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Original Article

Indonesia's Solar Generation Industry in 2045: Applying Deductive Scenario Planning for Testing Business Idea Study Case of an Indonesia – UAE Joint Venture Solar Developer Company

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Abstract: *Amid uncertainty in the direction and pace of Indonesia's energy transition, the C&I solar development landscape is being reshaped by interacting social, technological, economic, environmental, and political drivers. This study tests the long-horizon robustness of Dune Energy's business idea by integrating Business Idea Analysis with the Oxford Scenario Planning Approach (OSPA). Following van der Heijden's scenario tradition, the business idea is made explicit as a "success formula" linking customer value, offering/entrepreneurial invention, distinctive resources and competencies, and a reinforcing surplus loop, then "wind-tunneled" against four internally consistent futures—Avatar, Elysium, Wolf of Wall Street, and Mad Max: Fury Road (van der Heijden, 2001, 2005). Findings indicate material scenario contingency: several elements (e.g., comprehensive solution offering, international shareholder affiliation, and PLN-related partnerships/resources) weaken in cost-driven futures, motivating "low-regret" improvements (Wiest et al., 2025). Recommended priorities include low-cost decentralized PV across C&I rooftops, small–medium utility, and microgrids; stronger creative financing and risk-sharing; enhanced REC monetization; improved digital O&M/monitoring to protect yield and savings; and new capabilities in life-cycle assessment, carbon accounting, and end-of-life management, complemented by scenario-contingent options such as distressed-asset acquisition, industrial process electrification, and grid services/flexibility offerings.*

Keywords: *Oxford Scenario Planning Approach (OSPA), Strategic reframing, Business idea analysis, Indonesia, Solar PV, Commercial & Industrial (C&I), Rooftop, Third Party Ownership (TPO), Energy transition, Scenario planning, Critical uncertainties, Competitive advantage, Distinctive capabilities.*

I. INTRODUCTION

As an emerging economy, Indonesia faces a dilemma in transforming its power sector. Indonesia through its speech during Conference of the Parties 26 (COP26) in 2021 reveal its most ambitious goal yet, achieving Net Zero Emission (NZE) by 2060 (Ministry of Energy and Mineral Resources [MEMR], 2021), with growing commitment to emission reduction through implementation of multiple policy, financing and regulatory framework that are promised to reinvent Indonesia's energy landscape. Upcoming 2025-2045 Rencana Pembangunan Jangka Panjang Nasional (RPJPN) 2025-2045 also reiterates these NZE goals hand in hand with earlier published Enhanced Nationally Determined Contribution (NDC) 2022 (Ministry of National Development Planning/Bappenas, 2024).

However, achieving NZE by 2060 poses a significant challenge considering the GoI's ambition to become a high-income country by 2045 while being constrained by the budget. With almost 1,288 MTCO2eof GHG emissions in 2022, of which 60% of the emissions contributed from the energy sector amounted to 727 MTCO2e (Direktorat Statistik Ketahanan Sosial [BPS], 2024), an energy transition that accommodates clean energy while being affordable will be crucially needed to achieve both economic growth and NZE 2060. This dilemma positions the industrial sector in a unique intersection, as it holds strategic importance in driving both economic and climate target fulfilment. With 8% economic growth starting in 2028, Indonesia is entering a new phase of development where economic growth needs to be achieved in a carbon-minimal pathway, through green economic intervention such as industrial decarbonization (WRI LCDI et al., 2025).

To meet this demand, solar PV generation has significantly risen in popularity and is heralded as an energy source with enormous potential for the electricity sector (Comello et al., 2018). Solar PV promises scalability, technological maturity and cost competitiveness among other renewable energy sources (IEA, 2024). PT PLN (Persero), as a single supplier and off-taker for electricity generation in Indonesia, highlights the massive importance of solar generation to achieve the 2060 Net Zero Emissions target in its electricity supply business plan (RUPTL 2025-2034). Solar generation capacity is expected to increase

by 17.1 GW, equivalent to 24.5% of total capacity addition until 2034 (PLN, 2025). While the majority of this capacity addition is expected to come from utility-scale on-grid solar farms, such large-scale solar projects require high investment cost (Pramadya & Kim, 2023) and large dedicated land based on the site's geographical condition (Putranto et al., 2021). Land acquisition is regarded as one of the biggest problems in realizing electricity infrastructure development in Indonesia (Perdana & Rohman, 2021).

To circumvent these issues, rooftop solar systems become one of the "low-hanging fruit" to increase the supply of clean and environmentally friendly energy. Rooftop solar can be installed on unutilized residential, commercial and industrial roof areas without incurring any opportunity cost (Lazo et al., 2025) or additional land need (Duman & Güler, 2019). Unlike its conventional ground-mounted counterpart, a rooftop solar system does not require transmission and distribution, minimizing transmission losses and improving energy efficiency (Lazo & Watts, 2023). However, despite the benefits provided by rooftop solar systems, the adoption of rooftop solar systems remains prohibited by the high initial investment cost (Margolis et al., 2006). Sovacool (2018) and Outhred and Retnanestri (2015) highlight the high capital cost of PV systems, which influences the adoption decision for Indonesian consumers.

With high initial cost, limited financing availability and technical constraints pose significant adoption barriers, in which provide a gap for creative business solution to prevail. Third Party Ownership (TPO) model, or referred to operation expenses or solar leasing model, emerge as one of the most popular solutions that provide C&I and residential customers the use of rooftop solar system without upfront capital investment in exchange for an agreed recurring monthly fee or usage fee which oftentimes offer lower electricity rate compared to grid price. Capitalizing on the emergence of TPO business model and increasing government support, Dune Energy was established in 2021 through a strategic joint venture between UAE-based renewable energy developer, Al-Shams Energy and local energy and mining conglomerate PT Black Gem Tbk.. Combining Al-Shams Energy experience and expertise in global renewable energy development with strong local presence of PT Black Gem Tbk., Dune Energy aspire to provide competitive green energy solution in C&I sector with global quality standard, aligning with the focus of Indonesia's energy transition.

However, besides Dune Energy, many established conglomerations and aspiring entrepreneurs alike spot the increasingly lucrative C&I solar development space and start their own company. As a result, Dune Energy faces fierce competition in the race to conquer finite rooftop space. By 2025, Dune Energy's total developed capacity still lagged far behind the market leader in the sector, achieving only 15% of comparable market leader's total capacity. With growing competition and an uncertain future business environment constantly shaping opportunities and threats to the company, Dune Energy needs to rethink its current business idea, driving growth that stands the test of time.

II. LITERATURE REVIEW

Now, the world uncertainty index has reached its all-time high, from 17,245 in January 2008 to 122,422 in September 2025 (Ahir et al., 2025). The dynamic development of macroeconomic uncertainty, growing trade tensions driven by multipolarity, and the development of nascent technological changes such as artificial intelligence and machine learning have created sets of challenges for global corporations (Al-Thaqeb et al., 2020) (Steinbock, 2018) (Wu et al., 2020), including Dune Energy. In situations where the plausible future is uncertain and the signals are hard to decipher, the scenario planning framework has helped organisations develop a systematic yet creative approach to probable future environments, develop strategic responses, and test them in each of these environments. Scenario planning methods have been widely used at both corporate and national levels (Amer et al., 2012). In its practice, scenario planning helps organisations to test their strategy against a multitude of uncertain environments.

To assess whether Dune Energy's current business idea remains relevant in a plausible future, it is necessary to make explicit, using Business Idea Analysis, how the firm has translated its distinctive competencies into repeatable delivery outcomes in Indonesia's evolving C&I solar context. van der Heijden's Business Idea lens is useful because it forces a disciplined mapping between (i) the customer value actually captured, (ii) the offering and delivery model that enabled it, (iii) the distinctive resources/competencies, and (iv) the reinforcing surplus loop in which surplus is reinvested to maintain and renew those competencies. Business Idea Analysis provides a structured representation of what must hold true for Dune Energy's business to succeed, serving as the firm's "success formula".

Contextually, Oxford Scenario Planning Approach (OSPA) provide plausible future operating contexts, while Business Idea Analysis supplies the explicit causal logic of how Dune Energy expects to win so the combined method tests relevance by asking: If the contextual environment and inter-actor behaviors evolve along different plausible paths, which parts of the success formula still hold, which become fragile, and what capability or offering adjustments would preserve viability without betting on a single future?

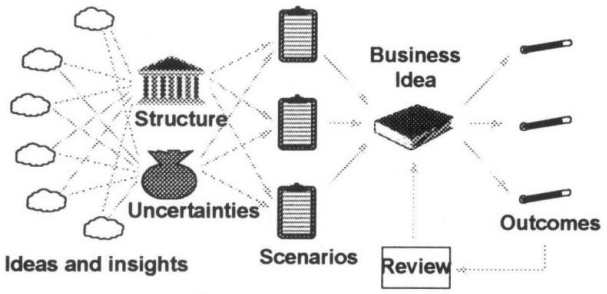

Figure 1. Scenario test the Business Idea (van der Heijden, 2005, p.56)

A) Oxford Scenario Planning Approach (OSPA)

In the context of organizational long term strategic planning, prediction has become increasingly less dominant as strategists continuously lose grip on futures that are closely linked with external uncertainties. With turbulence, uncertainty, novelty, and ambiguity (TUNA) driving complexity between the external environment and internal interactions, Ramírez and Wilkinson (2016) argue that decision makers need to adopt a phenomenological approach approach thgreateres higher imtoe towards indiviorganisationalizational learning as a strategy. This learning-as-strategy process enables "learners" in organization to develop a strategic reframing capability, an ability to challenge underlying assumptions and develop a new perspective.

In a business organization context, reframing is becoming increasingly relevant as the ability to be detached from existing cognitive frames allows decision makers to be equipped with a better understanding towards opportunities and challenges, develop options, and subsequently be more effective in coping with an increasingly uncertain business environment characterized by novel and unprecedented changes (Mukherjee et al., 2019). As the existing frame tends to partially show some elements in learners' view while hiding others, Day, G., & Schoemaker (2005) highlight the need for organization to build a peripheral vision to see beyond the familiar frame and understand environmental uncertainties and anomalies outside of the frame.

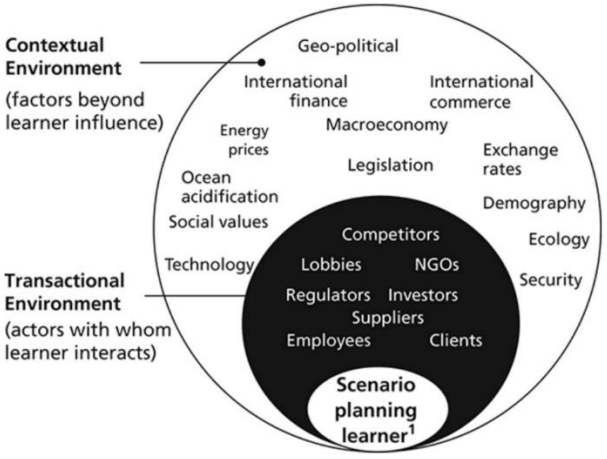

Figure 2. Transactional & Contextual Environment in OSPA

With the emergence of the scenario planning approach in the last few decades, growing TUNA conditions as a result of unprecedented turn of events such as the Ukraine Invasion and COVID-19, Rafael Ramirez, Angela Wilkinson and Kees van der Heijden introduce a distinctive approach to scenario planning developed at the University of Oxford: The Oxford Scenario Planning Approach (OSPA). OSPA determines scenario planning as a tool of intervention, challenging taken-for-granted assumptions by directing strategic attention to unexpected and less familiar changes in the wider context. Referring to a strategist as a learner, scenario learners are directed to examine broader settings of contextual and transactional environment, and how the transactional environment might be impacted and reshaped by a combination of changes in the contextual environment.

The learning process focused on utilizing scenario planning as a tool rather than being a means to an end. This revolves around the idea of developing learners' "sense of future" by redirecting attention from the individual self to open systems

thinking and model building in groups, facilitating the diffusion of tacit knowledge between learners, and generating multiple future contexts. As a result, OSPA can generate multiple snapshots of plausible futures that can be surfaced, tested, contested, questioned and improved.

In the context of strategic reframing, OSPA helps strategists and policymakers to better understand the existing frame through sensemaking based on current observations and experiences and open the possibility to reframe the perspectives by considering alternative frames. The continuous process of framing and reframing facilitates learners in reperceiving how their world works and the current situation they are in, clarifying available options and generating new options or a a course of action. With the continuous reframing-reperceiving loop being the distinctive feature of OSPA, it is important for OSPA to be done iteratively. Rather than just a one-off intervention, the OSPA method demands continuous exploration and learning, better known as "strategic conversation", to be a fundamental part of organizational culture and strategic capabilities, allowing for adaptive capabilities against a rapidly shifting TUNA environment.

B) Van der Heijden's Business Idea Analysis

In order to understand Dune Energy's current business idea, a business idea analysis is necessary. business idea analysis functions as the explicit articulation of an organization's "success formula" (the strategic logic of how it creates value, captures surplus, and renews the capabilities that sustain advantage), and it is treated as the internal "self" that must be examined alongside scenarios as representations of the external environment; practically, the analysis distinguishes a business idea (a higher-level, systemic representation of the whole business and how it makes money) from narrower descriptions such as a business model, and then structures management dialogue by mapping the causal linkages between evolving customer value/scarcities, the organization's entrepreneurial invention (offering), distinctive competencies/resources, and a reinforcing loop in which surplus is reinvested to maintain and renew those competencies after which the business idea is "wind-tunneled" against contrasting scenarios to identify fragilities, surface capability gaps, and generate robust strategic options that either exploit strengths (portfolio options) or deliberately build missing capabilities (capability options), thereby turning scenarios into a disciplined strategic conversation rather than a forecasting exercise (van der Heijden, 2001; van der Heijden, 2005).

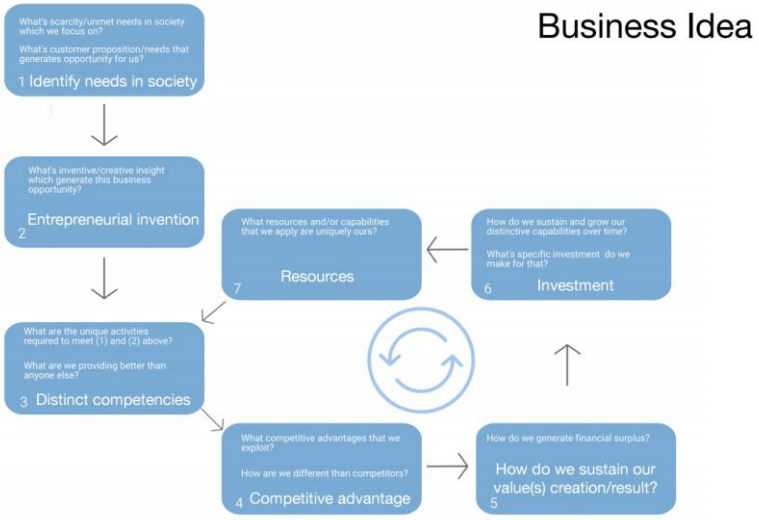

Figure 3. Business Idea Reinforcing Loop (Yuniarto, 2024) Based on a Generic Business Idea (Van Der Heijden, 2001).

Through this research, we seek to identify key driving factors and critical uncertainties that could affect the viability of the current business idea of Dune Energy against development in the solar business generation in 2045. The development of scenario planning is expected to help Dune Energy explore and articulate future possibilities, test current business ideas against them, and develop possible improvements or alternatives to the current business idea.

Furthermore, we aim to contribute to the literature on solar energy development in three ways. First, we seek to broaden the investigation to include business actors in solar PV development, particularly in the commercial and industrial sectors, which mainly employ the third-party ownership (TPO) model. While significant attention has been paid to solar PV end-user side, such as socio-technical assessment (Afifi et al., 2025) (Eliva et al., 2025) (Fathoni et al., 2021); and techno-economic feasibility assessment (Sovacool, 2018) (Outhred & Retnanestri, 2015) (Burke et al., 2019), such an emphasis potentially overlooked the role and action of the supply-side, business actor in enabling and influencing the trajectory of future Indonesia's solar photovoltaic landscape.

Second, our study aims to challenge the tendency in most Indonesian solar development literature to focus solely on the present state. The main aim is to understand the future plausibility of Indonesia's solar landscape and examine its impact on today's decision-making. With current studies emphasising trends and changes that have already pre-determined from the past and current reality, such an emphasis potentially overlooks future trends and possibilities that are coming toward our current reality independent of our will. Further, the result is often reflective or deterministic in nature, and neglects to consider potential divergence from a pre-determined future, which translates into decisions or policies that are irrelevant to future conditions that are dynamically changing.

Lastly, we seek to contribute to Indonesia's solar PV development literature in developing countries, as most of the previous research on renewable energy business and the TPO concept has been carried out in developed countries. Considering the differences in socio-political challenges and institutional arrangements in Indonesia, there is a need for a more detailed examination of transactional environment characteristics and how business strategies can be implemented in a developing world context (Ondraczek, 2013). Oftentimes, there is an implicit perspective on how solar PV development models from developed countries can be simply diffused to their developing counterparts (Wieczorek, 2017). However, such an approach can be problematic, as it fails to highlight geopolitical nuances, governance and economic priorities that businesses need to navigate in their operations (Newell & Mulvaney, 2013). Such simplistic framing might also risk undermining concerns and aspirations in relation to local solar PV development (Burger et al., 2022).

III. RESULTS AND DISCUSSION

With insight into how Dune Energy perceived its current business idea and how the external contextual environment shapes Indonesia's solar generation landscape, the scenario planning method is leveraged to unfold plausible future scenarios for the next 20 (twenty) year timeframe. Through the scenario planning method, the author seeks to identify potential gaps between Dune Energy's current business idea and a plausible future for Indonesia's solar generation landscape.

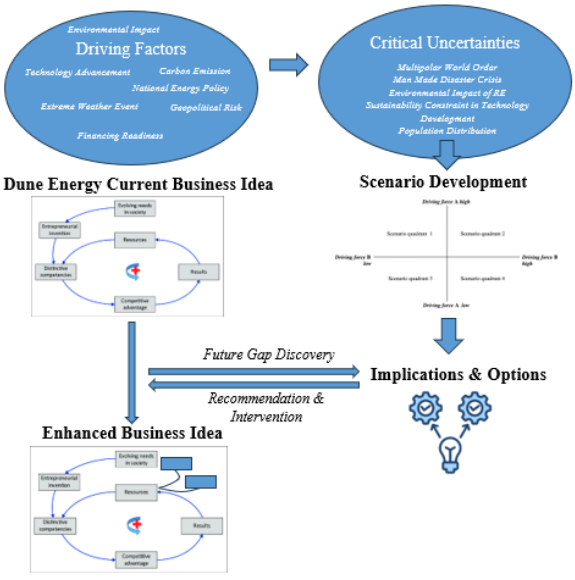

Figure 4. Ideation Stage (Author, 2025)

A) Business Idea Analysis

To complement the understanding of Dune Energy's current external contextual environment. The author utilises the business idea analysis framework by van der Heijden to understand how an organisation creates and captures value over time. Rather than using isolated forecasts or subjective understanding, business idea analysis is conducted through semi-structured interviews with 11 (eleven) Dune Energy employees across multiple business functions, including engineering, finance, legal, and business development, and at multiple seniority levels, from junior associate to chief level. The combination of the chosen respondents is to ensure that the analysis foundation is not solely focused on the individual judgment, but to present a holistic view of Dune Energy's current business idea.

The business idea analysis indicates that Dune Energy's proposition is perceived as fundamentally anchored in widely recognized market needs, cost reduction, decarbonization, and reliable energy supply, yet it is also interpreted very differently across respondents because "business idea" operates at multiple levels of abstraction (technology, commercial model, value

proposition, and organizational capability). As a result, participants did not converge on a single, uniform articulation of the business idea; instead, their responses clustered around distinct lenses: some framed the idea primarily as a product and delivery concept (affordable PV, reliable EPC/O&M execution), others as a financing and risk-allocation concept (TPO models, low-cost capital readiness, bankability), and others as a platform/ecosystem concept (partnerships with PLN entities, shareholder-backed credibility, integrated solutions including storage, RECs, and non-solar renewables). Based on the author's analysis, respondents have a hard time grasping a single, shared concept of business idea, as respondents naturally interpret "business idea" through the part of the system they work with most. The nature of the interview material recorded from this stage is also deemed "interwoven", where statements need to be further clustered and processed without imposing pre-determined categories, as participants bring different frames into the analysis (Van Der Heijden, 2005). Therefore, to further elaborate on the business idea analysis, the author creates a reinforcing feedback loop for Dune Energy based on the author's own analysis,, with consideration of the datareceived from the respondents.

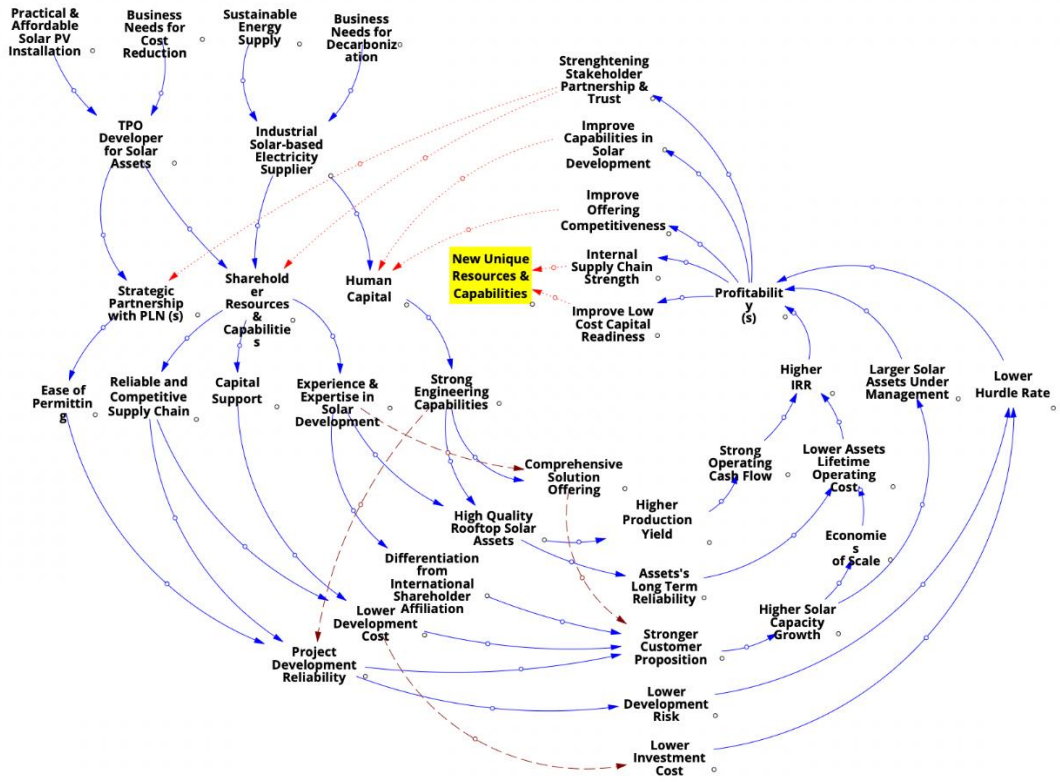

Figure 5. Dune Energy Current Business Idea Analysis (Author, 2025)

From the author's analysis, the interpretation of Dune Energy's current business idea starts from the need for businesses to decarbonize their supply chain while at the same time also reducing their energy cost. In other segments, such as off-grid development or IPP business, the societal value demands will focus on sustainable energy production and supply. To meet this demand, Dune Energy underwent two entrepreneurial inventions (1), providing TPO model development and financing for solar assets and became the developer of a solar-based electricity supplier. Due to its affiliation with Al-Shams Energy and Black Gem Group, Dune Energy enjoys a number of distinct competencies that shape its competitive advantage, namely 1) ease of permitting due to a strategic relationship with PLN, 2) strong supply chain relationships, low-cost capital support, and shared best practices and knowledge in solar assets development. As the subsequent result of the interaction between distinct competencies and unique resources that they have, Dune Energy is capable of offering a stronger customer proposition due to the perceived reliability of international shareholder affiliation; lower cost of investment due to minimized development risk and availability of low-cost capital; and lastly, strong operating cash flow that are generated by high quality, yield-optimized solar assets, on a greater scale of things, such competencies allow Dune Energy to widen the spread between its cost of investment and its time-adjusted return, ultimately translated as financial surplus.

In its current state, most of Dune Energy's executives focus on strengthening shareholder trust, improving capability in solar development, improving offering competitiveness in the form of a more competitive rate or relaxed operating lease terms, and developing an internal supply chain and low-cost financing capabilities. In the next chapter, existing assumptions of the Dune Energy business idea, mainly societal demand fulfilled, distinct competencies, and competitive advantages that shape the

business idea loop, will be tested against plausible futures to determine whether existing assumptions are relevant and justified against future scenarios.

B) Scenario Development

In the initial exploration stage, authors' data collection and analysis are done to identify, analyse, and rank driving forces in the macro-external environment, which is composed of things that we already know, or better known as pre-determined factors; and future uncertainties (Garvin and Levesque, 2006). Pre-determined factors specifically are things that already happen and are expected to continually impact the situation in the future. Meanwhile, future uncertainties can take shape in several forms, namely new development, weak signals, or disruptive changes (Ramirez and Wilkinson, 2016). The expected outcome from the scenario exploration stage will be the identification of external key factors and critical uncertainties that might change Indonesia's solar generation landscape over the next twenty years.

As part of the iterative process, FGD is conducted to enable iterative reframing-reperception of key factors. Different questions were asked to discover and clarify meaningful variability in possible future contexts in which key factors might be pre-determined (Ramirez and Wilkinson, 2016). The author's expected outcome from this process was to encourage respondents in the identification of unthinkable key driving forces and weak signals that might be missed or not mentioned beforehand. After FGD, each participant is requested to re-rank the key driving forces based on their impact and uncertainty.

The scenario will be developed using deductive methodology, in which the selected factors are required to be independent and mutually exclusive from each other to evoke contrasting scenarios that avoid repetition. In the OSPA, scenarios are built using plausible contexts in which the activities from the present (white arrow) are expected to occur. This plausible future is further structured to interact with the past certainties (black arrow) and the uncertainty of the novel, unfamiliar developments brought to the present state (shaded arrow). The result helps users to assess consequences and options for action. The usage of shaded arrows and black arrows is highlighted depending on the scenario planning purpose and its intended use (Ramirez & Wilkinson, 2016).

After combining the previous key driving forces identified (74 factors) and additional (11 factors) from FGD, we came up with a total of 85 key driving factors. The author started by grouping the consolidated factors into OSPA's Arrow of Time based on the author's own analysis. Furthermore, cross-impact analysis is also conducted on all selected key driving forces to further assess the interrelationship causality between variables within a system (Lindgren & Bandhold, 2003). The result of cross-impact analysis will be a foundational basis in the creation of a causal loop diagram (CLD) for the scenario. The key driving factors that will be used in the causal loop diagram will be derived from factors that are deemed as less dependent and strong drivers to enhance the scenario sensemaking.

After multiple alternatives of scenario framework are explored, the prototyping stage focuses on presenting the alternative scenarios provided back to respondents again to enable reframing-reperceiving iteration of the alternative scenarios provided; and also ensuring the chosen alternative is able to elaborate the strong coherence, relatability and practical usability with Indonesia's solar generation landscape. The iteration process is facilitated through the second round of FGD. The author's expected outcome from this process was to encourage respondents to use the alternative scenarios as facilitating tools for future forward thinking, in which respondents were able to reframe the future through scenario glasses and come up with "what might happen in the future?" rather than factors that we already know at the moment.

Considering the level of responses and thought-evoking discussion from respondents, the author chose an alternative scenario which consists of the combination of the critical uncertainties in Indonesia's national development direction and solar technology development direction. Considering that electricity demand is frequently mentioned during the FGD session with the respondents, the chosen alternative scenario introduces plausibility in future demand scaling that is more relevant for stakeholders within the solar generation business. In this alternative scenario, greater attention is focused on how Indonesia's long-term development pattern either entrenches or overcomes today's Java-centric structure. On one side of the matrix, the country manages to move beyond a Java-centric growth model toward a more distributed, archipelagic prosperity, where secondary cities and outer islands become real centres of economic activity and infrastructure investment, rather than permanent peripheries. Current data already show how far this shift would be: Java today still accounts for roughly 55–60% of Indonesia's GDP and more than half of its population, while eastern regions lag in infrastructure and basic services, including modern energy access (Ananda et al., 2023).

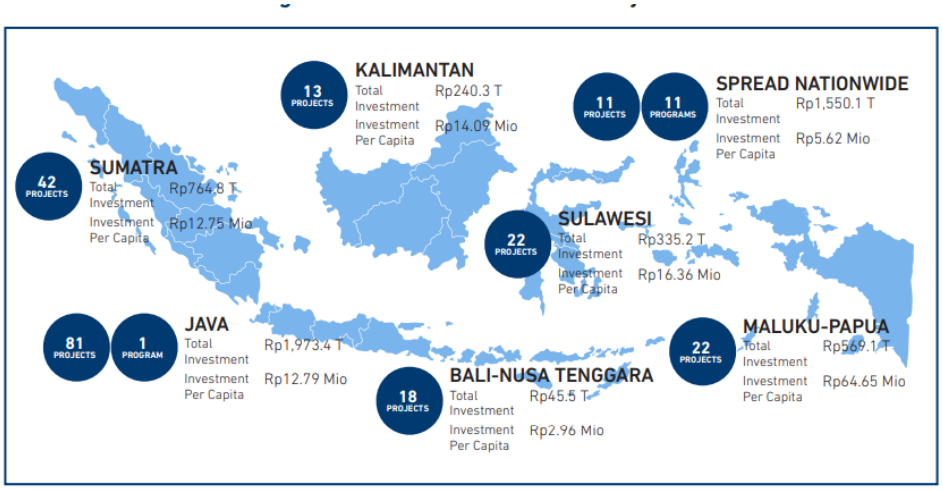

Figure 6. Distribution of Proyek Strategis Nasional (PSN) Projects (Ananda et al., 2023)

If those disparities are gradually reduced and energy systems are extended across the archipelago, then the way solar technology is advancing becomes critical. Where innovation is strongly constrained by environmental and climate goals sustainable mining, lower-impact manufacturing, and circular management of PV materials Indonesia can deploy solar as a backbone of a more equitable and resilient energy system: large plants for new regional industrial hubs, mid-scale projects for growing towns, and community microgrids for remote and coastal settlements, all built on cleaner supply chains that deliberately minimise long-term harm to people and ecosystems (Ho et al., 2025) (M. a. P. Mahmud et al., 2018). Even if the same distributed prosperity coincides instead with a more commercial, cost-and-efficiency-driven solar industry, rapidly falling PV costs global utility-scale solar LCOE has already dropped around 90% since 2010 and is now substantially cheaper than new fossil generation (IRENA et al., 2024). This would likely still trigger a multi-island solar boom, expanding capacity in any region where demand is strong, grids are bankable, and investors see clear returns.

Figure 7. Scenario Matrix of Indonesia's Solar Development
(Cameron, J. 2009), (Blomkamp, 2013) (Belfort, 2007) (Miller, 2015)
Generated with OpenAI GPT Image 1.5 using the prompt "Solar Generation Landscape based on [Movie Name]"

Scenario 1: Avatar

In the AVATAR scenario, Indonesia achieves a more balanced, multi-polar growth model: economic gravity shifts beyond Java as secondary cities and outer islands develop into credible industrial, logistics, tourism, fisheries, and digital hubs.

Rising incomes and improved public services translate into higher local demand for reliable, modern energy—making "Nusantara consolidation" tangible in day-to-day household and business activity across Sumatra, Sulawesi, Kalimantan, NTT, Maluku, and Papua. In parallel, the global solar value chain matures under climate risk and social pressure: critical-mineral supply tightens ESG standards, manufacturing decarbonizes and manages waste more rigorously, and circularity (including PV and battery end-of-life pathways) becomes embedded in commercial models rather than treated as peripheral compliance.

Indonesia channels this technology trajectory into a deliberately regionalised power system. Solar-plus-storage and hybrid renewable parks anchor new multi-island industrial corridors and export platforms, while rooftop and community solar scale with a larger middle class and SME base supported by financing and motivated by both cost savings and environmental awareness. In remote communities, ports, and border areas, resilient mini-grids and micro-grids reduce diesel dependence, strengthen clinics, cold chains, and telecom reliability, and improve climate-shock preparedness. Geothermal, small hydro, and wind expand selectively where resources and governance allow, guided by a disciplined planning norm: deploy the right technology in the right place, under the right conditions.

Scenario 2: Elysium

In the ELYSIUM scenario, global ESG and environmental requirements tighten faster than Indonesia can build the governance, project-preparation, and investment capacity needed to comply at scale. Banks, institutional investors, and export markets demand full transparency, rigorous environmental and social planning, and credible just transition pathways; projects that cannot demonstrate these standards alongside high-impact mineral mining, legacy fossil assets, and non-compliant technologies face refinancing constraints and rising risk of delay, cancellation, or stranding. Indonesia's response is predominantly defensive: ministries and PLN prioritize "paper alignment" with external standards while lobbying for larger volumes of international climate finance, rather than using the pressure to drive a clear, domestically owned transition strategy.

As a result, the power system remains centralized in practice and renewables expand unevenly. Formal plans show higher RE shares, but actual deployment concentrates where governance is strongest, capital is easiest to mobilize, and incumbents retain influence primarily in Java and Java-connected regions. Outside these cores, weak institutions, thinner demand, and limited bankable pipeline preparation cause both renewable and fossil project development to stall, leading to life extension of existing fossil units as the default reliability solution. New RE projects beyond Java occur selectively clustered where development banks, climate funds, or ECAs can partner with capable local actors while domestic firms largely reposition as implementers of imported designs and standards, with limited scope to develop outer-island-tailored technology pathways, supply chains, and business models.

Scenario 3: The Wolf of Wall Street

In the Wolf of Wall Street scenario, Indonesia experiences a broad-based boom in which growth and purchasing power spread beyond Java, creating strong electricity demand across secondary cities and outer islands. More financially sophisticated private sector conglomerates, regional developers, and new energy entrants pursue infrastructure and power projects aggressively for returns. At the same time, the global solar supply chain becomes a pure cost-optimization machine: high efficiency and record-low prices driven by speed and volume, with uneven environmental controls in critical-mineral extraction and growing PV/battery waste as cheaper generations displace older assets.

Domestically, renewables scale fast but primarily through deal-driven logic. Utility-scale solar farms and battery parks proliferate where land, grid access, irradiance, and industrial loads align, supporting new economic zones across multiple islands. C&I rooftop solar expands rapidly where creditworthiness and payback are clear, and middle-income households adopt rooftop systems via cash, leasing, or credit. Other renewables (geothermal, hydro, wind, sustainable biomass) grow as strategic complements in non-Java grids where they add value at acceptable cost. Service quality improves with lower tariffs, fewer outages, and cleaner local air, but externalities accumulate: ecosystem damage and social tension in mining regions, unmanaged PV and battery waste, and land conflicts around large projects.

Over time, solar has become the emblem of cost-driven energy capitalism. Falling component costs push LCOE to historic lows and make PV the default choice in most new-build decisions, prompting grid expansion, improved inter-island reliability, and more investable PPA and permitting frameworks to attract private capital into solar and storage. Deployment in remote, low-income areas remains opportunistic (telecom towers, high-value fisheries, tourism) rather than justice-led electrification. As visible harm rises, especially from mining impacts and informal recycling/disposal, regulators introduce targeted waste rules and baseline sustainability standards, first in major markets and then more widely. These measures add modest lifecycle and logistics costs, nudging LCOE up from its absolute minimum, but they do not materially slow the underlying momentum of rapid solar expansion.

Scenario 4: Mad Max: Fury Road

Solar dominates headlines, but the underlying transition is harsh and extractive. Globally, the industry prioritizes cost

and scale: critical minerals are mined with weak constraints, manufacturing is optimized for throughput over clean production, and rapid technology turnover leaves mounting PV and battery waste often handled through minimal compliance, informal recycling, or dumping. Other renewables expand only where they hold clear structural advantages (legacy hydro, established geothermal, biomass with direct co-benefits); if a technology cannot compete with Solar's LCOE in key markets, it is sidelined.

In Indonesia, this dynamic reinforces a development path that remains Java-centric. Strong grids, bankable offtakers, and deal-capable bureaucracy concentrate investment in Java and a few connected corridors in Sumatra and Kalimantan—exactly where utility-scale solar and dense layers of C&I and rooftop PV scale fastest. Industrial estates and large corporates secure very cheap solar-heavy electricity and brand exports as "green," even as upstream minerals and components originate from jurisdictions with far weaker environmental and social standards. Outside these cores, ultra-cheap modules do not solve weak grids, volatile demand, and high balance-of-system costs; solar appears only in isolated pockets with clear economics (telecom towers, high-value fisheries, select resorts or industrial sites), not as a systematic transition.

From a distance, the solar build-out looks impressive; up close, it is unequal. Policy prioritizes bankability in the main corridors, fast permitting, predictable PPAs for large players, and grid upgrades that further strengthen already-strong systems, while tariff reform, targeted support for weaker regions, and value-chain sustainability remain limited beyond what financiers require. Waste and end-of-life management remain deferred, and environmental burdens (mining impacts, industrial pollution, disposal sites) concentrate in less visible provinces, keeping national political pressure for deeper reform low. The result is gigawatts of cheap solar alongside persistent energy vulnerability and localized degradation, an energy revolution that benefits the core while pushing costs to the periphery.

c. Business Idea Testing

Based on van der Heijden (2005), the articulation of a business idea is mainly summarized through four core elements, namely (1) the societal / customer value created, (2) the nature of the competitive advantage exploited (3) the distinctive resources and capabilities, which enable competitive advantage (4) a positive feedback loop. Therefore, in the following author's analysis, each core element of the existing business idea will be assessed to see its relevance and adequacy to face each scenario condition. The recommendation will be proposed based on this analysis.

Business Idea Elements	Node Assessed	Relevancy			
		Avatar	Elysium	Wolf	Mad Max
Societal Value Provided	Pratical & Affordable Solar PV Installation	R	R	R	NR
	Business Needs for Cost Reduction	R	R	R	R
	Business Needs for Decarbonization	R	R	NR	NR
	Sustainable Energy Supply	R	R	R	R
Competitive Advantage Exploited	Comprehensive Energy Solution Offering	R	R	NR	NR
	High Quality Solar Assets	R	R	R	R
	Differentiation from International Shareholders Affiliation	R	R	NR	NR
	Lower Development Cost	R	R	R	R
	Project Development Reliability	R	R	R	R
Distinctive Resources & Competencies	Strategic Partnership with PLN	NR	R	NR	R
	International Shareholder Resources & Capabilities	NR	R	NR	R
	Human Capital Capabilities	R	R	R	R

Figure 8. Business Idea Element Testing (Author, 2025)

Based on the findings and further elaborated with the author's analysis, it is apparent that Dune Energy's preparedness towards a plausible future is noticeably skewed towards a sustainability-driven technology axis, in which most of its strategies are not relevant in a cost-driven technology axis. To better prepare for the future that yet remains to unfold, the author's improvement analysis will focus firstly on "low-regret" strategies, where business idea improvement strategies are elaborated on competitive advantages and distinct resources that perform reasonably well across a wide range of uncertain futures with minimum downside even if the future unfolds differently than expected (Wiest et al., 2025). Based on earlier analysis, the

author determines the low regret factors to be at least relevant in 3 or more scenarios, which will be further exposed to plausible future scenarios to uncover new business idea opportunities that might arise in each scenario. The result is tabulated in Figure 9below.

Business Idea Elements	Node Assessed	Improvement Recommendation
Societal Value Provided	Pratical & Affordable Solar PV Installation	Focus on low cost decentralized solar PV solution across three key segments, namely C&I Rooftop, Small-medium utility and Decentralized Microgrids.
		Development of organizational capabilities in creative financing / risk sharing structure.
	Business Needs for Cost Reduction	Enhance organizational capabilities on REC monetization to improve cost reduction proposition to customers.
		Develop digital O&M and system monitoring capabilities to improve yield and maximize savings to customers.
	Sustainable Energy Supply	Develop Organizational capability in Life Cycle Assessment and Carbon Accounting
		Develop organizational capability in End-of-Life Management of Solar Components.
Competitive Advantage Exploited	Capability to Develop High Quality Solar Assets	Acquisition of distressed or underperforming solar assets to be fixed and repowered.
		Develop offering in industrial process electrification (solar powered heaters and pumps)
		Develop Grid Services & Flexibility Solutions Offering for PT PLN
	Lower Development Cost	Develop indirect sales engine through co-branding & partner network
		Development of Community Co-ownership, Benefit-sharing models for Solar Assets

Figure 9. Future Business Idea Opportunity (Author, 2025)

Understanding the potential of a future business idea based on the analysis conducted previously, the author determines that existing business idea elements and their respective reinforcing feedback loops are inadequate to prepare against future plausible scenarios. As part of a refined solution, the author proposed an improved business idea by introducing entrepreneurial inventions that are future relevant, distinct competencies needed to fulfill proposed entrepreneurial invention, a competitive advantage that needs to be exploited, and lastly, the necessary investment needed to enable the business idea transformation to take place.

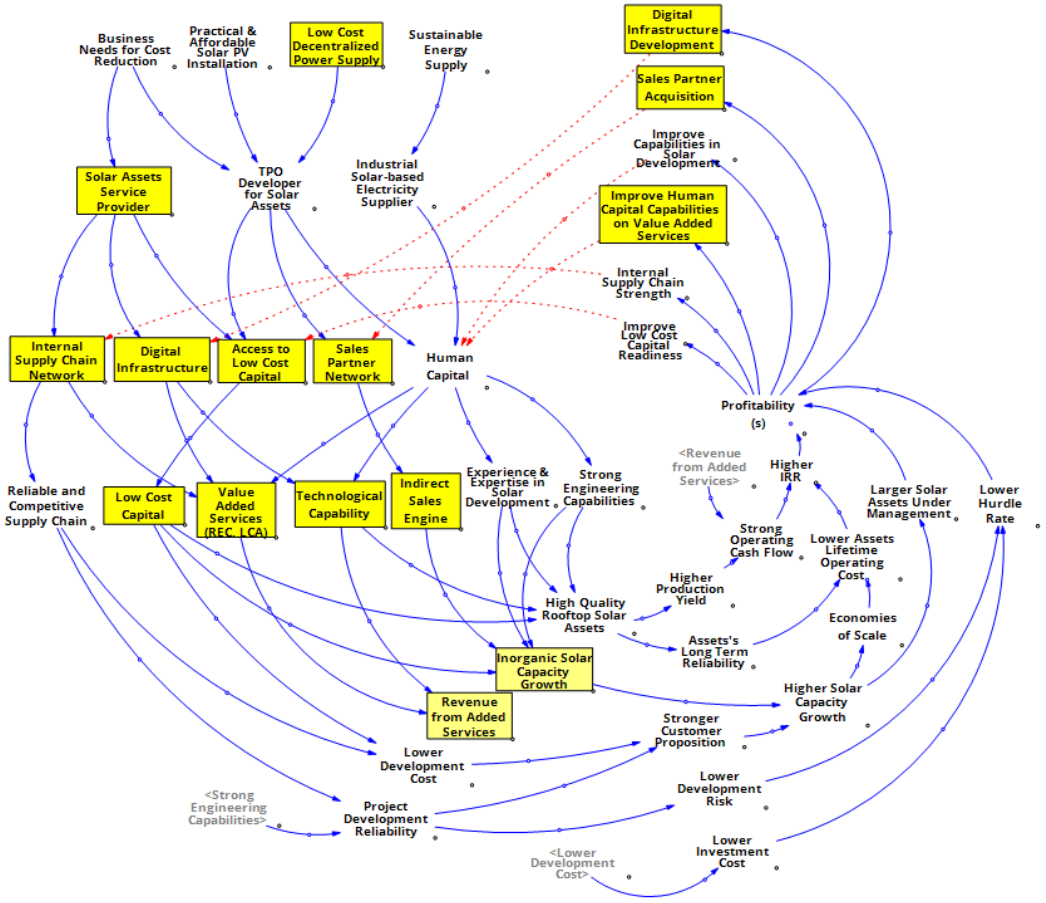

Figure 10. Updated Business Idea Reinforcing Loop

In the new business idea elements, low-cost decentralized power generation is becoming one of the emerging societal needs that grows from increasing population needs in scenarios Avatar and Elysium, while scenarios Wolf of Wall Street enable low-cost decentralized solution through ultra-low-cost solar components. Digital O&M capability will be paramount to be able to monitor and optimized decentralized solar assets performance, especially due to the small capacity, high volume nature of the distributed solution and also geographical challenges within the area of installation.

Through the future lens, author's also find that increasing needs for cost reduction in all of the scenarios will exacerbate needs for further value added services that are necessarily needed to justify the cost-to-benefit basis for solar generation, it can materialize in form of REC issuance, LCA analysis, green advisory services and end-of-life management of solar waste that potentially be a big issue in the next 15-20 years. The future opportunities arise in several scenarios, which also foretold a possibility of solar assets consolidation among developers due to a lack of sustainability concern and a cost-competitive environment. This environment poses an opportunity for inorganic solar capacity growth through the acquisition of distressed solar assets to propel capacity growth, economies of scale optimization and revenue maximization. Indirect sales engine will also improve the velocity at which the capacity growth can be optimized, especially in the Wolf of Wall Street and Mad Max scenario, where speed, connectivity and low-cost competitive landscape dominate.

With that being said, as part of the recommendation, the author also proposes necessary investment in digital infrastructure development, sales partner acquisition, and improving existing human capital capabilities in existing solar development capabilities and future value-added services. Such investment will allow necessary transformation to take places, creating new distinct competencies and competitive advantages against plausible futures.

IV. CONCLUSION

Based on the analysis conducted, the conclusion drawn is as follows:

Prior to scenario development, business idea analysis is conducted to gain insight into the current business idea of Dune Energy. Dune Energy's current business idea targets two demand segments: businesses that need supply chain decarbonization and energy-cost reduction, and off-grid/IPP customers that require a sustainable power supply. It operationalizes this through

two entrepreneurial inventions: (1) TPO-based solar asset development and financing, and (2) becoming a solar-based electricity supplier. Backed by Al-Shams Energy and Black Gem Group, Dune Energy benefits from permitting agility via PLN relationships, strong supply-chain access, low-cost capital, and shared solar-development know-how. These capabilities support a stronger customer proposition, lower investment costs through reduced development risk, and higher operating cash flow from yield-optimized assets collectively generating financial surplus.

The current business idea analysis of Dune Energy is tested against the created scenarios, resulting in finding that 33% of business idea elements are relevant to all scenarios, the other 8.3% are relevant to at least three scenarios, and the remaining 58.3% are relevant only to two of the scenarios. Using the least regret framework, the author determines current business idea elements that are relevant to future scenarios and how they can contribute to future business ideas and opportunities. A plausible future business opportunity for Dune Energy is to become a low-cost decentralised solar platform across C&I rooftops, small–medium utility, and microgrids, capturing rising demand for simultaneous cost reduction and decarbonization. The business idea is enabled by building repeatable capabilities in creative financing/risk-sharing, REC monetization, and digital O&M to protect yield and deliver guaranteed savings. Differentiation strengthens as regulations tighten through embedded LCA, carbon accounting, and end-of-life management. Growth can be accelerated via acquiring and repowering underperforming assets, expanding into industrial electrification, and selling grid flexibility services to PLN as distributed resources become system-relevant. Scale is supported by a partner-led sales engine, community co-ownership models, green industrial estate co-development, and decarbonization advisory to pull forward the pipeline and reduce adoption friction.

To ensure business ideas and opportunities that are culminated in each scenario are workable, the author also proposes an improvement to Dune Energy's business idea by adding future-relevant elements: a societal value proposition of low-cost decentralized power supply, an entrepreneurial invention positioning the firm as a solar asset service provider, and a financial-surplus logic driven by inorganic capacity growth and value-added service revenues. Across the scenarios, rising cost-reduction pressure and distributed demand elevate the importance of digital O&M and monitoring to manage small-ticket, high-volume, geographically dispersed assets, while tighter decarbonization and sustainability expectations expand monetizable services such as REC issuance, LCA/carbon accounting, green advisory, and end-of-life management as solar waste becomes material over the next 15–20 years. The scenario set also implies potential industry consolidation, creating opportunities to acquire and repower distressed assets to accelerate scale and improve economics, reinforced by a partner-led sales engine in speed- and price-driven futures. To enable this transformation, the author recommends targeted investments in digital infrastructure, sales partner acquisition, and human capital development for both core development execution and higher-margin value-added services, thereby building new distinctive competencies and competitive advantage for plausible futures.

To summarise, it is apparent that the reframing process to step outside today's dominant assumptions and consider how different future contexts still remains a challenge for the majority of respondents involved. One of the main improvements from this study is to be able to facilitate the reframing and re-perception process better through the author's intervention and guidance.

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