

Run-of-River Hydropower Site Selection – 15 Year Investment Ranking

1. Introduction

This report evaluates ten proposed run-of-river hydropower projects across different global regions. Each project would be constructed approximately 50 km downstream of an existing operating plant and is assumed to have the same installed capacity as the reference facility.

I estimated annual revenue, total project revenue, construction cost, and net profit using domestic electricity prices, seasonal precipitation-driven flow assumptions, and a 15-year investment horizon. Projects are ranked from highest to lowest investment return.

2. Project Locations (Google Map)

[Global Run-of-River Hydropower Projects](#)



Figure 1. Locations of candidate run-of-river hydropower projects.

3. Climate & Precipitation Analysis

Tropical Latitudes: Governed by monsoon systems and the Intertropical Convergence Zone (ITCZ), they consist of two main seasons:

Wet season (≈ 6 months): intense rainfall, high runoff.

Dry season (≈ 6 months): reduced flow.

Hydropower potential is high but strongly seasonal.

Mid-Latitude Regions: Influenced by westerlies and mid-latitude cyclones.

They consist of four distinct seasons. Moderate precipitation is distributed throughout the year, and snow accumulates during winter, with spring melt runoff.

These regions are more stable for year-round hydropower generation

Polar / High-Latitude Regions: These regions have four seasons with long, cold winters. Winter precipitation is stored as snow. Rivers are partially or fully frozen in winter. Peak runoff occurs during spring snowmelt. These projects will have lower annual generation potential for run-of-river systems.

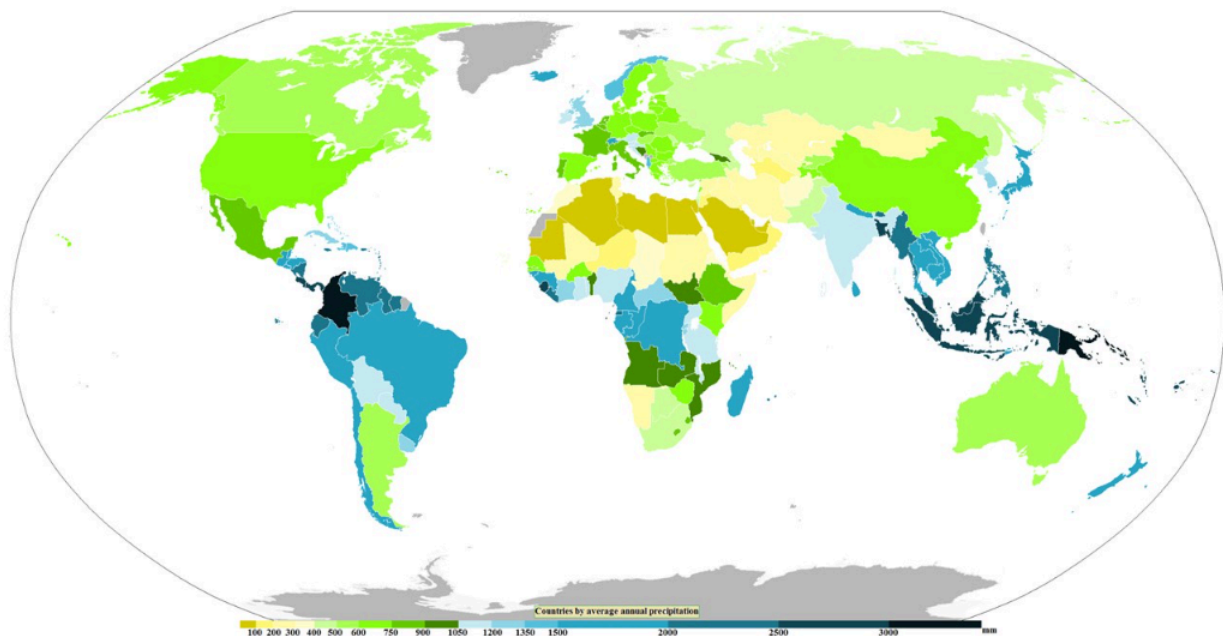


Figure 1. Global average annual precipitation by country. The legend is in mm/year.

4. Revenue Calculations

$$\text{Daily Revenue} = \text{Capacity (MW)} \times 1000 \times 24 \times (\text{LLH} + \text{HLH})$$

Where:

- Capacity (MW) = Installed plant capacity
- 1000 = Conversion from MW to kW
- 24 = Hours per day
- LLH = Low Load Hour price (\$/kWh)
- HLH = High Load Hour price (\$/kWh)

Annual Revenue Using Seasonal Multipliers + Maintenance

$$\text{Equivalent Full-Output Days} = 90 \times (\text{m}_W + \text{m}_{Sp} + \text{m}_{Su} + \text{m}_F) - 5 \times \text{m}_W$$

Where:

- m_W = Winter multiplier
- m_{Sp} = Spring multiplier
- m_{Su} = Summer multiplier
- m_F = Fall multiplier

$$\text{Annual Revenue} = \text{Daily Revenue} \times [90 \times (\text{m}_W + \text{m}_{Sp} + \text{m}_{Su} + \text{m}_F) - 5 \times \text{m}_W]$$

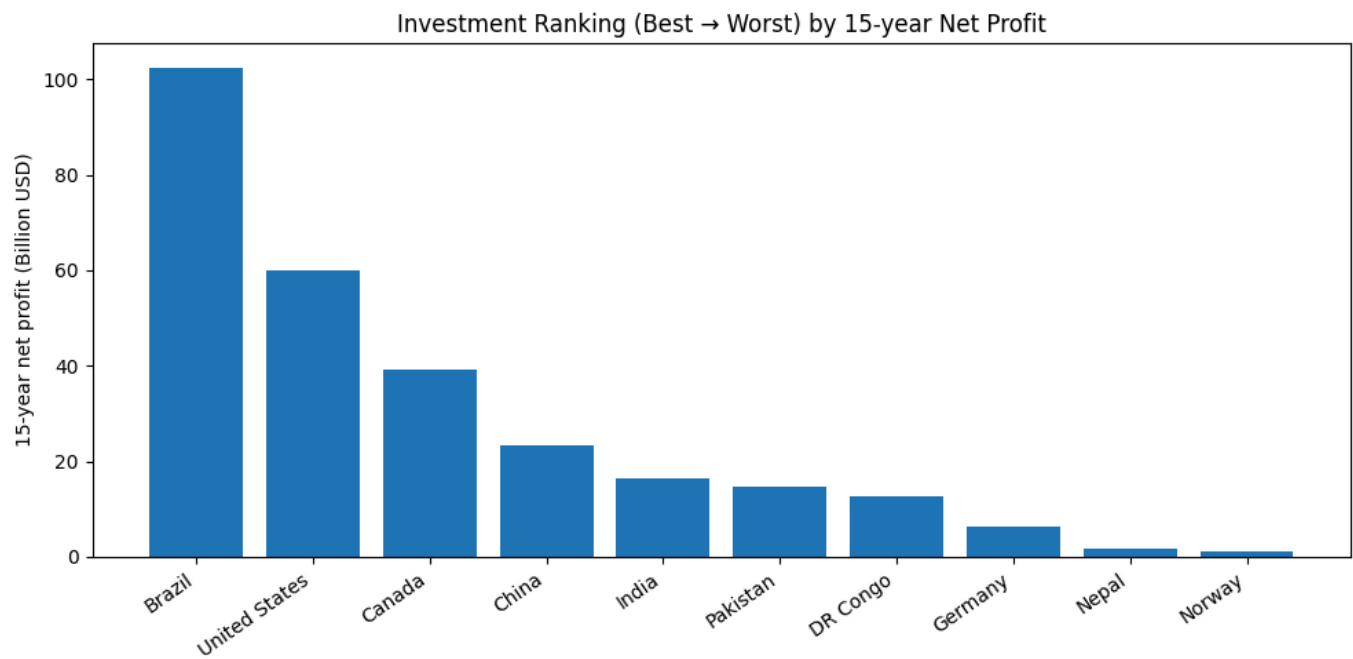
$$\text{Build Cost} = \text{Capacity (MW)} \times 2,500,000$$

Project	Country	Capacity (MW)	Latitude	Longitude	LLH Rate (\$/kWh)	HLH Rate (\$/kWh)	Weighted Avg (\$/kWh)	Latitude band
Jirau Dam	Brazil	3750	9.2° S	64.4° W	0.12	0.25	0.153	Tropics
Beauharnois Hydroelectric Power Station	Canada	1903	45.3° N	73.9° W	0.1	0.21	0.128	Mid-latitude
Tianshengqiao-II Hydropower Station	China	1320	24.9° N	105.2° E	0.07	0.18	0.098	Tropics
Inga Dam	DR Congo	1775	5.5° S	13.6° E	0.06	0.06	0.06	Tropics
Rheinfelden Hydropower Plant	Germany	100	47.6° N	7.8° E	0.44	0.44	0.44	Mid-latitude
Nathpa Jhakri Dam	India	1500	31.6° N	78.0° E	0.09	0.09	0.09	Mid-latitude
Kaligandaki A Hydroelectric Power Station	Nepal	144	28.0° N	83.6° E	0.07	0.11	0.08	Tropics
Hunderfossen	Norway	116	61.2° N	10.4° E	0.1	0.1	0.1	Polar
Ghazi-Barotha Hydropower Project	Pakistan	1450	33.8° N	72.2° E	0.06	0.11	0.073	Mid-latitude
Chief Joseph Dam	United States	2620	48.0° N	119.3° W	0.17	0.17	0.17	Mid-latitude

5. Cost & Profit Estimation (15 Years)

Daily_revenue_at_100%_capacity	Annual_revenue(Billion USD)	Build_cost(Billion USD)	15-year_net_profit(Billion USD)
\$33,300,000	\$7.451	\$9.375	\$102.388
\$14,158,320	\$2.934	\$4.758	\$39.257
\$7,920,000	\$1.772	\$3.300	\$23.282
\$5,112,000	\$1.144	\$4.438	\$12.720
\$2,112,000	\$0.438	\$0.250	\$6.316
\$6,480,000	\$1.343	\$3.750	\$16.395
\$622,080	\$0.139	\$0.360	\$1.728
\$556,800	\$0.095	\$0.290	\$1.134
\$5,916,000	\$1.226	\$3.625	\$14.766
\$21,379,200	\$4.431	\$6.550	\$59.913

6. Investment Ranking



7. Reality Check: Beauharnois (Canada)

To check the realism of the calculations, an independent comparison was done using the Beauharnois Hydroelectric Power Station in Canada. Beauharnois has a capacity of 1903 MW, which is about 5.5% of Hydro-Québec's total capacity. However, the calculated revenue share was much higher than this percentage.

This difference suggests that the simplified revenue model likely overestimates real-world revenue. Even so, the results are reasonable for a screening-level analysis and are useful for comparing projects, which is the main goal of this assignment.