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HARNESSING THE SOLAR POWER POTENTIAL OF THE KEN–BETWA LINK CANAL

Presented in

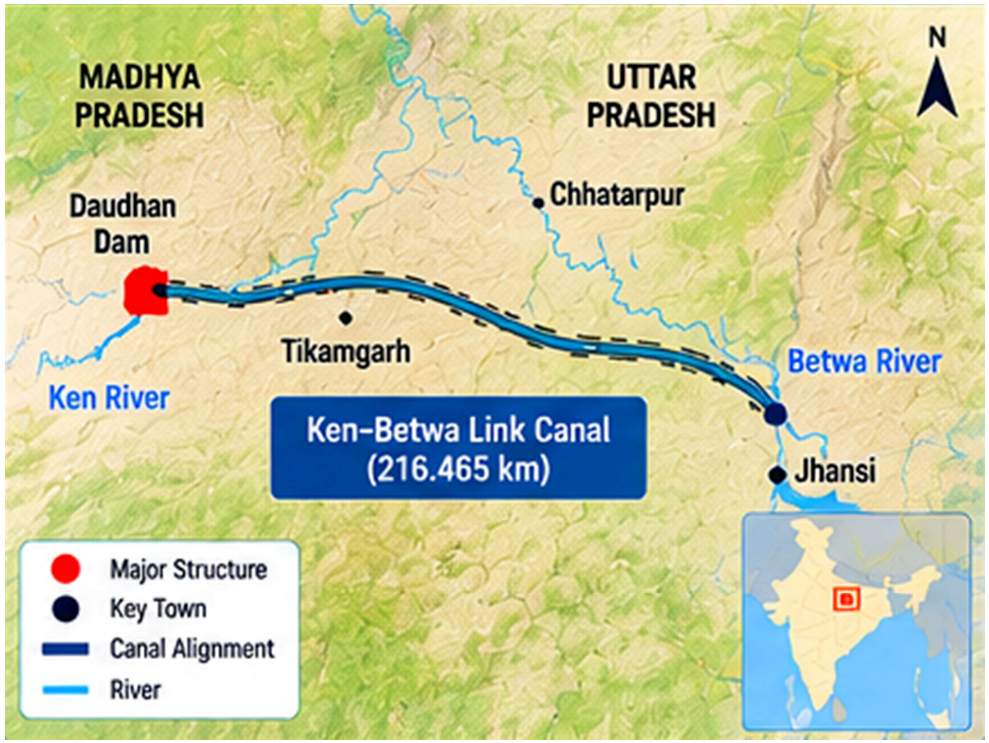
India Water Week 2026

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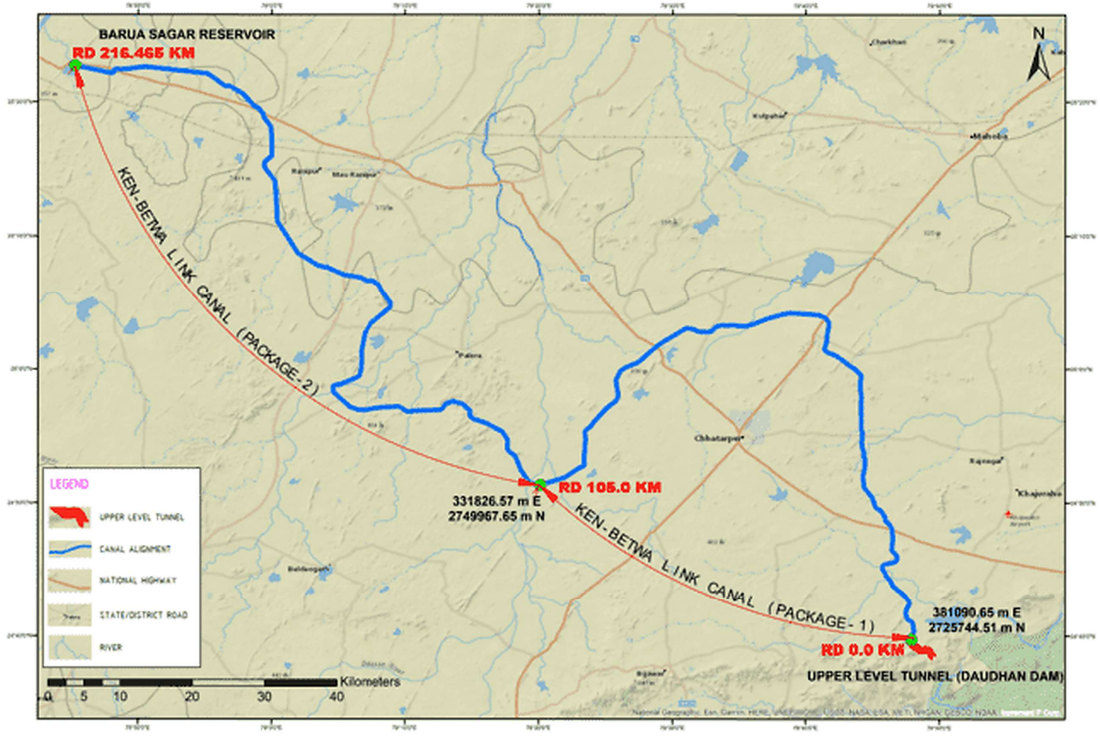
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KBLP TRANSFERS WATER FROM KEN BASIN TO BETWA BASIN

- KBLP transfers water from the Ken Basin to the Betwa Basin, implemented by KBLPA.
- It provides annual irrigation to 10.62 lakh ha, drinking water to 62 lakh people, and 103 MW of hydropower.



LOCATION & ALIGNMENT



PROJECT ON PM GATI SHAKTI PORTAL

KBLC IS THE PHYSICAL SOLAR-CORRIDOR PLATFORM

Total canal length	Villages crossed	2 EPC packages	Planned construction period
216.465 km	105 in MP + 11 in UP	RD 0–105 and 105–216.465 km	3 years



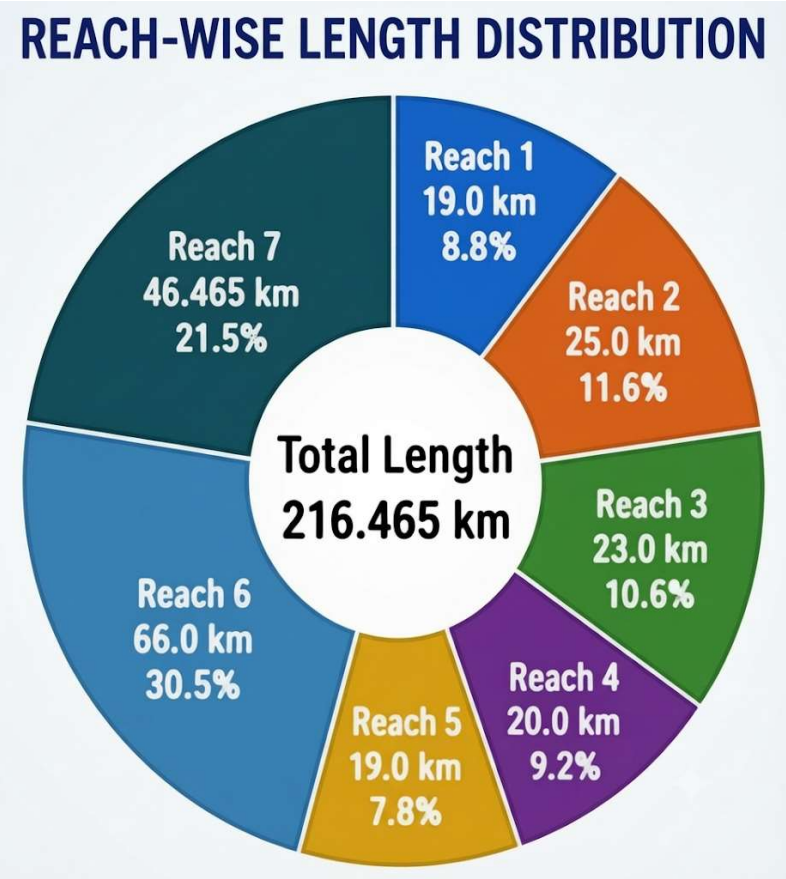
- Running from Daudhan Dam's Upper-Level Tunnel to Barua Sagar Dam, the alignment crosses highways, railways, rivers, and roads.
- Solar development aligns with the KBLC schedule, focusing on corridor integration, grid evacuation, and risk rather than just capacity.
- The findings serve as a preliminary screening assessment requiring DPR-stage validation
- While these structures require clearances, transitions, or exclusions for solar layouts, cross-regulators and lateral offtakes offer opportunities for local power use and automation support.
- Detailed chainage-wise data is provided in the source paper's annexures.

CANAL CORRIDOR HAS MULTI-USE POTENTIAL

Water security interface	Energy opportunity	Land efficiency
Solar must not compromise hydraulic safety, inspection or water-delivery reliability.	**PV capacity can be integrated with a long linear corridor and project loads.**	**The canal corridor reduces dependence on separate large solar-park land.**

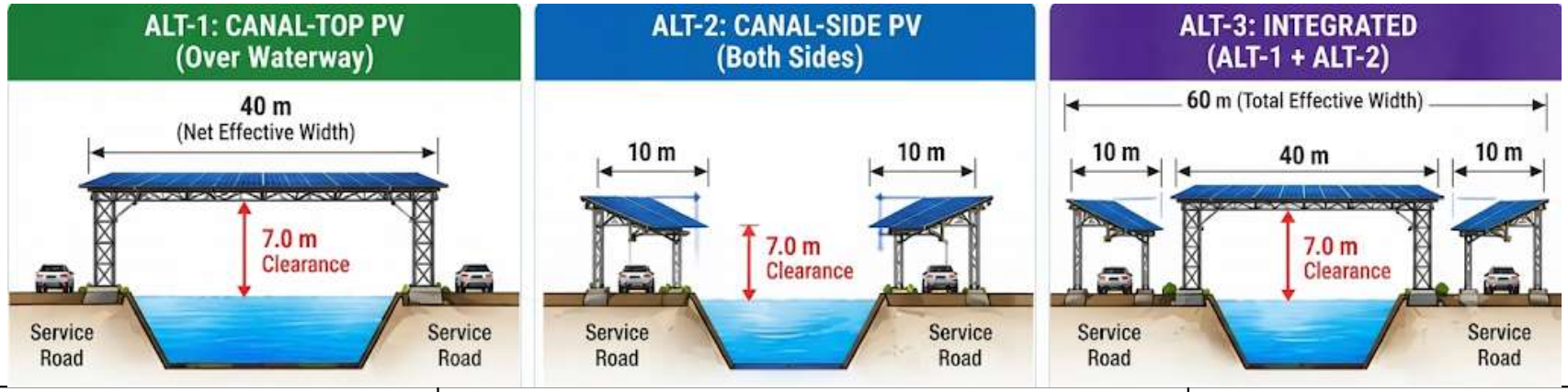
- **Safety & Operations:** Solar installations remain subordinate to canal hydraulic safety and service access, while supporting localized energy needs and surplus power evacuation.
- **Surveys & Feasibility:** Following initial NWDA and DPR-2010 surveys, KBLPA conducted LiDAR drone surveys via MPSEDC in 2024 to map alignment and topography. Final capacities require rigorous GIS, structural, and grid validation.
- **Implementation Schedule**: Synchronizing solar development with KBLC construction allows for early coordination of foundations, cable routes, access windows, and grid node

SEVEN HYDRAULIC REACHES FOR CAPACITY SCREENING



Reach	RD km	Length km	Bed width m	Top width m	FSD m	Flow m³/s
1	0.000–19.000	19.000	14.92	36–68	5.10	179.39
2	19.000–44.000	25.000	14.70	35–65	4.80	157.56
3	44.000–67.000	23.000	14.39	34–66	4.70	148.91
4	67.000–87.000	20.000	13.48	33–66	4.50	130.52
5	87.000–104.000	17.000	10.00	28–61	4.15	90.90
6	104.000–170.000	66.000	10.00	26–65	3.70	72.00
7	170.000–216.465	46.465	10.00	24–63	2.95	45.00

ALTERNATIVES CONSIDERED



ALT-1	ALT-2	ALT-3
• **Structure & Span:** ALT-1 is structurally demanding, requiring wide elevated steel portal or truss systems over a 40 m waterway width. • **Feasibility & Checks:** Overall feasibility depends heavily on long-span steelwork and canal-interface constraints. • **DPR Validation:** Actual spans must be rigorously verified chainage-wise against canal top widths, road-to-road geometry, and O&M clearance requirements.	• **Design & Layout:** Uses a total 20 m width (10 m on each side) with support elevations matching ALT-1. • **Complexity & Risk:** Features lower structural complexity than ALT-1 but higher Right-of-Way (ROW) sensitivity, making ROW availability a high-risk item. • **Commercial Potential:** Being more modular than ALT-1, it serves as the most natural early commercial package candidate, suitable for earlier scale-up and grid/corridor integration.	• **Scope & Mapping:** Combines ALT-1 and ALT-2 for a 60 m gross width (without double counting) as a corridor-level planning portfolio, requiring non-overlapping, GIS-based DPR mapping. • **Structural Design:** Final designs must comprehensively address wind, seismic action, deflection, vibration, fatigue, corrosion, and foundations.

COEXISTANCE WITH OPERATIONAL WATER INFRASTRUCTURE



- **Isolation & Foundations:** Must allow independent electrical and physical block isolation, keeping foundations outside canal lining and seepage zones unless specially engineered and approved.
- **Operations & Priorities:** Solar infrastructure must support O&M, remain subordinate to canal operations, and protect access, drainage, and crossings, while accounting for project energy loads like gates, pumps, and SCADA.
- **Rollout Strategy:** A pilot implementation is recommended prior to corridor-scale rollout.

REACH-WISE INSTALLED CAPACITY CONTRIBUTIONS

Installed capacity (MW_p) = $L \times W_{net} \times U \times 0.20 / 1{,}000$

L = Reach length in metres
Wnet = Width in metres
U = Reach-specific usability
0.20 = kWp/m² module density

- This is a geometric screening method, not a DPR capacity calculation.
- The formula is used to compute reach-wise capacity for all three alternatives.

Reach	RD, in km	Length, in km	Usability	Installed capacity for ALT-1 in MW_p	Installed capacity for ALT- 2 in MW_p	Installed capacity for ALT- 3 in MW_p
1	0.000–19.000	19.000	85%	129.20	64.60	193.80
2	19.000–44.000	25.000	85%	170.00	85.00	255.00
3	44.000–67.000	23.000	80%	147.20	73.60	220.80
4	67.000–87.000	20.000	75%	120.00	60.00	180.00
5	87.000–104.000	17.000	70%	95.20	47.60	142.80
6	**104.000–170.000**	**66.000**	**75%**	**396.00**	**198.00**	**594.00**
7	170.000–216.465	46.465	80%	297.38	148.69	446.06

ENERGY GENERATION

Gross generation = Installed MWp × 8,760 × 21% / 1,000

Net generation = Gross generation × (1 − 0.75% auxiliary consumption)

21%

CUF assumption

0.75%

auxiliary consumption

No degradation

constant-output 25-year table

Alternative	Installed MWp	Gross MU/yr	Net MU/yr	25-year net MU*
ALT-1	1,354.98	2,492.61	2,473.92	61,848
ALT-2	677.49	1,246.31	1,236.96	30,924
ALT-3	2,032.46	3,738.92	3,710.88	92,772

- *The 25-year total is a constant-output screening value, not a bankable forecast.
- It does not include degradation, curtailment, clipping, forced outage or transmission loss.



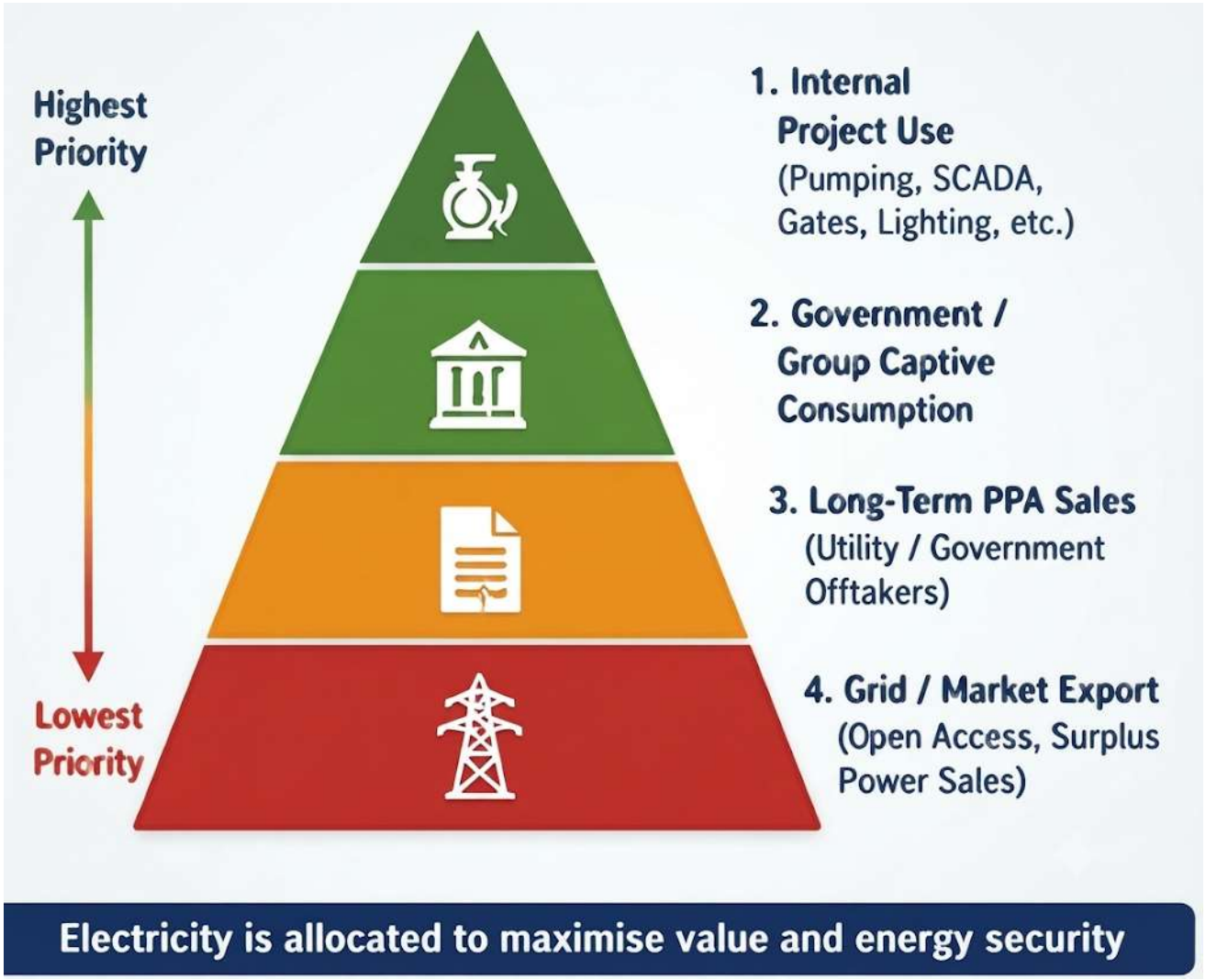
Type	Monocrystalline PERC / TOPCon
Module Power	580 – 620 Wp
Module Efficiency	21% – 22.5%
Power Density	~0.20 kWp/m² (Assumed Net)
Degradation	0.5 – 0.8% per year
Operating Temp	-40°C to +85°C
Warranty	25 years (Performance) 12 years (Product)

REACH-WISE NET-ENERGY

Reach	ALT-1 Net MU	ALT-2 Net MU	ALT-3 Net MU
1	235.89	117.95	353.84
2	310.39	155.19	465.58
3	268.76	134.38	403.14
4	219.10	109.55	328.64
5	173.82	86.91	260.72
6	723.02	361.51	1084.53
7	542.95	271.47	814.42
Total	**2473.93**	**1236.96**	**3710.87**



ENERGY UTILISATION PRIORITY



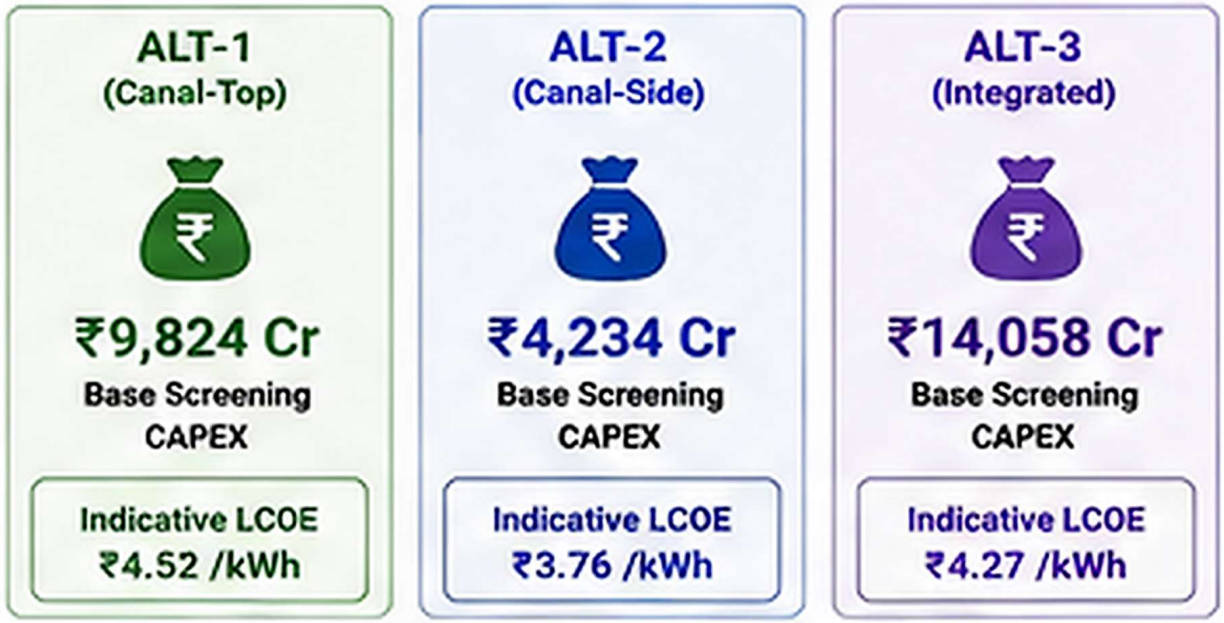
- Internal project use has the highest priority: pumping, SCADA, gates and lighting.
- Government or group captive use forms the second priority.
- Long-term PPA sales are third priority.
- Grid or market export is the lowest priority surplus route.



ALTERNATIVE-WISE CAPEX ASSUMPTIONS INCLUDE STRUCTURAL PREMIUM

Alternative	Unit CAPEX base ₹ Cr/MWp	Indicative range ₹ Cr/MWp	Base total CAPEX ₹ Cr	CAPEX range ₹ Cr	Initial O&M basis
ALT-1	7.25	6.50–8.00	9,824	8,807–10,840	1.25% of CAPEX/yr
ALT-2	6.25	5.75–6.75	4,234	3,896–4,573	1.00% of CAPEX/yr
ALT-3	Weighted	Weighted	14,058	12,703–15,413	ALT-1 + ALT-2

- These are screening rates, not tendered prices.
- Final BOQ, tendered EPC/O&M prices, grid scope and financing terms can materially change cost results.



EXPECTED BENEFITS

Clean energy

Clean and renewable energy generation

Water security

Enhanced water security and reduced evaporation/water losses

Land efficiency

Lower land requirement versus solar parks

Infrastructure use

Utilisation of existing canal corridor

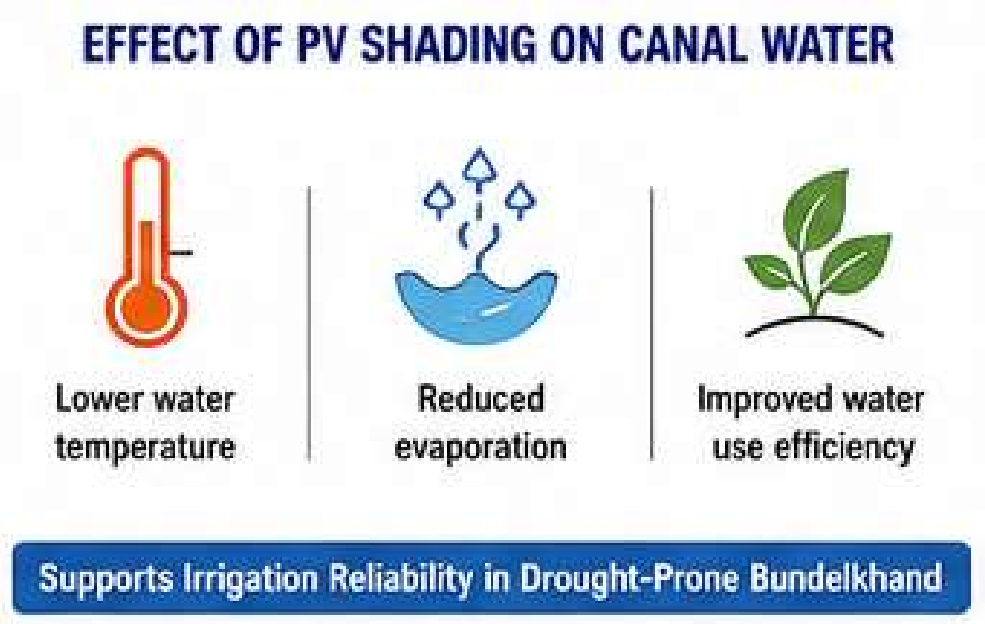
Energy resilience

Energy security and resilience for project and rural loads

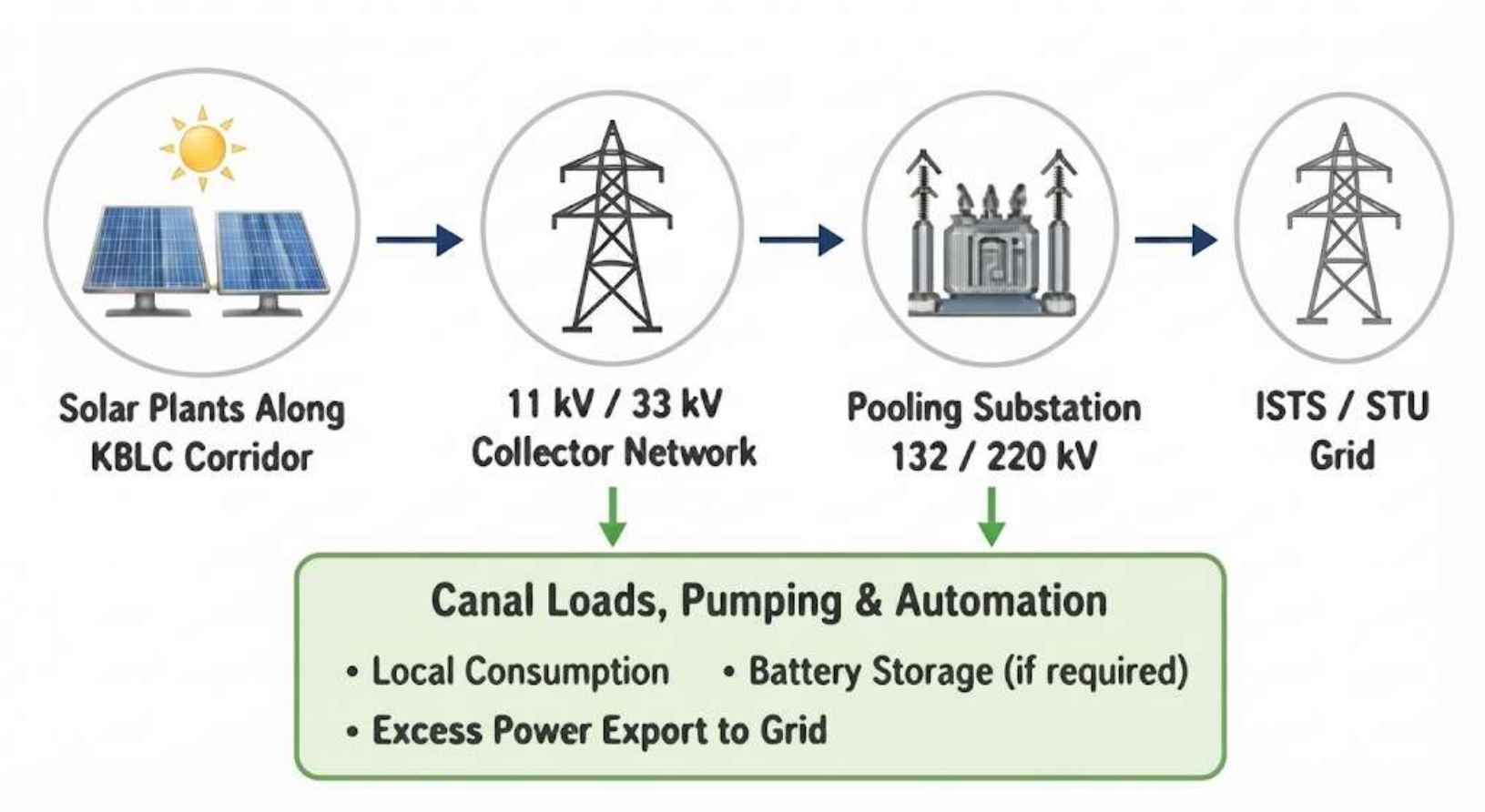
Operational coexistence

Coexistence with operational water infrastructure





UTILIZATION AND EVACUATION ROUTES



- **Pumping Operations:** Powers micro-irrigation networks from KBLC and backs up Upper-Level Tunnel pumping during low reservoir levels.
- **Power & Agreements:** Evacuates surplus power via substations or ISTS lines, with PPAs established between developers and KBLPA, GoMP, or GoUP on mutually agreed terms.

DEVELOPMENT APPROACH



1. **Opportunity assessment:** solar potential screening and corridor mapping.
2. **Feasibility and pre-development:** technical studies, surveys and grid/evacuation studies.
3. **Business model and structuring:** model selection and financial/risk structuring.
4. **Market sounding and RFQ:** prequalification and shortlisting.
5. **Competitive bidding and award:** RFP, evaluation, award and financial close.
6. **Development and operations:** construction, commissioning and long-term O&M.

RECOMMENDED ACTIONS

- **Mapping & Design:** Prepare a LiDAR/GIS atlas for the 216.465 km corridor, map ALT-2 strips, digitize exclusion zones, and complete structural, geotechnical, and embankment-stability designs for ALT-1 and ALT-2.
- **Energy & Grid Studies:** Conduct P50/P90 energy-yield simulations, load matching (pumping, SCADA, gates), and comprehensive grid interconnection and load-flow studies.
- **Financials & Pilot Rollout:** Develop chainage-wise BOQs, CAPEX, and O&M estimates using market quotations, followed by pilot block testing prior to corridor-scale implementation.

1. LiDAR/GIS atlas

Screening ⟶ bankable evidence

2. Structural pilot

Screening ⟶ bankable evidence

3. Energy & grid studies

Screening ⟶ bankable evidence

4. BOQ & market sounding

Screening ⟶ bankable evidence

5. Package procurement

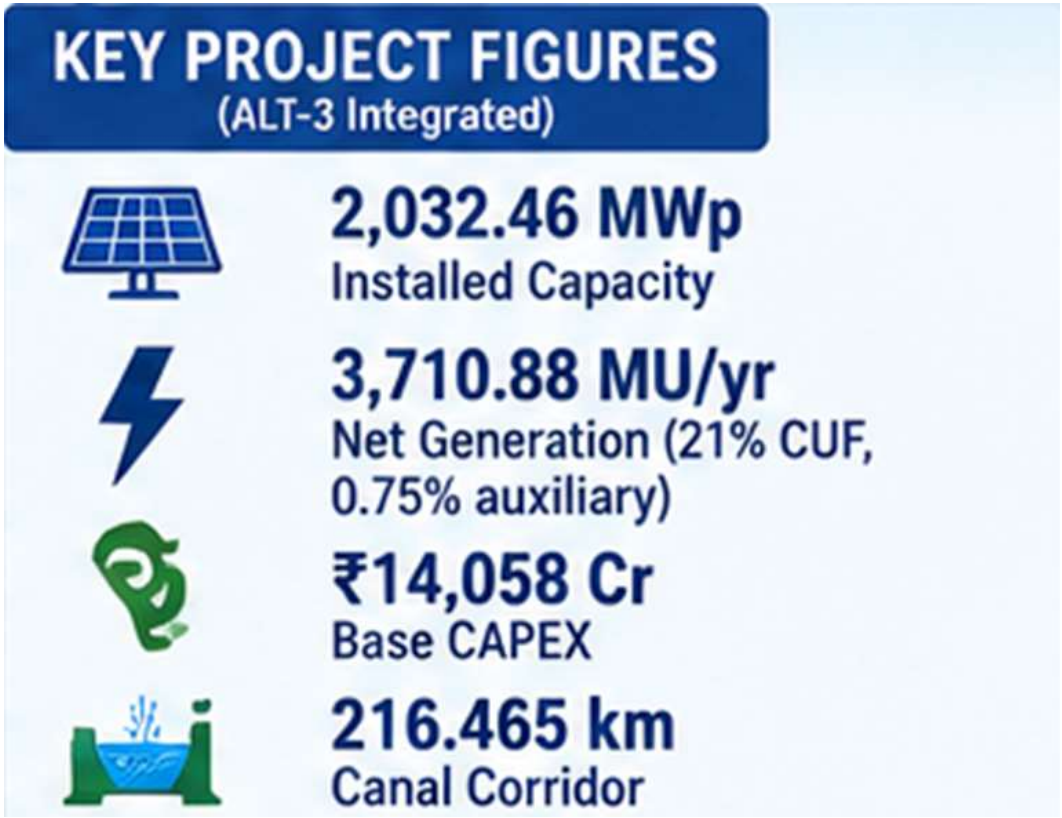
Screening ⟶ bankable evidence

6. Scale-up & O&M

Screening ⟶ bankable evidence

CONCLUSIONS

- **Key Benefits:** Solves land scarcity by utilizing existing corridors, meets rural energy needs while exporting surplus power to the grid, and uses running water below for natural cooling and reduced algae growth.
- **Investment Criteria:** Overcoming capacity uncertainties requires bankable, chainage-wise evidence covering structural design, energy yield, grid capacity, project-load coincidence, and BOQ-based costs.
- **Strategic Next Steps:** Retain ALT-3 for corridor-level planning and immediately progress from screening to a validated DPR, pilot, or package-development program





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