

Innovative New Capital Value Process for New Energy Developments





Introduction and Problem Statement

The energy transition requires all the support to achieve the ambitious yet necessary climate targets sought by governments, industry leaders and humanity. This includes the way in which capital projects are conceived, developed and delivered. Developers of Power-to-X (PTX), Carbon Capture, Utilisation and Storage (CCUS), Long Duration Energy Storage (LDES) and similar projects utilising nascent technologies that serve to meet the “sustainable” aspect of the energy trilemma we currently face, require traditional project development frameworks to be optimised to achieve success.

io consulting stands at the intersection of established energy expertise and future energy solutions. Our role as project architects and systems integrators, built on decades of Front End Loading (FEL) expertise, has given us unique insight into what drives project success. Through our work with developers across PTX, CCUS, LDES and industrial decarbonisation projects, we've positioned ourselves to find solutions for new energy projects to see the light. In doing so we are convinced the traditional Capital Value Process (CVP), that is used consistently and almost religiously across all oil & gas development projects, must evolve to meet the distinct requirements of new energy developments.

Time and capital efficiency are paramount in this rapidly evolving landscape. To move projects confidently from a blank sheet of paper to a comprehensive development plan worthy of sanction, developers need a refined approach that addresses the specific challenges of new energy ventures in the most time and capital-efficient manner.

This isn't merely an enhancement nor is it a total re-write of existing methods, which has evolved over decades and incorporated valuable lessons learned, instead it's a strategic refinement and fusion of certain steps in the existing process to achieve these efficiencies amidst uncertainty.

Our pioneering implementation of an alternative FEL stage gate process is delivering compelling results across our new energy projects, validating our vision for a more agile and effective project development approach during FEL. This paper presents our view on this alternative process which is aimed to help developers better plan their projects, maximise the probability of reaching Final Investment Decision (FID), and ultimately ensuring successful execution and start-up of green energy and chemicals development projects. With the 2030 milestone rapidly approaching, this transformation in project delivery methodology is not just beneficial – it is essential for governments and nations to meet their Paris Agreement commitments, where delay puts net zero targets, and the world in which we and our future generations will live, further at risk.

Front End Loading - The Traditional Way

FEL is the critical journey that takes a project from its infancy of assessing a business opportunity through to its conceptualisation and further basic design and engineering on the selected concept to provide sufficient technical, commercial and execution planning definition that allows project sanction (FID) and hence entry to the execute phase.

In a traditional stage gate process, FEL 1 is the starting point. This is often referred to as feasibility. FEL 1 involves assessing and validating the business opportunity and identifying suitable alternatives to be analysed in the next stage. FEL 2 is typically split into FEL 2a and 2b (but typically awarded as one stage with no formal gate approval between the two). In FEL 2a (concept select), the alternatives identified in FEL 1 are analysed technically, commercially, and strategically to select the preferred option(s) for further definition in FEL 2b (sometimes referred to as concept definition or PreFEED). During FEL 2b, the selected concept(s) is further defined to mature the technical definition and improve the accuracy of cost and schedule estimates. The outputs from FEL 2b form the technical dossier and basis of design (one concept only) used to tender and commence the next and final FEL phase.

FEL 3, known as Front End Engineering Design (FEED) or define, is significantly larger than FEL 2b and requires the developer to commit more resources towards the project from a design and engineering perspective, often involving a specialist subcontractor for these services.

At the completion of FEED, the developer has a comprehensive dossier of multidiscipline documentation, resulting in improved accuracy of cost and schedule estimates. This dossier is used to tender the Execute phase, evaluate these tenders technically and commercially, and select the most suitable one. These are necessary inputs for formal reviews and approvals to gain FID and project sanction. The FID represents the culmination of all prior project development efforts - where vision meets reality, and years of meticulous planning transform into tangible action. At this pivotal moment, formal contracts are awarded to the winning tenderer(s), launching the Execute phase with its comprehensive scope of detailed engineering, procurement, construction, commissioning, and support to the Owner's operation team in start-up. FID is where investor confidence meets project readiness, marking the transition from potential to reality.

The above is tried and tested from decades of oil & gas developments where the demand for the product is well established with certainty on global sales price in any given economic period. There is strong political and financial backing for such projects because of their significant contribution towards oil producing countries' GDP. A wealthy historic database and hence cost norms for such projects exists to provide greater certainty in lifecycle costs and economic analysis even during the early stages of FEL. The supply chain supporting such developments is far greater with mature and proven technology contributing to increased competition and more favourable pricing. Overall this results in more attractive economics with greater confidence of reaching FID when these stages of project development are followed.

Figure 1: Traditional Capital Value Process



From Concept to Commitment: A Green Hydrogen Case Study

A recent example of our innovative Capital Value Process (CVP) in action is a large-scale off-grid green hydrogen development for an American private developer. This project includes over 600 MW of PV solar, more than 300 MWh of Long Duration Energy Storage (LDES), and 400 MW of electrolysis to produce, store, liquefy, and offload both gaseous and liquefied hydrogen to sales customers via trucks. Initially, we were approached to perform an FID readiness review, which allowed us to identify critical gaps in the project's planning and execution strategies. Using a comprehensive checklist of what constitutes a successful FID, we highlighted the areas needing better engineering and design definition.

Recognising the need to address these gaps, the developer competitively tendered a FEL scope to allow them to move closer to FID. Notably, there was no set scope provided by the developer, only a high-level objective statement. Using this end-in-mind approach and our CVP as outlined in this paper, we developed an appropriate scope for FEED, understanding that some key decisions were yet to be made and the finalisation of key technology providers was pending. In a competitive tender, we were awarded the scope and delivered a comprehensive Preliminary Investment Decision Design (PID) package, strategically combining elements of FEL 2b and FEL 3.

This approach allowed us to meet the developer's timelines and budget by delivering sufficient engineering and design definition to engage EPC contractors and lenders, and even complete an Independent Engineers due diligence, which is crucial for lenders' evaluation and investment consideration.

Through close collaboration with the client and key vendors, we ensured comprehensive system integration and clearly defined vendor scopes, setting the stage for the integration of these technologies by the EPC contractor. This meticulous planning enabled the client to engage EPC contractors, lenders and investors effectively. As the project progressed towards FID, our Final Investment Decision Design (FIDD) phase provided the necessary technical and commercial assurance, paving the way for successful project execution. This structured and efficient process not only enhanced investor confidence but also ensured that the project was delivered in a cost and time-efficient manner, ultimately contributing to the client's success in the new energy sector and moving them a step closer to making these plans for a new energy development a reality.



Applicability to New Energy Developments - Pinpointing the Challenges

The journey to FID for energy transition projects reveals a landscape fundamentally different from traditional oil & gas developments. While conventional energy projects benefit from decades of established practices, robust supply chains and long-term purchase agreements, new energy ventures face a more complex path to investment security.

Consider the inherent flexibility of oil & gas: refineries can vary, to some degree, between several end products based on market demands, from aviation fuel to petrochemicals, all supported by well-established global trading networks and decades-long supply contracts. In contrast, new energy projects require new technology which is limited in its supply and more expensive, often commit to a single product stream - whether it's green hydrogen, sustainable aviation fuel, or other clean alternatives - typically serving a specific industry with evolving demand patterns and without the safety net of long term offtake agreements and overall less competitive in price when compared to more established grey sources of energy.

New energy projects navigate through uncharted waters: evolving regulatory frameworks, technologies racing to achieve commercial scale, and a stark absence of reliable cost benchmarks for investor confidence. The competitive landscape presents additional hurdles—emerging technologies, despite promising efficiencies, have yet to reach viable price points, while varying regional government support creates further uncertainty.

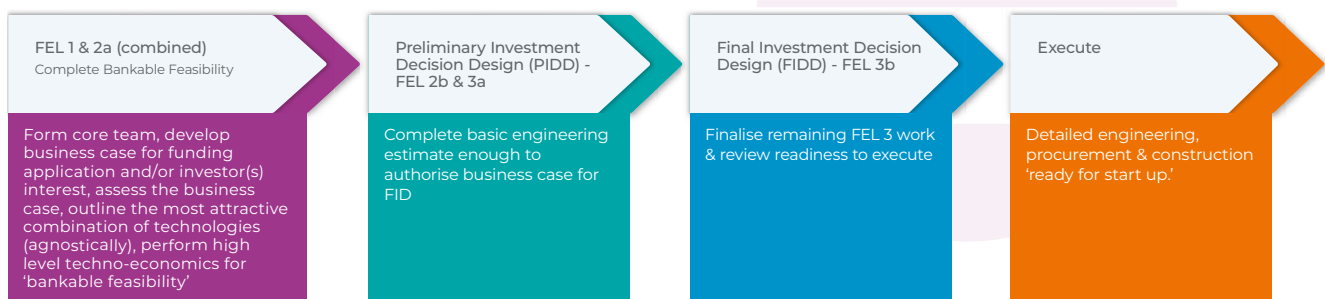
Applying traditional oil & gas FEL processes to these ventures could work but, given the complexities mentioned above, is not deemed ideal. These projects require a different approach - one that builds investor confidence earlier, adapts to the unique characteristics of energy transition ventures without spending too much time and resources in getting there - managing it in "right sizes".

io's recommended CVP for FEL success

io's approach to success is not about bypassing any of the steps in the traditional CVP, which has reliably led to the successful sanction of numerous oil & gas developments we've all worked on. Instead, it's about streamlining these steps into

fewer, more efficient stages and being objective about what is delivered at each stage and when. There are three distinct stages we envision, as outlined in Figure 2, before achieving FID and sanctioning the project for execution.

Figure 2: Emerging CVP for New Energy Developments



New clean energy projects do not always prioritise cost or schedule, but instead favour the need to demonstrate willingness to invest in the new industry.

The Start

What transforms a promising new energy venture from an idea to reality? The answer lies in one critical word: bankability.

The key to unlocking investment in renewable energy projects starts with a Bankable Feasibility Study (BFS). This combines aspects of FEL 1 and 2a where a combination of technology selection, market assessment, right sizing along with identification of various concepts to achieve these outcomes with sufficient certainty in their techno-economic assessment to select one that best validates the business case, is aligned with the client's value drivers, while maintaining vendor neutrality. This foundational step charts the course for project success by establishing credible economics before technology / Original Equipment Manufacturer (OEM) selection. This approach allows the project to take shape through a series of strategic decisions. First, it determines the optimal mix of variable renewable energy sources.

Next, it identifies the most viable molecules for production and monetisation, alongside the most suitable generation technology and storage requirements, both electrons and molecules, to ensure the most favourable levelised cost. io's **emerge** dynamic techno-commercial modelling tool is a key facet of our offering in this phase. Through careful analysis of development lifecycle costs and product off-take revenue, a clear picture of project economics emerges. This comprehensive assessment then informs potential investment and funding strategies, creating a roadmap to financial viability. Following which a basis for the project is prepared and it is ready to move into the next stage. This limits the time and expenditure developers need in order to decide on the business case's viability, while still gaining valuable insights and baselines to attract investment and market assurance. In the case of private developers, often self-funded at this stage, or with limited grant funding, this investment is critical to fund the project during the next FEL stage.

The Middle

Here lies the cornerstone of our reimagined approach for new energy projects, a transformative evolution in project development methodology. During this pivotal stage, we have crafted the Preliminary Investment Decision Design (PIDDD), a strategic fusion of FEL 2b and the right amount of FEL 3 (we have defined as FEL 3a). This innovative phase intensifies focus on engineering and design maturity on the single selected concept following the BFS, enabling the crucial selection of technology providers and incorporation of their specific design requirements in to the project. It also enables progression on contracting strategies formulating and solidifying what success could look like for the developer. PIDDD represents more than just a process refinement, it is a fundamental shift in how new energy projects advance from concept to reality. PIDDD brings shape to the project through basic engineering, whilst focused on value protection and continuous enhancement, in order to mature the technical, commercial and project execution definition based on specific vendors technologies and defining to suitable levels of definition what the integrators' need to do. The OEMs are selected in a competitive process during the early stages of PIDDD (FEL 2b) and form part of the integrated design team during FEL 3a so that the basic design is specific to their offering and importantly the integration aspects that will be critical to the execution contractor are well defined.

PIDDD is where the project ecosystem is created, and allows engagement with EPC contractors, in whatever manner the contracting strategy for the project envisions, takes place, ensuring the successful integration of selected OEMs' technology. This stage attracts investment and provides confidence to project investors and financial institutions, enabling them to authorise the funds for the project whilst it progresses to FID and financial close.

The End

FEL 3b, reimagined as the Final Investment Decision Design (FIDD), showcases the full potential of tomorrow's energy solutions and provides the "rubber stamp" for its evolution in to reality. In this defining stage, the technical decisions, the commercial strategies and innovative approaches are given a final polish and seal of approval by those organisations that will bring the project together (OEMs, EPC integrators, regulators, etc.) such that further confidence in gaining FID and financial close becomes a reality. This is where new energy projects prove their capability to reshape industries and energy systems. Only with this final, precise alignment of every project element can we unlock that pivotal moment: FID. In our process, FEL 3b is performed by the OEM's selected during PIDDD and the EPCs that will integrate their components (either one or more to enhance competition depending on the developers' appetite for risk versus the effort they want to spend in this last FEL stage) to ensure a holistic solution and functioning plant.

FEL 3b is commensurate with the latter stages of FEED and the EPC bidding process, focusing on preparing multidiscipline design deliverables to finalise the Basis of Design. This stage ensures an appropriate level of technical definition to support a capped price or similar commercial arrangement, enhances the accuracy of cost and schedule estimates, and develops integrated execution plans for the project. Depending on the contracting strategy set during PIDDD, it is likely that the partners selected for the project, and who will perform FIDD, will work with the developer in an Open Book Estimate (OBE) manner during FIDD and covert in to Lump Sum (or Fixed Fee) for the EXECUTE phase. This promotes transparency and assurance for all parties involved, particularly financial institutions supporting debt structuring to make the project a reality.

Conclusion

In conclusion, we believe our reinvention of the CVP for new energy projects represents a transformative evolution from traditional hydrocarbon development methodologies where the FEL stages are critical in this journey, starting from the initial business case assessment in FEL 1, through the detailed technical and commercial analysis in FEL 2, and culminating in the comprehensive design and engineering efforts of FEL 3. This structured approach ensures that projects are meticulously planned and defined, providing a solid foundation for FID and subsequent execution phases. The traditional CVP has been tried and tested over decades, offering a wealth of historical data and established practices that contribute to the successful sanctioning of projects.

However, the journey to FID for new energy projects presents unique challenges that require a reimagined approach. Unlike conventional energy projects, new energy ventures must navigate evolving regulatory frameworks, emerging technologies, and a lack of reliable cost benchmarks. This necessitates a more flexible and adaptive methodology, such as the Preliminary Investment Decision Design (PIDDD) and Final Investment Decision Design (FIDD). These innovative stages focus on early engineering and design maturity, strategic vendor selection, and comprehensive project ecosystem creation. By streamlining traditional steps and incorporating specific requirements of new energy developments, this refined approach builds investor confidence and ensures financial viability, ultimately paving the way for successful project execution and the realisation of new energy solutions.



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