ZGlobal Inc.

Power Engineering and Energy Solutions

Fatal Flaws Assessments of Utility Scale Renewable Projects

Prepared By: Jesse Montano, Herve Pare, & Brian Rahman P.E.

The development of renewable energy generation impacts the reliability of the power grid while affecting the price of energy paid by end users, the retail consumers. Investing in renewable energy projects is a multifaceted process that involves complex considerations encompassing project revenues, capital investment, operating costs, return on investment, tax incentives, environmental limitations, land availability, interconnection capacity costs, project scheduling, and other determinative factors. These considerations collectively determine the long-term viability and profitability of such investments.

During the initial phases of a project, some of these factors are already established, while others remain uncertain. Pre-determined factors are those shaped by federal, state, and local policies and regulations, while undetermined factors are often intricate and elusive, necessitating in-depth analyses.

This case study delves into the complex interplay of these variables and their impact on the development cycle, using a real-life project to illustrate the key elements of transforming an ordinary project into one that is attractive.

ZGlobal staff also have a remarkable 37-year track record in the realm of project development, engineering, construction, and operations. ZGlobal staff also have profound knowledge of the California energy market and the operation of utility power grids. In the past 18 years, ZGlobal's expertise has been instrumental in facilitating the development of more than 656 large-scale utility-generating projects across the United States. These projects include over 97,822 megawatts (MW) of generation, 48 high-voltage transmission, distribution, and substation projects ranging from 500 kV to 34.5 kV. As depicted in Figure 1, project development is a multifaceted process that necessitates collaboration with a diverse array of stakeholders. These stakeholders encompass landowners, federal, state, and local governmental bodies, utility providers, vendors, load-serving entities, environmental advocates, water agencies, indigenous tribes, neighboring communities, and the public.

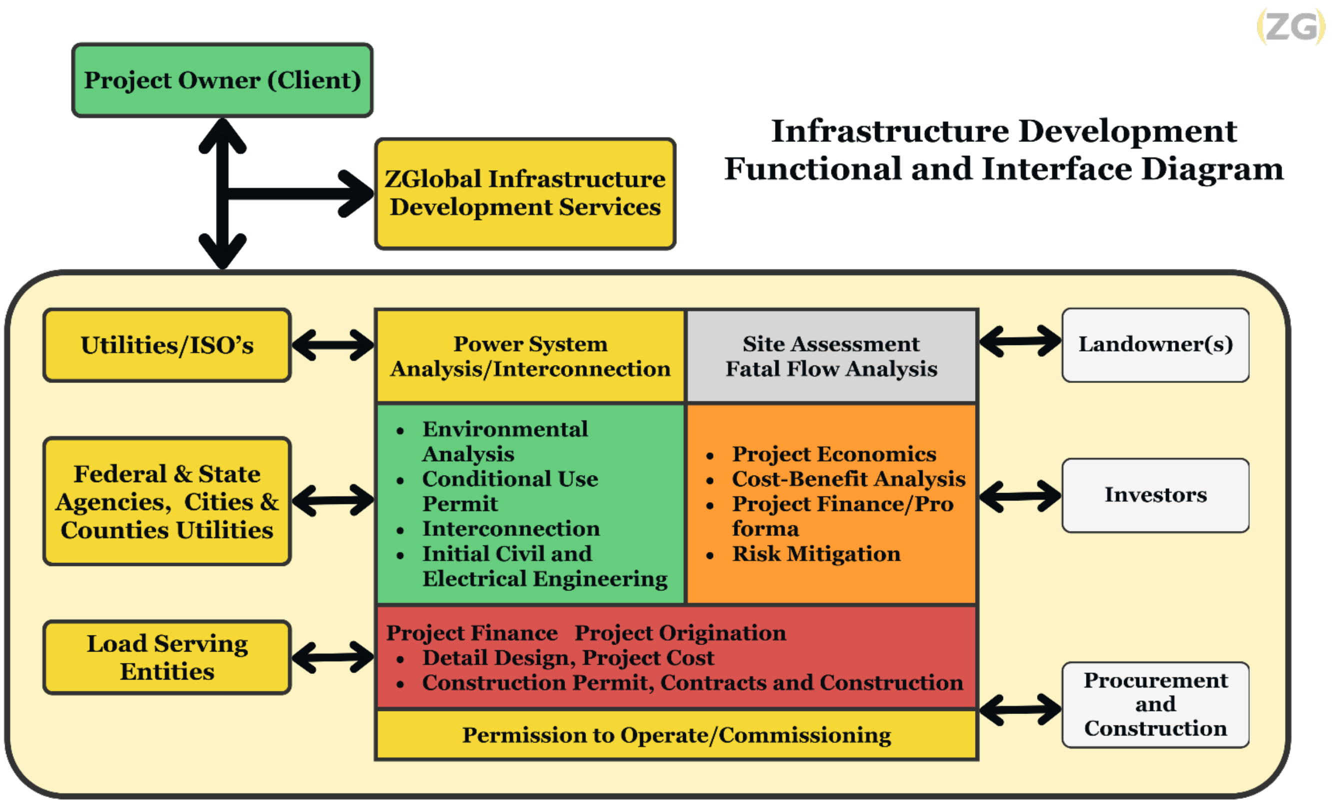

Figure 1: ZGlobal Infrastructure Development Interface Diagram.

Our extensive experience and network of interactions underline ZGlobal's ability to navigate the intricate landscape of project development, leveraging the synergy required for sustainable and successful energy projects.

Framework for Informed Decision-Making

The investment decision is not an impulsive action; it entails the allocation of substantial resources and considerable at-risk investment and, thus, demands a normative approach supported by a systematic evaluation. This discussion on the process of decision-making is rooted in the normative perspective. The decision-making process can be divided into distinct phases: **Frame**, **Evaluate**, and **Decide** as illustrated in Figure 2.

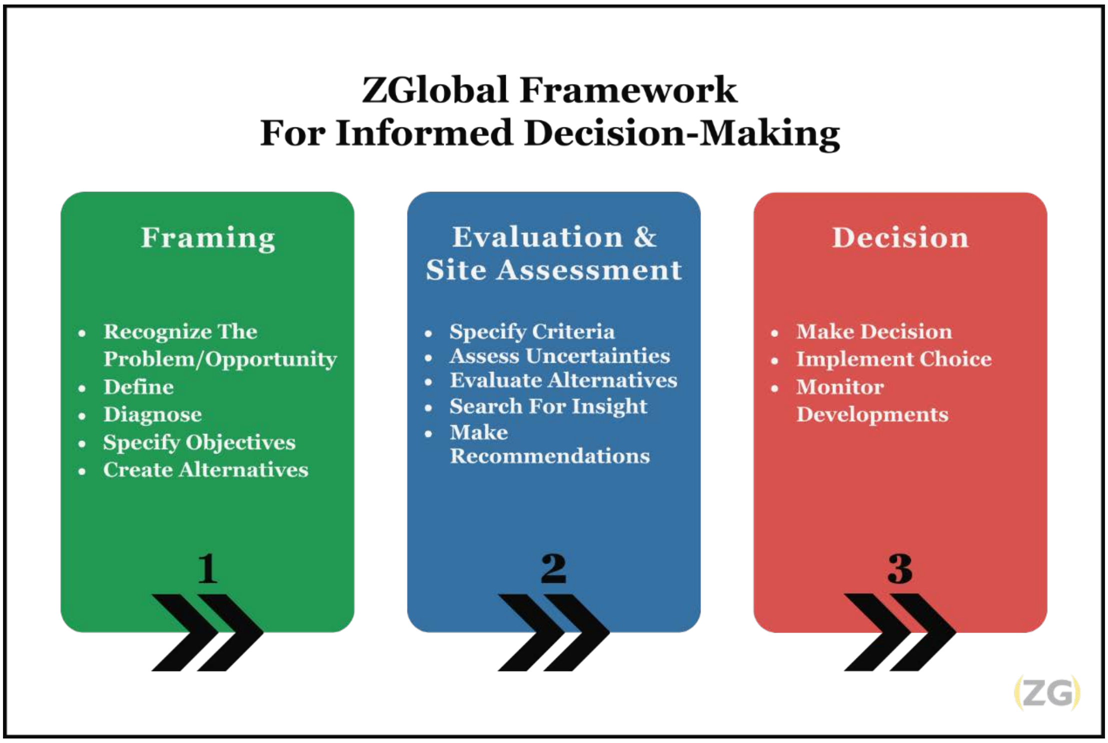

Figure 2: Decision-Making Framework

Framing Phase

In the framing phase, the primary goal is to comprehensively define the problem or opportunity at hand and establish clear criteria and objectives for the necessary decision. A valuable technique for sharpening the decision frame involves asking fundamental questions, such as:

- What are the objectives?
- What is the timeframe?
- What is the expected return on investment?
- What is my risk tolerance?
- What uncertainties exist, and how can they be mitigated?

Evaluation & Site Assessment Phase

The second phase involves evaluating the project based on a set of criteria established during the first stage (**Feasibility Period**) as shown in Figure 3, which outlines ZGlobal's approach to providing Infrastructure Development Services for renewable and non-renewables resources.

This step encompasses three critical components:

1- Formulating a set of criteria.
2- Develop an evaluation method.
3- Presenting results and recommendations.

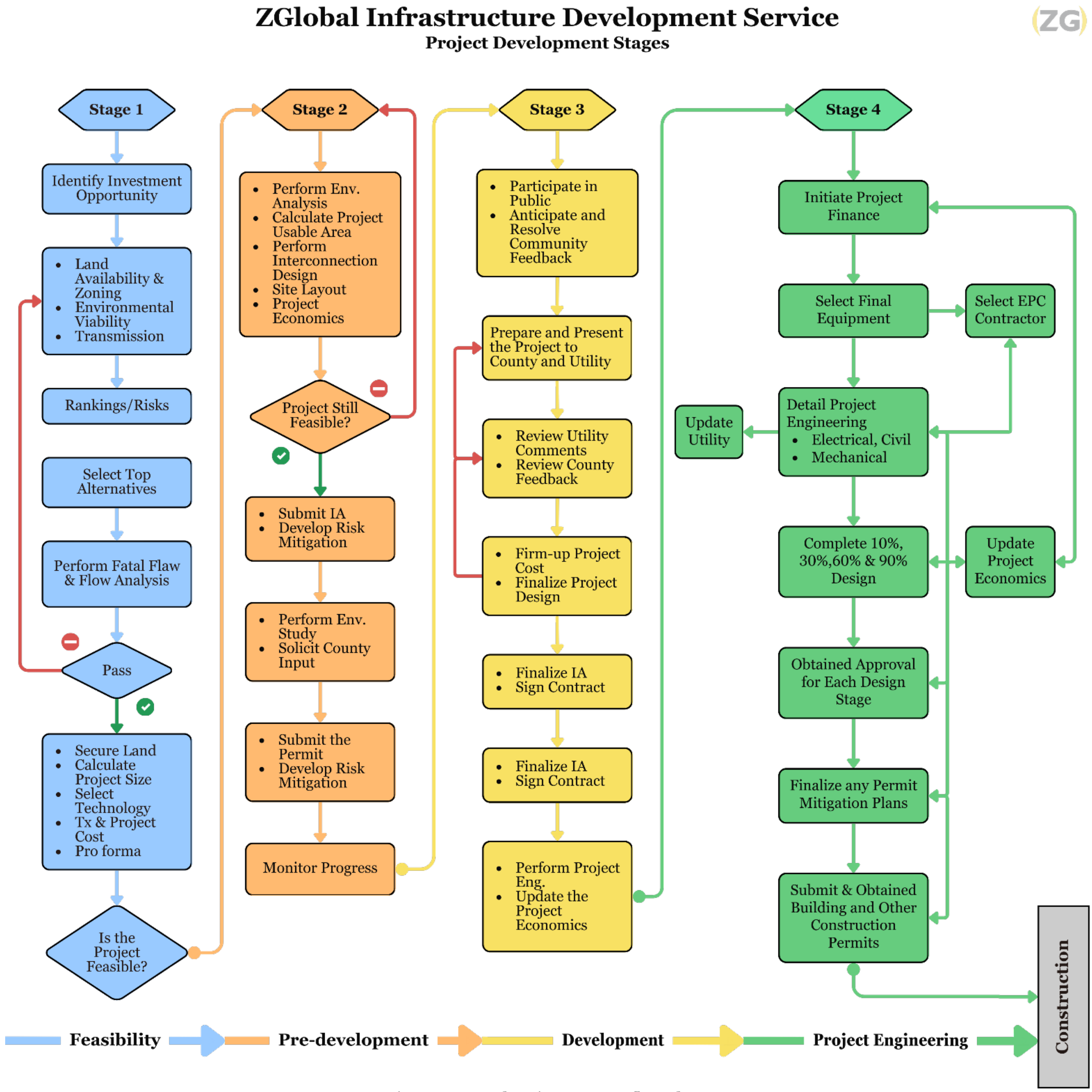

Figure 3: Evaluation Stages flowchart

It is analogous to conducting comprehensive assessment of several potential project sites, with the aim of selecting the most optimal one or two sites and advancing to the next stage. This framework offers a structured and analytical approach to decision-making, ensuring that investments align with well-defined criteria and objectives, ultimately leading to more successful and sustainable projects.

Stage 1 – Feasibility Development:

In Stage 1, the development of a set of criteria is paramount to informed decisions. Most projects share a common set of criteria that are methodically developed and applied to multiple potential project sites. The goal is to identify the rank potential project sites that exhibit the most promising attributes, warranting advancement to Stage 2. This strategic evaluation at Stage 1 is a fundamental factor in the success of project development, encompassing a comprehensive understanding of project constraints, economic considerations, and potential risks.

Stage 1 assessment initiates by pinpointing specific factors, including:

1- **Land:** This includes considerations such as size, easements, minerals rights, costs, prior land use, the surrounding environment, and whether the land is publicly or privately owned. For solar and wind, the quality of solar and wind are large factors that influence the expected electricity production.

2- **Zoning:** An assessment of the extent to which zoning regulations align with intended use.

3- **Proximity to the nearest grid interconnection:** Evaluating the distance to the nearest and most suitable point of interconnection, right-of-way requirements, and availability and ownership of the rights-of-way.

4- **Available transmission capacity:** The availability of transmission capacity at the point of interconnection is critical to cost and timing. Readily available transmission capacity that does not necessitate lengthy and costly upgrades is preferred. For energy storage, an important factor is whether the energy storage can use energy from the grid to store it for later use. Capacity and deliverability aspects can also play an important role and impact the economic viability of a project.

5- **Environmental screening:** Conducting an initial environmental analysis, covering aspects such as biological and cultural considerations, geotechnical analysis of the soil, wetland constraints, water availability, and the identification of various local, state, and federal regulations required for a conditional use permit.

6- **Development period:** The time taken for development, influenced by the criteria mentioned above, significantly impacts risk and cost. A lengthier development period increases costs and potentially puts a project at risk, thereby negatively impacting the expected return.

7- **Project return:** The financial evaluation of the project involves assessing investment costs and the cash flows generated from the investment. It synthesizes the developer's knowledge of key success factors and assesses project risks. Tax credit, unlevered or levered return over the life of the project should be considered. Value engineering and experience can bring significant benefits to the project by way of returns.

8- **Risk profile:** Examining the risk associated with the project site, which may be feasible, but could require a lengthy development period.

9- **Overall ranking:** Combining the results of strategic, economic, technical, and financial evaluations to determine the overall ranking of the project's potential.

Once the project has undergone this comprehensive assessment, a critical decision must be made regarding whether it's worth investing in or not. Before delving into the specifics of investment decisions for capital projects, it is important to understand the broader principles of decision-making within a business.

Practical Illustration of ZGlobal Methodology

In this case study, we've considered six potential sites in the Southern California/Nevada region, with the objective of developing a 100 *to* 130 *MWac* solar facility with energy storage (Hybrid).

These principles have been applied to a real project currently in construction in Southern California, serving as a practical illustration of the methodology. This phase culminates in the development of a project finance proforma, involving initial engineering to estimate project costs, revenues, operating expenses, and tax equity. The outcome is an estimated unlevered and levered Internal Rate of Return (IRR), which is a good measure that calculate the annual return that makes the Net Present Value (NPV) equal to zero. The project IRR is based on stated and realistic assumptions.

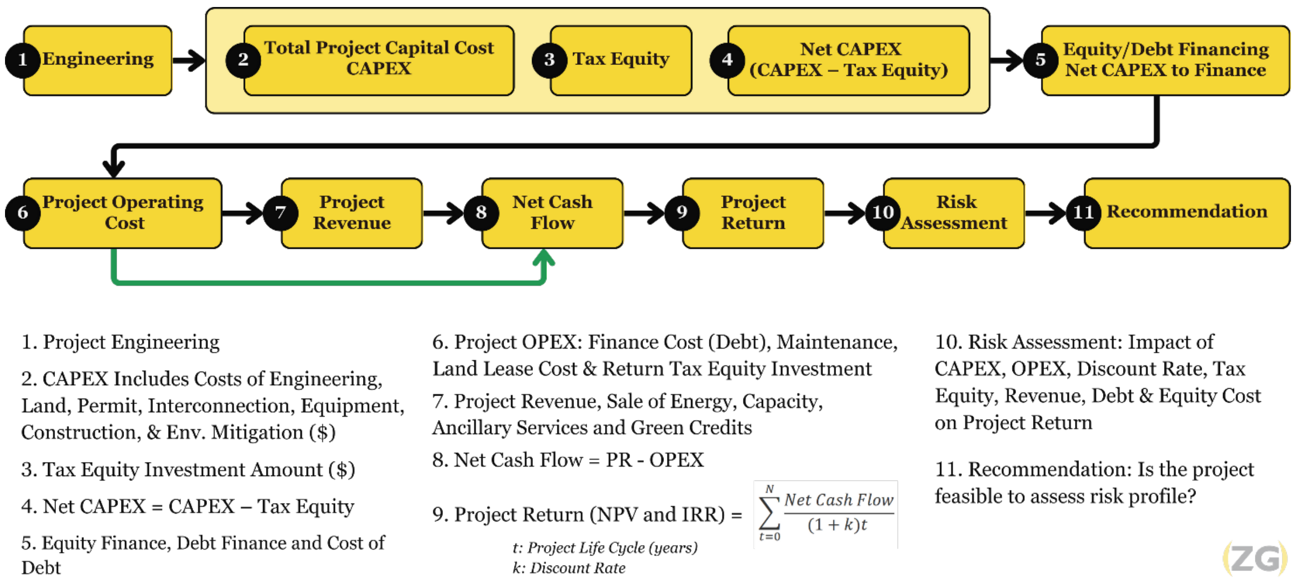

Figure 4: An Overview of the Project Engineering and Finance

Project Risk Assessment Factors

Project Risk Factors are reviewed on a regular basis to identify roadblocks and key issues for successful project development.

Project Status	• What stage of development? • What are the possible challenges
Economics	• What is the estimate of the baseline capital cost? • Have all other development costs been included? • What are the project cycle revenues and costs? • Is resource validation required? What is the status? • What are the existing utility rate and existing tariffs?
Real Estate	• What is the land cost and the terms? • What is the Land Title, easements, usable land, & conditions of the land?
Regulatory (Legal)	• What are the regulatory limits for interconnection, and net-metering? • What is the status of getting the required permit approvals?
Off-Take	• Who is going to buy the energy and at what value? • Contract terms and conditions
Integration (Technical)	• What are the technical issues to connect to the grid (e.g., substation, line capacity, etc.) • What is the status of the required interconnect or flow studies?
Environmental / Permitting	• What are major environmental and mitigation issues? • Who will implement the mitigation and what is the timeline?
Acquisition	• What is the acquisition strategy and timeline to implement? • What performance risks are there with the developer or other partners?

Figure 5: An Overview of the Project Engineering and Finance

These processes facilitate a logical and systematic approach to decision-making and project evaluation, ensuring that investments are well-informed and aligned with the defined criteria and objectives, fostering successful and sustainable outcomes.

Decision Phase

The decision-making process takes on various forms depending on the project's development stage and the specific decisions at hand. Projects move through the stages outlined in Figure 2, ultimately transitioning into the detailed engineering phase. Following this, the implementation phase commences, involving procurement, construction, and commissioning.

In Table 1, you can see the results of the Stage 1 evaluation, which led to the selection of three sites: Sites 2, 3, and 6. These sites are further analyzed in Stage 2 to refine the decision-making process.

Table 1: Stage 1 Results

Site	1	2	3	4	5	6
Land	Public. no ability to expand	Private, limited ability to expand	Private. no ability to expand	Public. no ability to expand	Private, Ability to expand	Private, Ability to expand
Zoning	Poor ag, previously farmed	Poor Ag, previously farmed	Average Ag Quality	Undisturbed desert	Prime land	Poor Ag, previously farmed
Proximity to Grid	3 miles	On-Site	On-site	½ miles	1 mile	On-Site
Available Transmission Capacity	No	Yes	Limited / Needs Upgrade	Limited	Yes	Yes
Pass Environmental Screening	Yes	Yes	Yes	No	No	Yes
Development Period in years	4	3	6	5	3	2
Project Return (Unlevered IRR)	7%	13%	11.9%	8.5%	11%	15.1%
Risk Profile	High	Low	Medium	High	High	Low
Overall Ranking	6	2	3	5	4	1

Stage 2 - Development

The goal in Stage 2 is to initiate the pre-development phase, which includes commencement of environmental studies that adhere to the relevant justifications. While environmental screening was performed in Stage 1 it was insufficient for purposes of environmental compliance. Therefore, additional studies are initiated, including:

- Air Quality/Greenhouse Gas Emissions Assessment
- Energy Consumption Assessment
- Noise Impact Assessment
- Biological Resources Assessment (BRA)
- Wetland Delineation
- Aquatic Resources Delineation (ARD) & Report
- Cultural Resources Assessment (CRA)
- Traffic Impact Study
- Water Supply Assessment
- Visual Impact Analysis/Photo Simulation
- Glare Analysis (if necessary)

Concurrently, an American Land Title Association (ALTA) Survey is conducted, providing a detailed land parcel map with information that includes existing property improvements, utilities, and significant observations within the insured estate. A geotechnical investigation is also performed to gather data on soil and rock properties, crucial for designing appropriate foundations and other structures that require earth disturbance.

The combination of the environmental, ALTA, and geotechnical assessments forms the precise project site plan, project size and expected electricity generation and provides the baseline for the initial project engineering, which includes the selection of trackers, solar panels, battery storage, and inverters. This process leads to an estimate of the project's capital costs, operating expenses, and hourly electricity generation, which in turn informs project revenue projections.

At this stage, we revisited the three sites we selected in Stage 1 - Sites 2, 3, and 6. Here are the results:

Site #6 IRR decreased from 15.1% to 14.57% due to environmental costs while Site#2 IRR increased from 13% to 14.42% due to favorable environmental conditions. Stage 2 analysis flipped the recommendation from Site # 6 to Site #2 for two reasons, the IRR are virtually identical (14.42% for site #2 and 14.57% for site #6 and most importantly, the size of the investment for site #2 of $283 million results in more cash than site #6 of an investment amount of $226 million.

Table 2. Results of the three selected sites from Stage 1

Site	2	3	6
Project size in MW DC / MW AC	140/130	190/130	161/130
Net Electricity generation into the grid (MWh)	270,765	420,440	309,502
AC/DC ratio	1.07	1.46	1.23
Net Capital Investment (Capital Cost net Tax Incentive)	$212,958,738	$283,266,659	$226,697,981
Project Return (Unlevered IRR)	13.84%	14.42%	14.57 %
Overall Ranking	2	3	1

Stage 2 Return on Investment (ROI) Analysis:

Upon conducting a comprehensive Stage 2 analysis, the ROI for each of the selected sites exhibited the following changes from their respective Stage 1 values:

- For Site 6, the ROI was determined to be 14.57% in Stage 2, a slight decrease from the initial 15.1% in Stage 1.
- Site 2 demonstrated an ROI of 13.84% in Stage 2, reflecting a marginal increase from the earlier Stage 1 value of 13%.
- The most substantial shift was observed in Site 3, which saw its ROI surge from 11.9% in Stage 1 to an impressive 14.42% in Stage 2.

The notable variation in ROI between Stages 1 and 2 was primarily evident in Site 3. While the project returns significantly improved to 14.42%, making it an attractive choice, it also introduced a challenge due to its extended 5-year development cycle. This prolonged timeline primarily results from the necessary upgrades to the interconnection, estimated to require five years and incur an approximate cost of $20 million. It's important to note that the final duration and costs associated with the interconnection upgrades remain uncertain until the application is submitted and assessed by the transmission provider, a process anticipated to take at least two years to yield results.

This inherent uncertainty in the study timeline, along with the potential for additional delays in executing the upgrades by the utility, may also influence procurement costs and discount rates. However, since the IRR is virtually identical (14.42% for site #2 and 14.57% for site #6 and most importantly, the size of the investment for site #2 of $283 million results in more cash than site #6 of an investment amount of $226 million, this could lead to selecting all three sites (sites 2,3, and 6) if investment capital is available and the level of risk is determined tolerable.

Considering these factors, a careful evaluation led to the conclusion that Sites 6 and 2 should be prioritized over Site 3 due to lower interconnection risk. All three sites exhibit similarities in environmental and permitting processes, as well as project cost per MW-DC. In this particular scenario, the interconnection requirements emerged as the primary determining factor. Consequently, ZGlobal recommends the simultaneous pursuit of Sites 6 and 2, aligning with the goal of optimizing the investment portfolio with the caveat that site 3 may be pursued depending on investment capital available. Ultimately, we did not recommend pursuing development of the remaining sites.

Final note. The same analysis was performed using levered IRR where the cost of capital becomes a driving factor. The results favor the same recommendation as the length interconnection process and the unpredictable interconnection cost and associated grid upgrades for site 3 add an additional possible economic pressure if cost of capital increased.