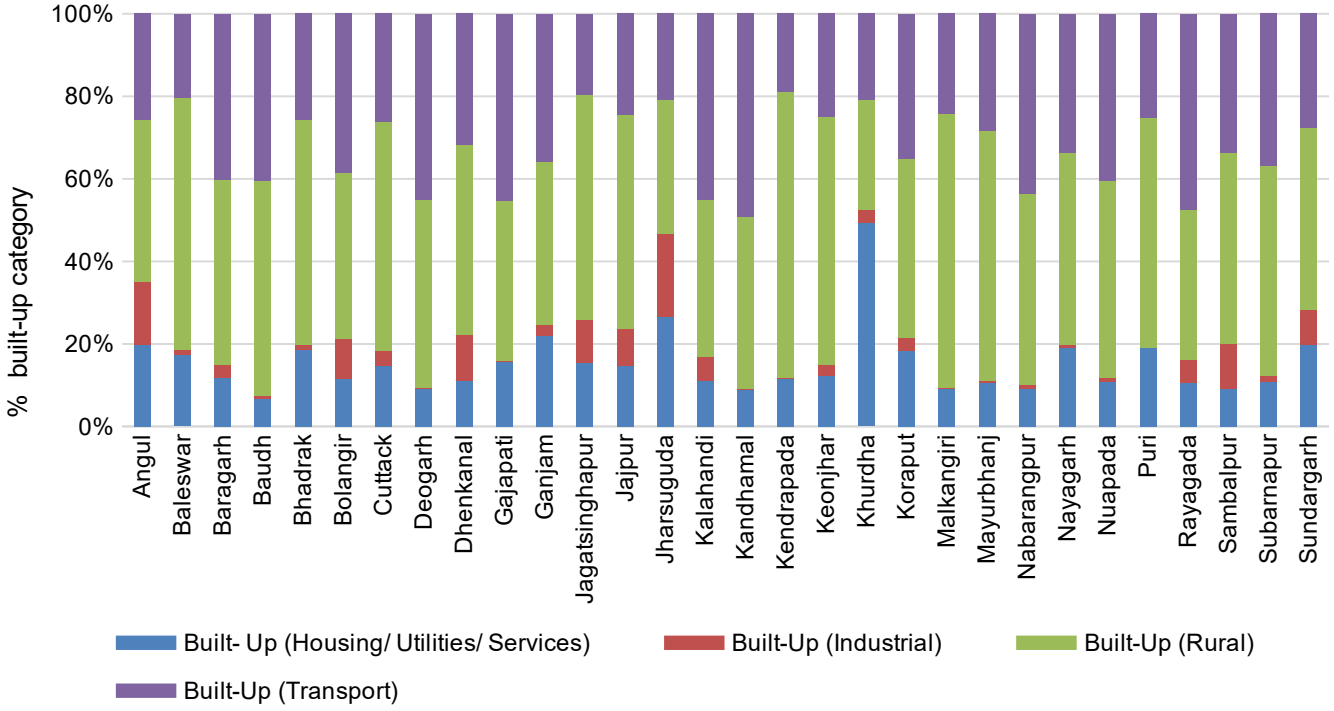
Rooftop Solar Potential Assessment Methodology

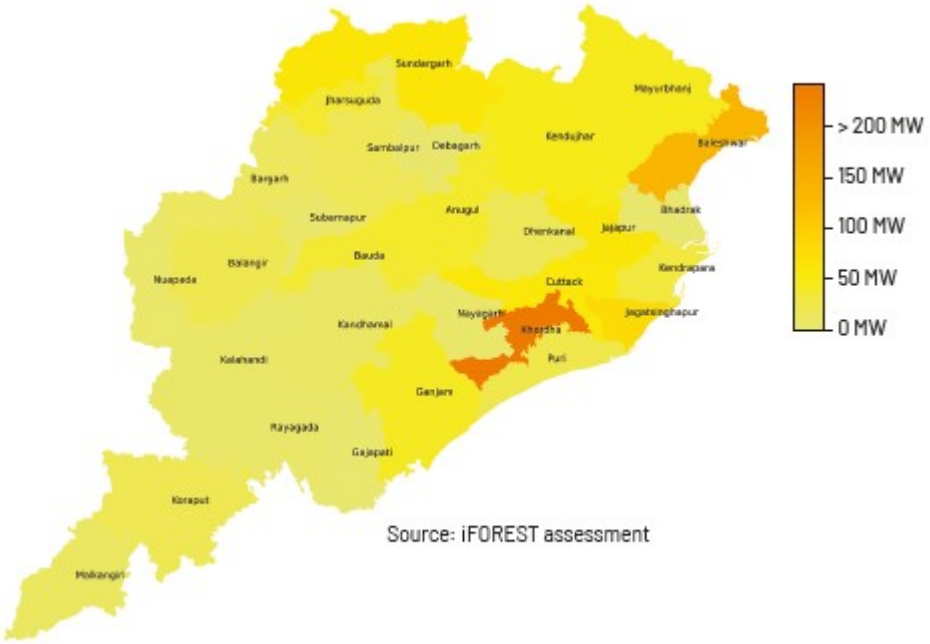


Data	Source/Tools
Flat and slanted roof data	ORSAC
Building structural data calculation	Rhythm Singh, Approximate rooftop solar PV potential of Indian cities for high-level renewable power scenario planning, Sustainable Energy Technologies and Assessments, Volume 42, 2020, 100850, ISSN 2213-1388
Standard module considered for installation	Tata Power Solar TP300 export series
Solar technical parameters calculations	Google earth, University of Oregon solar radiation monitoring lab and NASA LaRC

Rooftop Solar Potential Reassessment

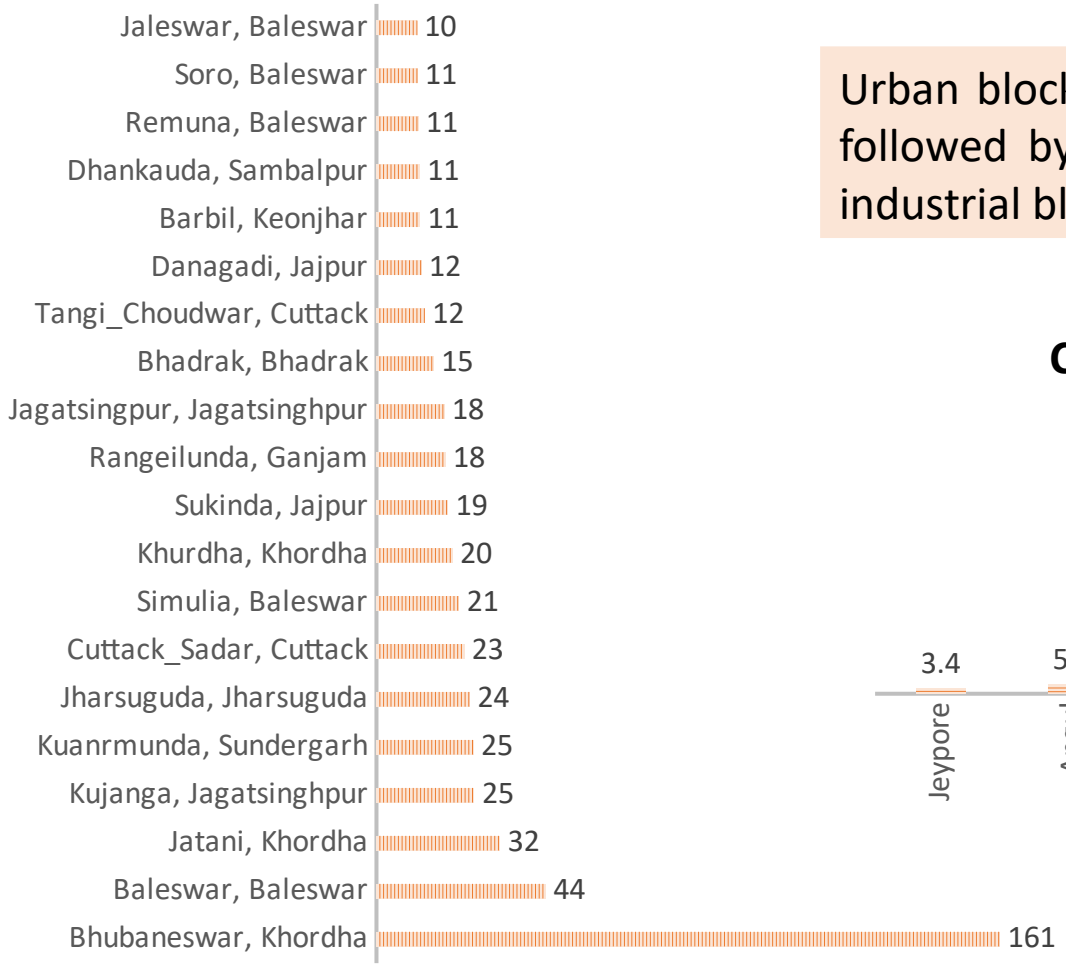
Solar rooftop potential estimated to be 1,133 MW at a utilization. Khordha district accounts for the highest potential, followed by Baleswar and Jagatsinghpur.





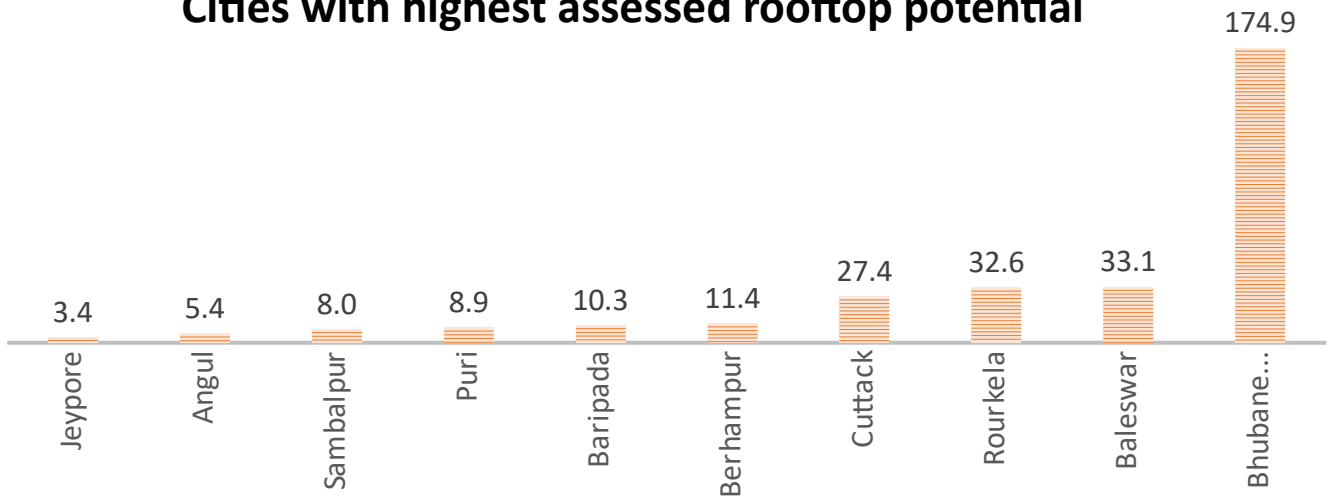
Source: ORSAC; iFOREST Assessment

Blocks with highest assessed solar rooftop potential



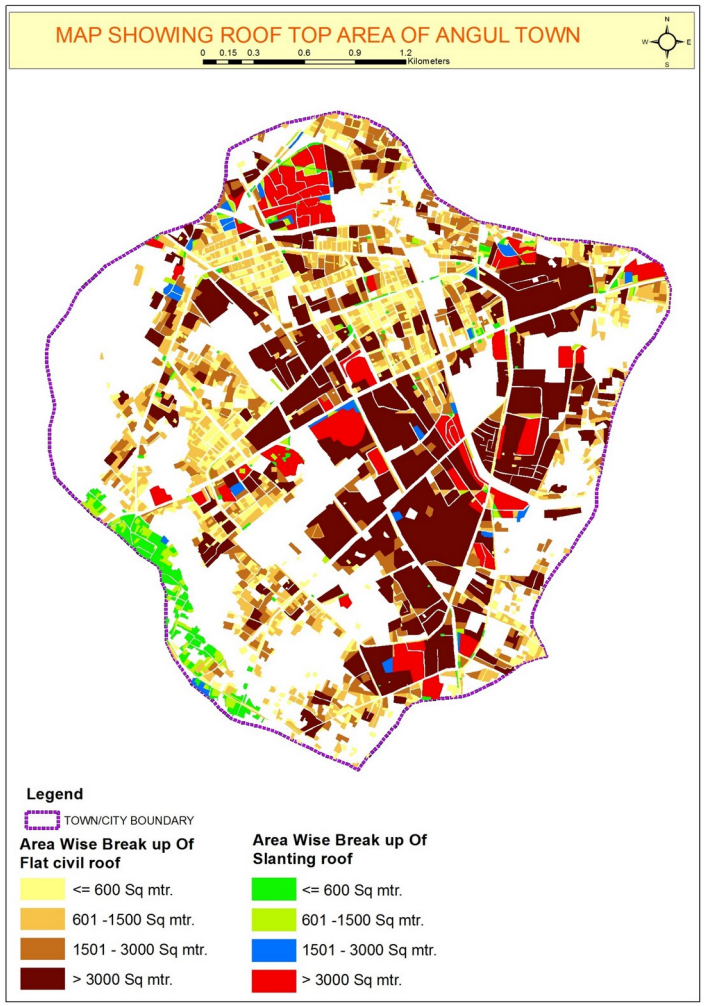
Urban block of Bhubaneshwar has the highest assessed potential, followed by other urban blocks of Baleshwar and Jatani and the industrial blocks of Kujanga, Kuanrmunda, and Jharsuguda.

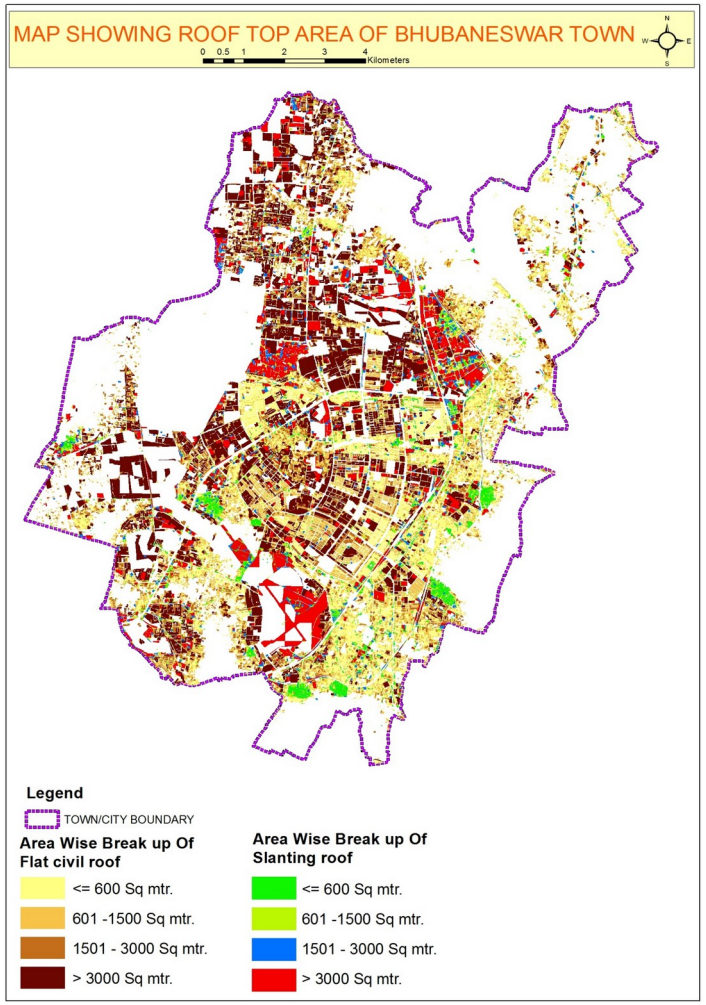
Cities with highest assessed rooftop potential

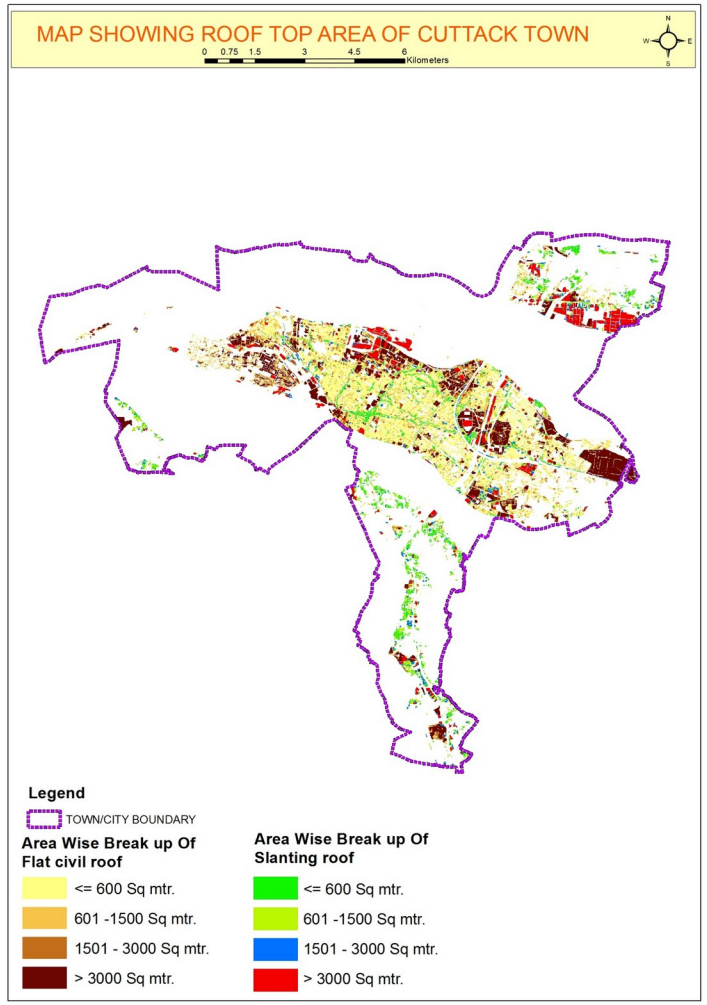


Source: iFOREST Assessment

Rooftop GIS maps

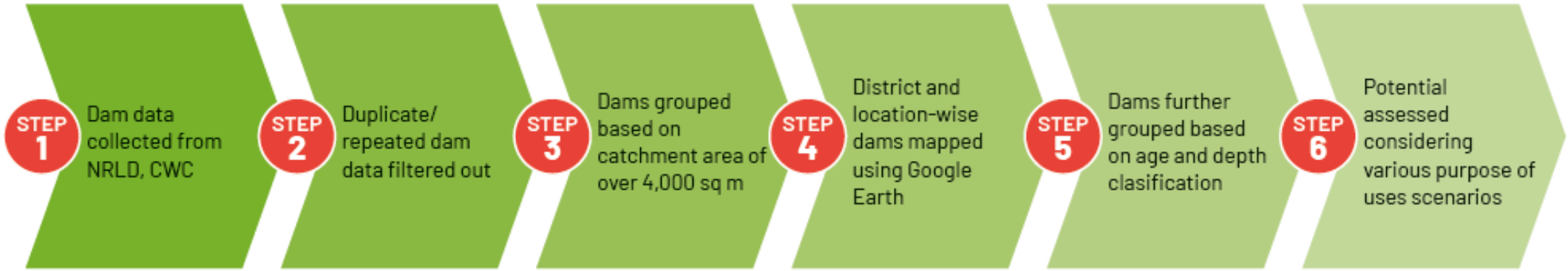






Source: ORSAC

Floating Solar Potential Assessment Methodology



Data/Parameter	Source/Tool
Reservoir data, 2019	CWC, NRLD
Reservoir mapping	Google earth
Water occurrence, spread area and water level	IWRIS, ISRO Bhuvan WBIS

Floating Solar Potential Assessment

Considering conservatives estimates of dam area utilization, 125 dams in Odisha can support 6 GW of floating solar capacity under a low utilization scenario and up to 25.9 GW under high utilization scenario

Category-wise number of operational dams in Odisha

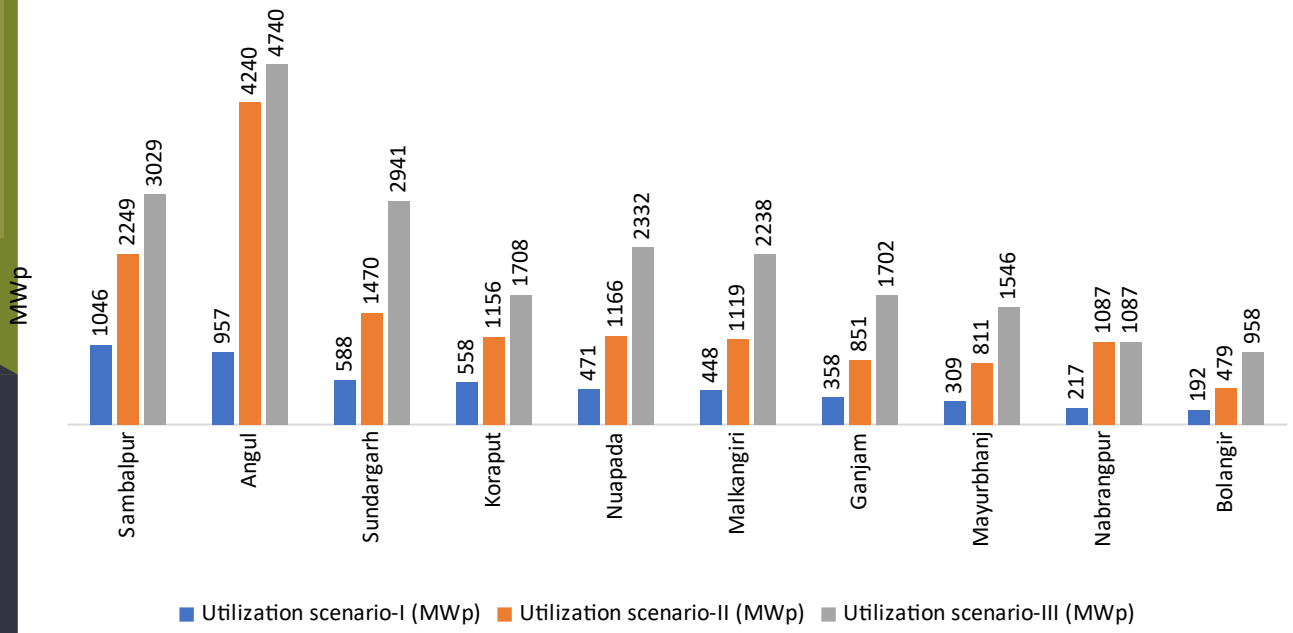
	Young (0 to 20 years)	Middle (20 to 50 years)	Old (50 to 100 years)	Very old (>100 years)	Total
Very low depth (3 to 10 m)	0	0	0	0	0
Low depth (10 to 15 m)	2	51	5	0	58
Medium depth (15 to 30 m)	4	96	7	3	110
High depth (30 to 100 m)	1	13	4	0	18
Very high	0	0	0	0	0
Total	7	160	16	3	186

Area utilization scenarios for assessment of floating solar potential (% of area)

Reservoir purpose	Scenario - I	Scenario - II	Scenario - III
Irrigation and water supply	5	10	20
Irrigation	10	25	50
Flood control, hydroelectric, Irrigation and water supply	1	2	2
Hydroelectric	3	5	10
Water supply	10	25	50
Irrigation, flood control	5	10	10
Irrigation, hydroelectric, navigation	2	5	10
Irrigation, hydroelectric	2	10	10
Irrigation, hydroelectric, water supply	2	5	5
Irrigation, pisciculture	5	10	20
Irrigation, pisciculture, water supply	5	10	20

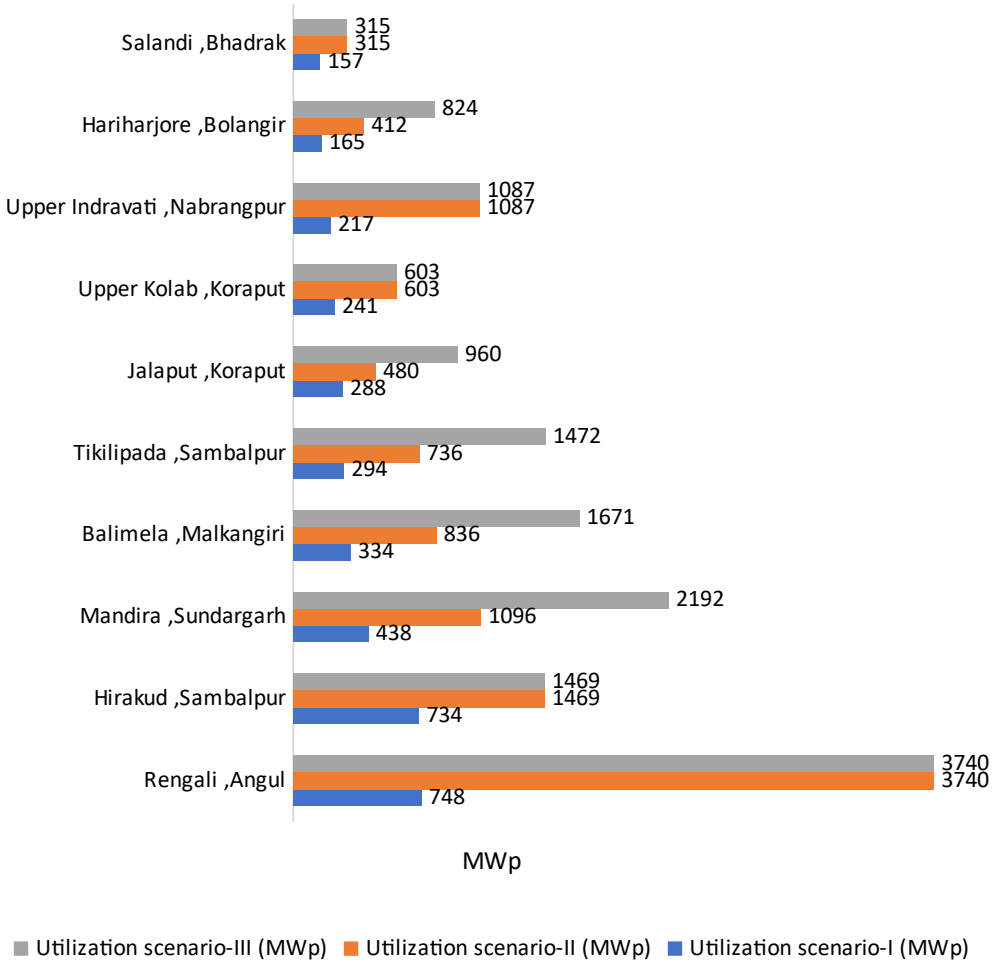
Floating Solar Potential Assessment

Leading districts for floating solar installation



Given the assumption, over 1 GW capacity can be accommodated at reservoirs like Rengali, Tikilipada, Upper Indravati, Nabrangpur, Jalaput and Hirakund.

Leading reservoir sites for floating solar installation



Floating Solar Potential Assessment

Monthly water spread area trends at leading dams over last decade

Dam Name, District	Total reservior area (Sq.km)	Water spread area parameter (Sq.km)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rengali, Angul	378	Average	346	341	344	316	285	302	195	312	340	336	352	349
		Min	303	302	296	266	188	187	140	259	277	287	319	318
Hirakud, Sambalpur	743	Average	658	661	591	591	517	380	464	563	662	656	649	660
		Min	608	589	550	471	387	311	356	435	598	564	616	629
Mandira, Sundargarh	44	Average	39	41	37	33	31	29	27	28	27	31	36	38
		Min	28	30	28	26	22	26	25	22	21	27	29	30
Balimela, Malkangiri	169	Average	155	153	148	142	133	119	119	127	150	158	154	159
		Min	135	133	132	118	109	93	69	87	105	131	133	135
Tikilpada, Sambalpur	30	Average	24	23	20	20	16	17	11	16	22	22	22	23
		Min	13	14	13	13	10	13	6	6	13	8	13	13
Jalaput, Koraput	97	Average	68	68	69	63	54	53	54	66	70	73	69	69
		Min	62	60	55	56	43	38	42	46	54	47	52	64
Upper Kolab, Koraput	122	Average	98	102	94	90	78	72	58	89	96	103	97	96
		Min	81	82	70	67	50	44	40	52	76	70	59	80
Upper Indravati, Nabrangpur	110	Average	105	102	97	95	86	66	80	83	99	81	102	104
		Min	86	83	84	80	75	80	73	83	83	96	80	85
Hariharjore, Bolangir	17	Average	12	11	11	10	8	7	8	12	12	13	12	12
		Min	9	8	7	8	4	5	6	5	6	8	9	9
Salandi, Bhadrak	32	Average	22	25	23	25	21	23	22	25	27	24	24	24
		Min	11	18	20	20	17	21	19	19	23	15	20	20

- Water spread analysis of major reservoirs indicates much higher potential for solar panel installations
- For instance, water spread area for the 378.4 sq. km Rengali reservoir for the last 10 years has been lowest in the month of July ranging between 195 sq km to 140 sq km. Potentially 7 to 10 GW can be set up on the reservoir, at 50-70% of lowest spread area.

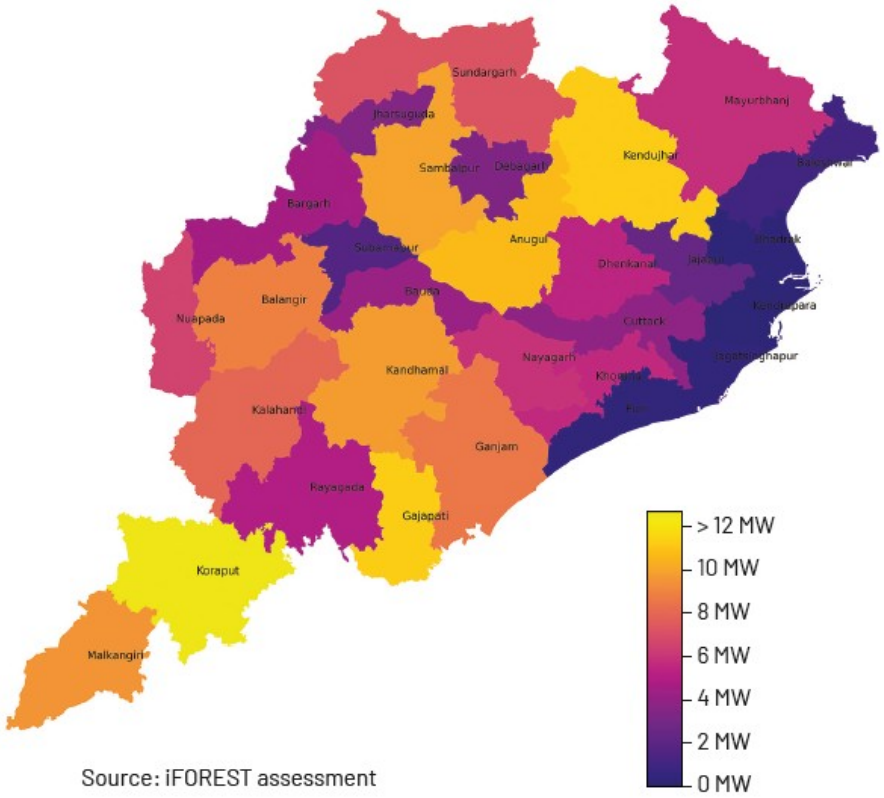
Canal Top Solar Potential Assessment

410 km of existing concrete-lined irrigation projects can accommodate canal top solar of up to 256 MW.

Canal project name	Target length (km)	Achieved length (km)
Talasara Medium Irrigation Project	43.71	43.72
Sarafgarh Medium Irrigation Project	33.45	33.45
Pitamahal Medium Irrigation Projects	24.11	24.12
Gompakunda Main Canal of Potteru Major Irrigation Project	16.68	16.58
Tamasa Main Canal and Udayagiri distributary of Potteru Major Irrigation Project	21.44	21.51
Parjang Branch Canal of Rengali Major Irrigation Project	142.05	115.74
Right Main Canal of Upper Indravati Major Irrigation Project	83.71	-
Astaranga minor of Mahanadi Delta-II Major Irrigation System	1.95	1.95
Kendrapada Main Canal of Mahanadi Delta-I Major Irrigation System	28.75	28.70
Jajpur Main Canal and its system of Baitarani Major Irrigation system	40.93	36.06
Kanas Branch Canal of Mahanadi Delta-II Major Irrigation system	40.44	40.44
Anandapur Main Canal and its system of Salandi Major Irrigation Projects	57.50	47.64
Total	534.72	409.91

Source: Dept. of water resources, Odisha

Aggregate Assessed Solar Potential



Source: iFOREST assessment

Category	Potential (GW)
Ground-mounted	148.6
Floating	25.9
Rooftop	1.1
Canal	0.2
Total	**175.8**

Koraput district leads solar potential with 7% share, followed by 6% each in Gajapati, Keonjhar, Angul, Sambalpur, Kandhamal, and 5% in Malkangiri, Balangir, Ganjam, Kalahandi.

Source: iFOREST Assessment

Wind Energy

02/10/2025

Wind Potential Sites Identification

- Global Wind Atlas (GWA 3.1) utilized to assess wind resources and Google Earth to understand land features.
- 86 locations identified with average wind speed ranging from 6.2 m/s to 8.8 m/s at 150m hub height across 16 districts.
- Nearly 65% of identified locations are in Koraput, Kalahandi, Angul, Rayagada, Gajapati and Kandhamal.

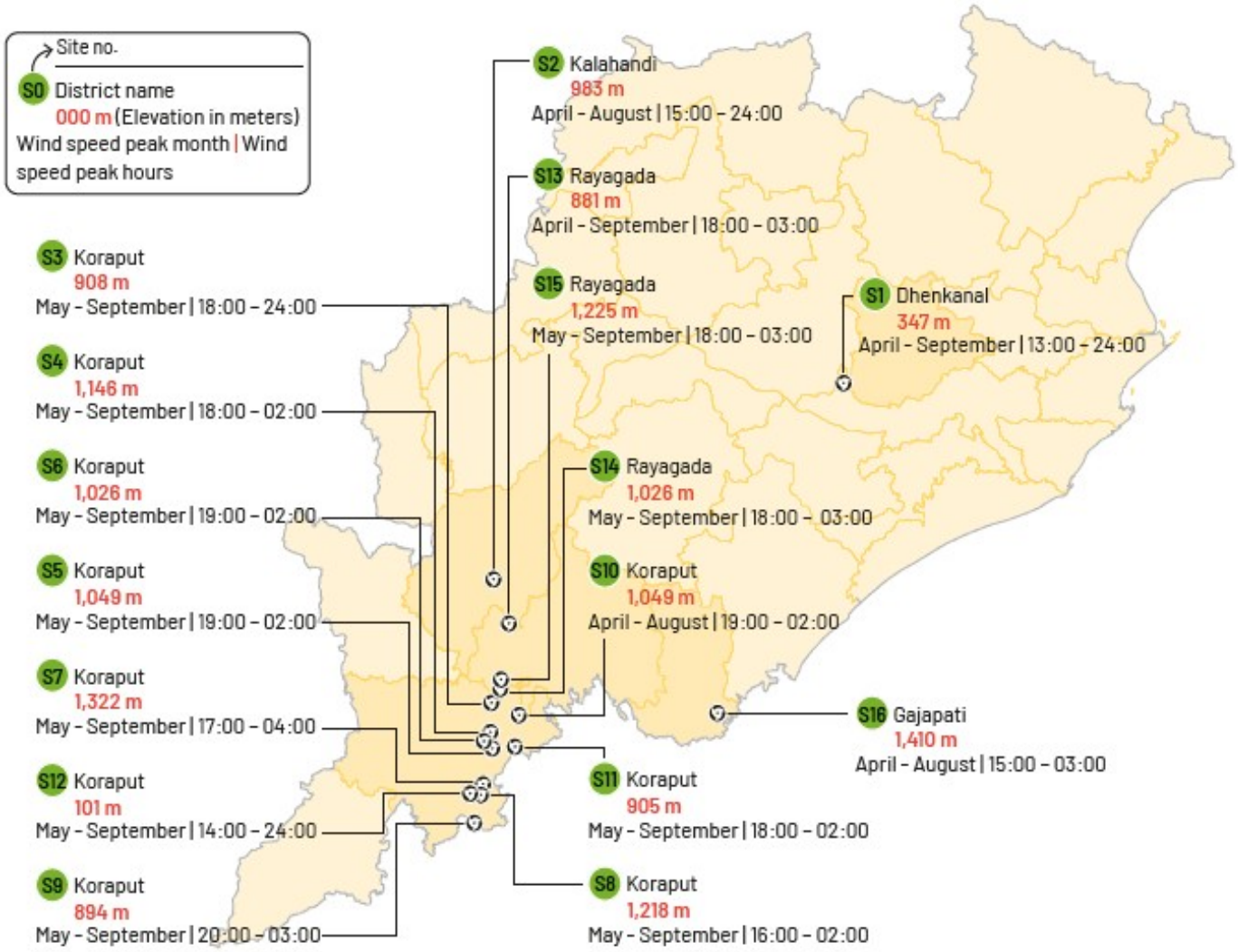
Wind speed (m/s)
5.8 – 6 | 6 – 7 | 7 – 8 | > 8

District	Parameter	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13
Angul	Lat, Long	20.622181°, 85.092201°	20.63182°, 85.049973°	20.667481°, 84.932556°	20.709556°, 84.932899°	20.755472°, 84.863205°	20.807151°, 84.935303°	20.75804°, 84.835925°	20.811323°, 84.566231°	20.827047°, 84.496193°				
	Speed at 100 m	7.14	7.32	6.58	5.97	6.34	6.53	6.52	6.85	6.26				
	Speed at 150 m	7.44	7.62	6.85	6.22	6.60	6.80	6.79	7.13	6.52				
Baleswar	Lat, Long	21.461376°, 86.673889°	21.454986°, 86.64917°	21.473837°, 86.767616°	21.376999°, 86.564369°									
	Speed at 100 m	7.09	6.82	6.69	6.38									
	Speed at 150 m	7.38	7.10	6.97	6.64									
Boudh	Lat, Long	20.642744°, 84.37294°	20.607399°, 84.215355°	20.586831°, 84.199905°	20.619932°, 84.157677°	20.65688°, 84.06086°								
	Speed at 100 m	6.01	6.77	6.64	6.63	5.94								
	Speed at 150 m	6.26	7.05	6.91	6.90	6.19								
Dhenkanal	Lat, Long	20.617361°, 85.129623°												
	Speed at 100 m	7.48												
	Speed at 150 m	7.80												
Gajapati	Lat, Long	18.951428°, 84.397316°	18.909859°, 84.410706°	18.990389°, 84.37809°	18.986688°, 84.36264°	19.106892°, 84.343071°	19.183435°, 84.302216°	19.199971°, 84.197845°	18.89102°, 84.335175°					
	Speed at 100 m	7.79	7.3	7.8	8.19	7.55	7.22	7.85	7.28					
	Speed at 150 m	7.69	7.49	7.63	8.12	7.63	7.51	7.77	7.36					
Ganjam	Lat, Long	19.748286°, 85.125504°	19.717263°, 85.14576°	19.689468°, 85.168419°										
	Speed at 100 m	6.76	7.09	6.81										
	Speed at 150 m	7.04	7.38	7.09										
Jajpur	Lat, Long	20.661056°, 86.246796°	20.632142°, 86.240959°	20.702491°, 86.085091°	20.699279°, 86.110497°									
	Speed at 100m	6.95	6.02	7.3	7.1									
	Speed at 150m	7.24	6.27	7.60	7.39									
Kalahandi	Lat, Long	19.481158°, 83.212852°	19.517081°, 83.189507°	19.493133°, 83.190193°	19.66522°, 83.077927°	19.692698°, 83.06797°	19.682354°, 83.051834°	19.734714°, 82.947807°	19.657461°, 82.914848°	19.590197°, 82.589122°	19.624803°, 82.537193°			
	Speed at 100m	7.08	7.09	7.37	7.41	7.78	6.6	7.18	7.03	7.74	6.99			
	Speed at 150m	7.37	7.38	7.67	7.72	8.10	6.87	7.46	7.32	8.06	7.28			

District	Parameter	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13
Kandhamal	Lat, Long	20.590688°, 84.332428°	20.526718°, 84.337921°	20.566903°, 84.317322°	20.587795°, 84.327965°	20.191324°, 84.152527°	20.2142°, 84.115448°	19.654227°, 84.006271°						
	Speed at 100 m	6.64	6.58	6.4	6.65	7.43	6.36	6.72						
	Speed at 150 m	6.91	6.85	6.66	6.93	7.74	6.62	7.00						
Khordha	Lat, Long	19.820005°, 85.230217°	19.897503°, 85.326004°	19.964959°, 85.472946°	19.9869°, 85.453377°	20.159743°, 85.645294°								
	Speed at 100 m	6.18	6.11	6.02	6.34	6.43								
	Speed at 150 m	6.44	6.36	6.27	6.60	6.70								
Koraput	Lat, Long	19.069908°, 83.071747°	18.93714°, 83.04016°	18.991363°, 83.150368°	18.864057°, 83.061447°	18.906286°, 83.051834°	18.812393°, 83.110199°	18.806868°, 83.163757°	18.711293°, 83.028145°	18.617616°, 82.998619°	18.627377°, 82.965317°	18.494261°, 82.992439°	18.396882°, 82.899055°	18.363975°, 82.937851°
	Speed at 100 m	8.11	8.06	7.48	8.07	8.34	7.29	7.84	8.02	8.43	7.73	6.74	8.2	7.23
	Speed at 150 m	8.45	8.39	7.79	8.40	8.69	7.59	8.16	8.35	8.78	8.05	7.02	8.54	7.53
Malkanagiri	Lat, Long	18.683976°, 82.029419°												
	Speed at 100 m	6.34												
	Speed at 150 m	6.60												
Nawarangpur	Lat, Long	19.748609°, 82.53788°	19.848102°, 82.398148°	19.59796°, 82.143402°	19.580817°, 82.184944°	19.601841°, 82.09259°								
	Speed at 100 m	6.76	6.02	6.82	6.69	6.34								
	Speed at 150 m	7.04	6.27	7.10	6.97	6.60								
Nayagarh	Lat, Long	19.979479°, 85.278282°	20.017226°, 85.218544°											
	Speed at 100 m	7.7	7.27											
	Speed at 150 m	7.97	7.84											
Rayagada	Lat, Long	19.407021°, 83.574028°	19.469829°, 83.562698°	19.530024°, 83.439102°	19.512227°, 83.438416°	19.575318°, 83.419189°	19.482453°, 83.158264°	19.048488°, 83.06797°	19.074448°, 83.070717°					
	Speed at 100 m	6.52	6.23	7.25	6.94	7.26	7.82	7.92	8.12					
	Speed at 150 m	6.79	6.49	7.55	7.23	7.56	8.14	8.25	8.48					
Sambalpur	Lat, Long	21.162962°, 84.010048°												
	Speed at 100 m	6.1												
	Speed at 150 m	6.35												

Detailed Assessment of Key Wind Sites

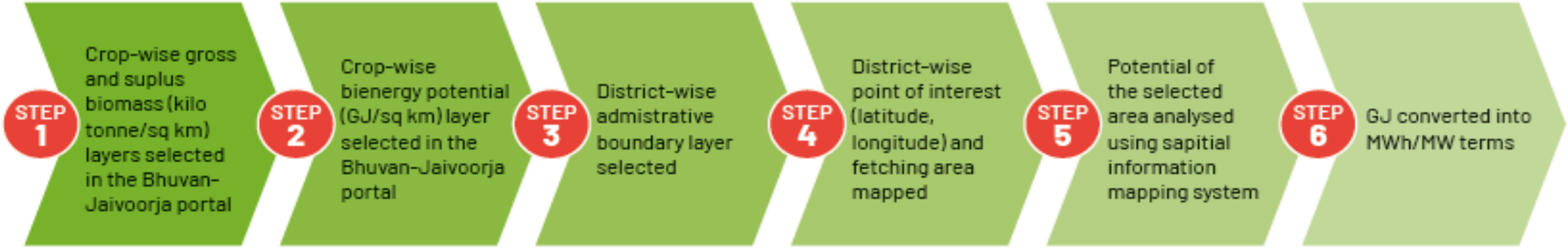
- 16 key sites assessed with wind speed of 7.6-8.6 m/s at 150m hub height, which can generate CUF of 22% to 29%.
- Mostly sited on hilly terrains with average elevation of 968m, and highest elevation of 1,410m.
- Peak wind speed months are April to September (aliging with peak demand months of July to September)
- Peak wind speed hours typically starts in the evening till after midnight (aligning with evening peak from 1800 Hr to 2100 Hr)



Biomass

02/10/2025

Biomass Potential Reassessment



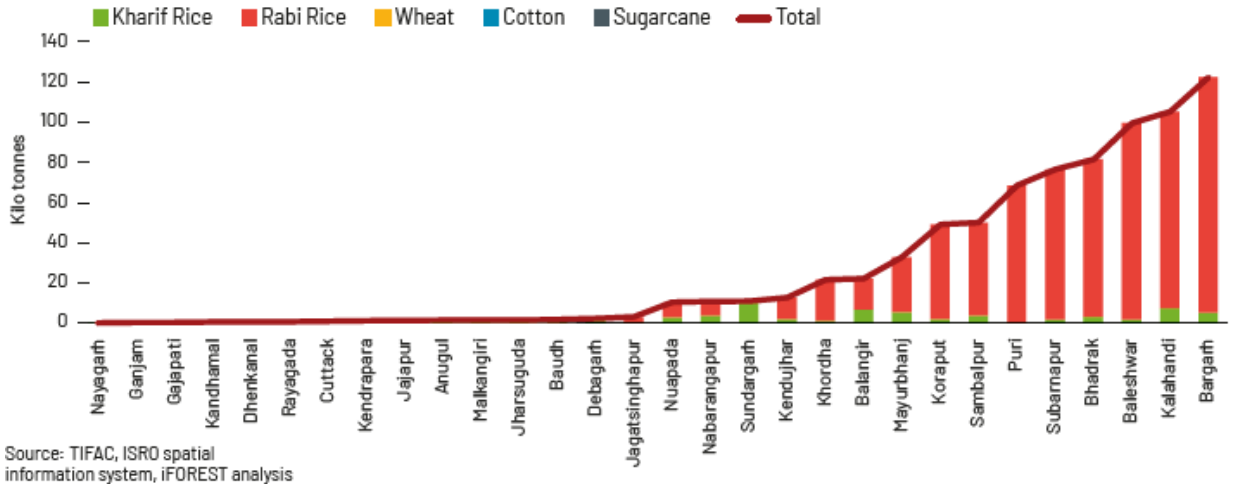
Productivity and heating value for crop residue-based bioenergy production

Crops	Yield/Productivity (kg/ha)	Dryness factor (%)	Residue type	Heating value (MJ/kg)
Rice	2,730	0.86	Straw	15.54
			Husk	15.54
Wheat/Maize/Ragi	3,195	0.86	Straw	17.15
			Husk	17.39
Cotton	547	0.80	Stalk	17.4
			Husk	16.7
			Boll shell	18.3
Sugarcane	72,268	0.83	Bagasse	20
			Top and leaves	20

District-wise Assessed Biomass Potential

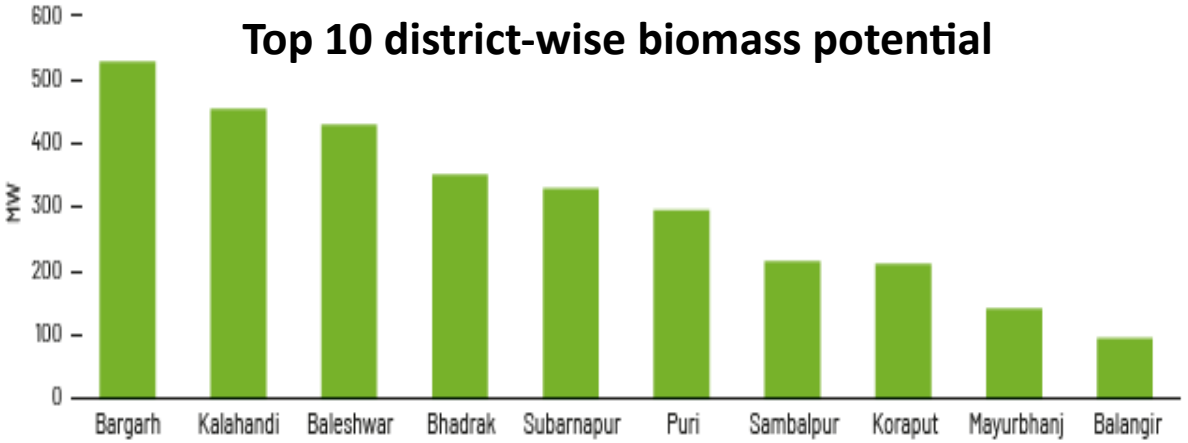
- Cumulative biomass potential assessed to be around **3.4 GW**, largely dependent on rabi rice crop (75%- 90% of the gross and surplus biomass potential)
- Bargarh district leads with 16% share in surplus biomass generated, followed by Kalahandi and Baleswar with 12-13%

District-wise and crop-wise yearly surplus biomass generation



Source: TIFAC, ISRO spatial information system, iFOREST analysis

Top 10 district-wise biomass potential



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Thank You.