

Research on the Application of Equity Incentive Plans in a Photovoltaic Enterprise

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Abstract: Against the backdrop of global energy transition and China's "dual carbon" goals, the photovoltaic (PV) industry has experienced rapid development and become a core pillar of the new energy sector. As a technology-intensive and capital-intensive industry, PV enterprises rely heavily on the stability and creativity of their talent pool. Equity incentive, as a crucial long-term motivational mechanism in modern corporate governance, effectively aligns employees' personal interests with the long-term development of the enterprise, mitigates principal-agent conflicts, and stimulates the innovative vitality of core teams. However, in the current implementation of equity incentive plans among Chinese PV enterprises, prevalent issues include improper selection of incentive targets, unreasonable exercise condition settings, incomplete performance appraisal systems, and unsustainable incentive effects, all of which constrain the intended role of equity incentives. Based on this analysis, this paper takes Company A, a PV enterprise, as a case study to systematically explore the application value, existing problems, and optimization strategies of equity incentive plans in corporate management, aiming to provide useful references for PV enterprises to improve their equity incentive mechanisms and enhance the effectiveness of human resource management.

Keywords: Equity Incentive; Photovoltaic Enterprise; Human Resource Management; Incentive Mechanism

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1. Introduction

As global climate change becomes increasingly severe, the transition of energy structures has become a shared choice for countries worldwide to achieve sustainable development. China, as the world's largest PV installation market, has witnessed leapfrog development in its PV industry driven by policy support and technological advancement. China's newly installed PV capacity has reached record highs, with production across all segments of the supply chain dominating the global market^[1]. Against this backdrop, PV enterprises face unprecedented development opportunities while simultaneously enduring intense market competition and continuous pressure from technological iteration.

Talent serves as the most core strategic resource for enterprises, playing a decisive role in the development of the PV industry. The PV industry is characterized by its technology-intensive nature, encompassing every stage from polysilicon purification and cell research and development to module process optimization, all of which require highly qualified technical talent and management teams. However, due to intensified industry competition and high talent mobility, PV enterprises commonly face the risk of losing core talent. How to retain talent and unlock their potential through effective incentive mechanisms has

become an important management issue for PV enterprises.

Equity incentive, as a motivational approach that aligns employee interests with the long-term development of the enterprise, can effectively alleviate principal-agent problems and stimulate the enthusiasm and creativity of core employees. By granting employees a certain number of company shares or stock options, employees can share in the benefits brought by the enterprise's growth, thereby enhancing their sense of belonging and responsibility to the company^[2]. Nevertheless, from current practices, Chinese PV enterprises still face numerous shortcomings in the design and implementation of equity incentive plans, which affect the effective realization of incentive outcomes. Therefore, this paper takes Company A, a PV enterprise, as the research subject to systematically explore the application value, existing problems, and optimization strategies of equity incentive plans in PV enterprises, with the aim of providing reference for similar enterprises to improve their incentive mechanisms.

2. The Role of Equity Incentives in Photovoltaic Enterprises

2.1 Binding Core Talent and Stabilizing Technical Teams

The pace of technological iteration in the PV industry is rapid, with each technological breakthrough—from PERC to TOPCon to HJT cell technology—requiring robust R&D team support. Core technical personnel hold critical process know-how and determine the direction of research and development. Their departure not only results in the loss of intellectual assets but may also lead to disruption of technological roadmaps. Equity incentive grants core technical personnel a certain number of restricted stocks or stock options, with reasonable vesting periods and performance conditions, deeply aligning their personal wealth with the long-term value of the enterprise. When employees become shareholders of the enterprise, the cost of their resignation increases significantly, thereby effectively reducing talent turnover rates. Meanwhile, equity incentive enhances the cohesion of technical teams, promotes knowledge sharing and collaborative innovation, and provides stable talent support for technological breakthroughs^[3].

In the practice of Company A, through the implementation of equity incentive plans for core technical backbone personnel, vesting periods were set at 3–4 years with batch unlocking. This approach reduced the average annual turnover rate of key-position employees from 15% to below 5%, significantly improving the stability of the R&D team. Motivated employees demonstrated higher engagement and a stronger sense of responsibility in the enterprise's technological breakthroughs, driving improvements and optimizations in multiple critical processes.

2.2 Alleviating Principal-Agent Conflicts and Optimizing Corporate Governance

In the modern enterprise system, the separation of ownership and management rights leads to principal-agent problems. Management may make decisions that deviate from shareholders' interests in pursuit of their own benefit maximization, such as excessively pursuing short-term performance while neglecting long-term R&D investment. Equity incentive transforms management into company shareholders, aligning their interests with those of shareholders, thereby effectively mitigating principal-agent conflicts. When management holds company stock, they pay greater attention to the enterprise's long-term value creation and sustainable development, comprehensively considering factors such as technological innovation, market expansion, and risk control in their decision-making.

For PV enterprises, the governance effect of equity incentives is particularly pronounced. The PV industry is characterized by large-scale investment, high uncertainty in technological roadmaps, and significant cyclical market fluctuations. The quality of management decisions directly affects the survival and development of the enterprise. By granting equity incentives to directors, senior executives, and core management personnel, they can be encouraged to make investment decisions more prudently, balance the relationship between short-term profitability and long-term development, and avoid sacrificing the enterprise's technological accumulation and competitive advantages in pursuit of short-term performance^[4].

2.3 Stimulating Innovation and Enhancing Corporate Competitiveness

Competition in the PV industry is essentially competition in technological innovation and cost control. To remain invincible in fierce market competition, enterprises must continuously drive technological progress and process optimization. Equity incentive effectively stimulates employees' innovation motivation because its returns are linked to the enterprise's long-term value growth, giving employees stronger incentives to promote technological innovation and efficiency improvement.

When employees can share in the benefits arising from the enterprise's technological progress and performance growth, their willingness to innovate and level of engagement both increase significantly.

After implementing equity incentives, Company A observed significantly increased participation from motivated employees in patent applications, process improvements, and technological breakthroughs. The enterprise established a performance appraisal system centered on innovation contribution, incorporating indicators such as technological breakthroughs and cost reduction into the unlocking conditions, guiding employees to align their innovative behavior with the enterprise's strategic goals. This model, which deeply integrates incentives with innovation, effectively enhanced the enterprise's R&D efficiency and achievement transformation capability, strengthening its core competitiveness in the industry^[5].

2.4 Attracting External Talent and Optimizing Talent Structure

Against the backdrop of rapid expansion in the PV industry, the demand for high-end technical talent and compound management talent has become increasingly urgent. Equity incentive, as a competitive compensation tool, can create a differentiated advantage in talent recruitment^[6]. Compared to pure cash compensation, equity incentive signals to potential candidates the enterprise's confidence in its future development and provides candidates with the opportunity to share in the enterprise's growth dividends, enhancing the attractiveness of positions.

For Company A, through the establishment of a comprehensive equity incentive system, the enterprise has achieved positive results in attracting high-end R&D talent and international management talent. The reasonable expansion of incentive plan coverage has made more outstanding external talent willing to join the enterprise, driving continuous optimization of the talent structure. Meanwhile, the combination of equity incentive with career development channels provides employees with diversified growth paths, forming a virtuous cycle of talent attraction, development, and retention.

3. Problems in the Application of Equity Incentives in Photovoltaic Enterprises

3.1 Inaccurate Selection of Incentive Targets

In the process of implementing equity incentives at Company A, the selection of incentive targets exhibited the coexistence of overly narrow and overly broad coverage. On one hand, some core technical personnel were excluded from the incentive scope due to position-level or tenure limitations, diminishing the effectiveness of incentives. On the other hand, some non-core position personnel were included in the incentive list due to historical reasons or relationship factors, diluting the effectiveness of incentive resources. The core competitiveness of PV enterprises lies in technological R&D and process innovation; incentive targets should be prioritized toward positions undertaking critical technological breakthroughs and having irreplaceable roles. However, in practice, there is often an "egalitarian" tendency that fails to adequately reflect position value and contribution differences.

Furthermore, the selection criteria for incentive targets lack transparency and scientific rigor, easily triggering doubts about internal fairness. When determining the incentive list, Company A primarily relied on department recommendations and superior evaluations, lacking an objective quantitative assessment system. Some grassroots technical backbone who made genuine contributions were omitted, while some personnel with close relationships to management obtained incentive qualifications, affecting the credibility of the incentive plan and employees' sense of identification^[7].

3.2 Unreasonable Exercise Condition Settings

Exercise conditions are the core element of equity incentive plans, directly determining the orientation and binding effectiveness of incentives. Company A exhibited two prominent issues in setting exercise conditions: first, performance appraisal indicators were overly singular, excessively relying on financial indicators such as operating revenue and net profit, while insufficiently focusing on indicators reflecting industry characteristics such as technological innovation, cost control, and market share; second, performance target values were set too low or too high—targets that are too low reduce incentives to "welfare," losing their motivational significance, while targets that are too high discourage employees and diminish their motivation to exert effort.

The PV industry exhibits pronounced cyclical characteristics, being significantly affected by fluctuations in raw material prices, policy adjustments, and changes in market supply and demand. When setting exercise conditions, Company A failed to adequately consider the impact of industry cyclical fluctuations, adopting fixed performance growth rates as assessment

standards. These targets were easily achievable during periods of high industry prosperity but nearly impossible during industry downturns, resulting in a pronounced pro-cyclical effect of the incentive plan that failed to truly serve as an incentive and constraint mechanism.

3.3 Incomplete Performance Appraisal System

A comprehensive performance appraisal system is the foundational guarantee for the effective implementation of equity incentives. However, Company A exhibited numerous shortcomings in performance appraisal: first, the design of appraisal indicators was not sufficiently scientific, with unreasonable weight allocation between individual and team performance, leading to “free-riding” phenomena; second, the appraisal process lacked effective supervision, with evaluation results being heavily influenced by subjective factors; third, the linkage mechanism between appraisal results and incentive unlocking was not sufficiently tight, failing to create a strong constraining effect.

In specific operations, Company A’s performance appraisal focused on outcome-based indicators with insufficient attention to process-based indicators. For R&D personnel, the cycle from technology development to mass production is lengthy; using only short-term performance as an appraisal basis fails to truly reflect their contribution value. Meanwhile, the informatization level of performance appraisal was low, with insufficient data collection and analysis capabilities, affecting the timeliness and accuracy of appraisals and making appraisal results difficult to be convincing.

3.4 Lack of Dynamic Adjustment Mechanisms in Incentive Plans

The PV industry develops rapidly, with technological roadmaps, market competition patterns, and macro policies all potentially undergoing significant changes. Company A’s equity incentive plan lacked dynamic adjustment mechanisms during implementation; once the plan was established, it remained unchanged throughout its validity period, making it difficult to adapt to changes in the external environment. For example, when significant shifts occurred in industry technological roadmaps, the original incentive orientation might no longer align with the enterprise’s new strategic direction; when market competition patterns changed significantly, the original performance targets might lose their rationale.

Additionally, Company A also exhibited deficiencies in the accounting treatment, tax planning, and information disclosure of equity incentives. The recognition and measurement of share-based payment expenses were not sufficiently standardized, affecting the accuracy of financial statements; tax guidance for incentive targets was inadequate, making it difficult for them to reasonably plan exercise and divestment timing; the timeliness and completeness of information disclosure needed strengthening, making it difficult for investors and stakeholders to fully understand the implementation of incentive plans and their impact on corporate value.

4. Optimization Strategies for Equity Incentives in Photovoltaic Enterprises

4.1 Scientifically Determining Incentive Targets to Achieve Precision Incentives

To address the problem of improper selection of incentive targets, Company A should establish a scientific and transparent screening mechanism. First, clarify the core criteria for incentive targets, using position value, competency, and performance contribution as the three core dimensions, prioritizing the motivation of employees who master core technologies, undertake critical responsibilities, and have high replacement costs. Second, establish a stratified and classified incentive system, designing differentiated incentive schemes for employees at different levels and in different sequences—for senior management, focus on long-term performance binding; for technical personnel, emphasize innovation contribution rewards; for management personnel, focus on operational efficiency improvement.

At the operational level, quantitative assessment tools should be introduced to form objective and fair screening criteria through position value assessment, competency evaluation, and historical performance data analysis. Establish a publicity and appeal mechanism for incentive target selection to enhance procedural transparency and credibility. Meanwhile, reasonably control the scope of incentive coverage to avoid incentive generalization, ensuring that incentive resources are concentrated on the core groups that contribute most to enterprise value creation, maximizing incentive effectiveness.

4.2 Optimizing Exercise Condition Design to Enhance Incentive Orientation

The design of exercise conditions should reflect strategic orientation, industry characteristics, and operability. Company A should construct a diversified performance appraisal indicator system, adding non-financial indicators reflecting industry

characteristics on top of financial indicators. For example, incorporate battery conversion efficiency improvement, non-silicon cost reduction, module shipment growth, and number of patent authorizations into the appraisal scope, closely linking incentive targets with the enhancement of the enterprise's core competitiveness. Simultaneously, introduce industry benchmarking mechanisms, using industry averages or major competitors as reference frames to enhance the external fairness of assessments.

In response to the cyclical characteristics of the PV industry, it is recommended to adopt a flexible target-setting mechanism that dynamically adjusts performance targets by combining external variables such as industry prosperity indices and raw material price indices. Set tiered unlocking ratios, determining different unlocking coefficients based on the degree of target achievement, maintaining both challenge and achievability. Furthermore, appropriately extend the validity period of incentive plans to 5–10 years, aligning with the technological iteration cycle and investment return cycle of the PV industry, strengthening long-term incentive effects.

4.3 Improving the Performance Appraisal System and Strengthening Process Management

Establishing a comprehensive performance appraisal system that supports equity incentives is key to ensuring incentive effectiveness. Company A should optimize performance appraisal in the following aspects: first, optimize indicator structure, balancing the relationship between outcome indicators and process indicators, financial indicators and non-financial indicators, short-term indicators and long-term indicators; second, introduce diversified evaluation methods such as 360-degree feedback and critical incident recording to reduce subjective bias in appraisals; third, establish a performance feedback and coaching mechanism, conducting regular performance interviews to help employees identify improvement directions.

Specifically, a differentiated appraisal mechanism should be established for R&D personnel, fully considering the long-term and uncertain nature of R&D activities, introducing milestone assessments and phased achievement evaluations to avoid judging solely by short-term performance. Strengthen the informatization of performance appraisal, establish unified data collection and analysis platforms, realize real-time data collection, automatic calculation, and multi-dimensional analysis of appraisal data, improving the objectivity and efficiency of appraisals. Strictly link appraisal results with incentive unlocking, resolutely implementing repurchase or cancellation clauses for personnel who fail to meet standards, maintaining the seriousness of incentive plans.

4.4 Establishing Dynamic Adjustment Mechanisms to Enhance Plan Adaptability

To adapt to the rapid changes in the PV industry, Company A should establish dynamic adjustment mechanisms for equity incentive plans. First, establish a regular evaluation system, conducting comprehensive annual evaluations of incentive plan implementation effectiveness, analyzing key indicators such as behavioral changes of incentive targets, target achievement rates, and talent turnover rates, promptly identifying problems and making adjustments. Second, establish plan adjustment clauses, authorizing the board of directors to reasonably revise incentive plans when significant changes occur in the enterprise's strategic direction, notable fluctuations appear in the industry environment, or adjustments occur in laws and regulations.

At the operational level, the professional management of equity incentives should be strengthened. Establish dedicated equity incentive management committees or working groups responsible for plan design, implementation management, and effectiveness evaluation. Enhance coordination and cooperation among finance, legal, human resources, and other departments to ensure the standardization of share-based payment accounting treatment, the compliance of tax planning, and the timeliness of information disclosure. Meanwhile, establish training and communication mechanisms for incentive targets, helping them correctly understand the content and significance of incentive plans, reasonably plan personal exercise and divestment strategies, so that incentive plans truly achieve their intended effects.

5. Conclusion

As an important tool in modern enterprise human resource management, equity incentive plays an irreplaceable role in attracting, retaining, and motivating core talent for PV enterprises. By deeply aligning employee interests with the long-term development of the enterprise, equity incentive can effectively alleviate principal-agent conflicts, stimulate innovation vitality,

optimize talent structure, and build sustainable talent advantages for PV enterprises in fierce market competition.

However, from the practice of Company A, current PV enterprises still face numerous challenges in the design and implementation of equity incentive plans. Issues such as inaccurate selection of incentive targets, unreasonable exercise condition settings, incomplete performance appraisal systems, and lack of dynamic adjustment mechanisms constrain the intended role of equity incentives. These problems stem from both the limitations of enterprises' own understanding and capabilities and are closely related to industry characteristics and changes in the external environment.

To this end, Company A should systematically optimize equity incentive plans by scientifically determining incentive targets, optimizing exercise condition design, improving performance appraisal systems, and establishing dynamic adjustment mechanisms. By building precise, effective, and flexible long-term incentive mechanisms, equity incentive can truly become an important engine driving enterprise technological innovation, management improvement, and value creation, helping enterprises achieve sustained growth and long-term value maximization in the high-quality development of the PV industry.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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