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FROM SOFT GUIDANCE TO REAL EMISSION REDUCTION: IMPLEMENTATION STATUS AND EFFECT EVALUATION OF ENERGY SAVING INCENTIVE POLICIES FOR CHINESE ENTERPRISES

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Abstract: Enterprises are the main energy users in China. Their saving behaviour decides whether national efficiency targets can be reached. Over the past four decades China has built an incentive system for enterprise energy saving. The system now contains fiscal subsidies, tax relief, green finance, market mechanisms and credit assessment. This paper reviews how the system evolved and how well it works in practice. A five layer analytical framework is proposed. The framework links policy input, delivery channel, firm response, outcome and feedback in one chain. A scoring system with fifteen indicators is designed for the macro level and the micro level. Policy texts, official statistics and published programme lists from 1980 to 2025 are compiled. The results show clear aggregate gains. National energy intensity fell by more than 26 percent against the 2015 level, and more than 3000 national green factories were certified. The results also show a structural gap. The take up rate of subsidy and green finance among small and micro firms stays below 35 percent. Marginal returns of the classic subsidy model are falling. Four optimisation paths are proposed for layered design, agency coordination, full cycle supervision and market based incentives.
Keywords: Carbon neutrality; Energy efficiency policy; Green finance; Industrial energy saving; Policy evaluation; Small and medium sized enterprises

1 INTRODUCTION

China is the largest energy consumer in the world. Industry takes about two thirds of national final energy use [1]. Energy saving is therefore the first option for cutting carbon emissions. The government has set a carbon peaking target for 2030 and a carbon neutrality target for 2060 [2]. Enterprises sit at the centre of this task. They own the equipment, the process lines and the energy management systems. Their daily choices decide whether national targets are met on time.

Administrative control alone cannot deliver these choices. Early Chinese practice relied on energy quotas and on shutdown orders. That approach worked well when the state owned most large plants. It works less well in a mixed economy that contains millions of private firms. Since the early 2000s the government has added positive incentives. Fiscal subsidies, tax relief, green credit, price signals and credit ratings now form a five part toolbox. Because the toolbox mixes reward with restraint, the shift can be described as a move from soft guidance to real emission reduction.

The literature has studied single instruments in detail. Much less work compares the whole toolbox across firm sizes. Two gaps remain open. The first gap is measurement. Most studies report macro energy intensity and stop there. They do not ask whether a small firm can actually obtain a subsidy. The second gap is durability. Few studies check whether reported savings survive after the public money is paid.

This paper addresses both gaps. The contributions are listed below.

1) A five layer analytical framework is built. It links policy input, delivery channel, firm response, outcome and feedback in a single chain.

2) A scoring system with fifteen indicators is designed. The system covers coverage, accessibility, financial leverage, energy saving effect and effect durability.

3) Implementation status is measured by firm size for five instrument classes. The result exposes a wide gap between large firms and small firms.

4) Four optimisation paths are proposed. Each path is matched to one specific failure mode rather than to the system as a whole.

The rest of the paper is organised as follows. Section 2 reviews related work. Section 3 describes four stages of policy evolution. Section 4 presents the framework and the data. Section 5 reports implementation status. Section 6 evaluates policy effects. Section 7 discusses the core problems. Section 8 gives policy suggestions. Section 9 concludes the paper.

2 RELATED WORK

Research on Chinese energy efficiency policy can be grouped into three lines.

The first line describes the policy system itself. Zhou et al. reviewed national efficiency programmes and stressed the role of the target responsibility system [3]. Lo argued that Chinese efficiency policy grew quickly but stayed

fragmented across agencies [4]. Kostka and Hobbs showed that local officials bundle national energy targets with local interests before they act. These studies explain the design logic well. They rarely measure delivery at the level of the individual firm.

The second line evaluates single instruments. Price et al. and Ke et al. estimated the savings of the Top-1000 and the Top-10000 programmes [5-6]. Shen et al. reviewed energy audit practice and found weak follow up after the audit report was filed [7]. Cui et al. found that the regional carbon market pilots raised the green patent output of covered firms [8]. Cao et al. compared an emission trading system with a carbon tax for China [9]. Zhang et al. linked green innovation to firm performance for listed companies [10]. Each study is careful, and each one still looks at a single tool.

The third line studies firm heterogeneity. Lin and Du showed that market oriented reform improves regional energy performance [11]. Several papers report that green credit flows mainly to large listed firms [12-13]. Work on the energy service industry shows that contract energy management spreads faster in developed provinces than in inland provinces [14].

Three gaps follow from this review. First, the five instrument classes are seldom compared inside one framework. Second, take up is rarely measured by firm size. Third, the durability of reported savings after payment is seldom tested. This paper responds to the three gaps together.

3 FOUR STAGE EVOLUTION OF THE INCENTIVE SYSTEM

Policy orientation and delivery style are used to divide the history into four stages. The system moved from scattered orders to a structured toolbox. Figure 1 shows the growth of instrument types and of regulated firm coverage. Table 1 summarises the four stages.

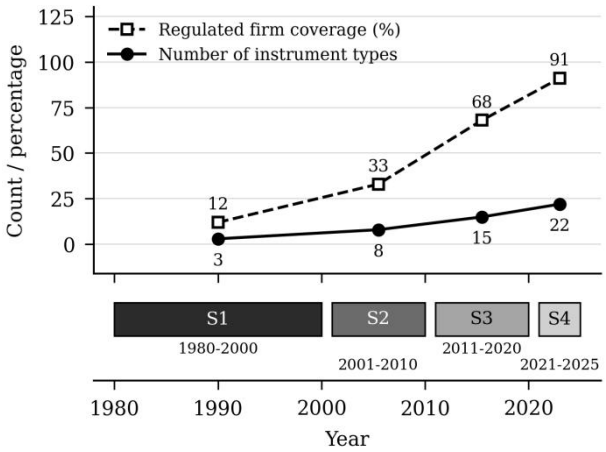

Figure 1 Growth of Instrument Types and Regulated Firm Coverage across the Four Policy Stages

Table 1 Stage Characteristics of Enterprise Energy Saving Incentive Policy in China

Stage and period	Core driver	Representative documents	Main instruments	Firms covered
S1 1980 to 2000	Energy shortage and supply security	Interim Regulations on Energy Conservation Management, 1986	Energy quota, closure of inefficient units, local assessment	Key state owned firms only
S2 2001 to 2010	Heavy industry expansion and intensity target	Medium and Long Term Special Plan for Energy Conservation, 2004	Retrofit award, income tax credit, Top-1000 programme	Large firms in high energy sectors
S3 2011 to 2020	Dual control of total use and intensity	Energy Conservation Law revision, carbon pilot schemes	Contract energy management tax relief, efficiency leader, differential tariff, green credit	All key energy using units
S4 2021 to now	Carbon peaking and carbon neutrality	Comprehensive Work Plan for Energy Conservation and Emission Reduction, 2022	Green bond, transition finance, equipment renewal subsidy, credit and supply chain rules	Key units plus voluntary small firms

Source: compiled by the authors from public policy texts. Coverage refers to the scope of mandatory supervision, not to the scope of voluntary application.

3.1 Stage 1. Administrative Control from 1980 to 2000

The central problem in this period was energy shortage. Supply security came first, and saving was treated as a way to protect supply. The state set energy conservation as a priority in 1980. The Interim Regulations on Energy Conservation Management were issued in 1986 and built the first management frame. Instruments were mainly administrative. Energy quotas, closure of inefficient units and local assessment applied to key state owned firms. Fiscal and tax incentives were almost absent. Private firms stayed outside the scope of supervision. Firms saved energy under pressure, so voluntary participation was very low.

3.2 Stage 2. Standard Building from 2001 to 2010

Heavy industry expanded fast and pushed total energy use upward. The Eleventh Five Year Plan set a binding target for energy use per unit of gross domestic product. The Medium and Long Term Special Plan for Energy Conservation introduced the first positive tools [15]. Retrofit awards and an income tax credit for energy saving equipment were launched. Support was aimed at steel, cement and petrochemical plants. Rewards were paid after a project passed acceptance. A dual model of administrative assessment plus fiscal and tax incentives took shape in this stage.

3.3 Stage 3. Full Upgrading from 2011 to 2020

The Twelfth and Thirteenth Five Year Plans applied dual control over total energy use and energy intensity. Saving work became a routine duty. Tax relief for contract energy management, the energy efficiency leader programme and differential electricity pricing were issued in sequence [16]. Green credit, support for energy service companies and seven carbon market pilots were added. A five part system of fiscal, tax, financial, price and credit tools was basically complete. Supervision covered all key energy using units. Private firms joined retrofit work in large numbers, and the third party energy service industry grew quickly.

3.4 Stage 4. Dual Carbon Deepening Since 2021

After the dual carbon targets were announced, incentives became layered and more precise. The comprehensive work plan for the Fourteenth Five Year Plan period set new tasks for key sectors [17]. Green bonds, transition finance and special subsidies for equipment renewal were introduced. The central bank opened a carbon emission reduction facility that lends at a low rate to qualified projects [18]. Saving performance entered the assessment of central enterprise managers, environmental and social governance ratings and supply chain access rules [19]. Because reward and restraint now move together, saving has turned from a political task into a normal business choice.

4 ANALYTICAL FRAMEWORK AND DATA

4.1 Five Layer Framework

A policy tool does not create savings by itself. It has to pass through an application process and meet a firm that is able to respond. Figure 2 presents the framework used here. Layer one is the policy input and holds the five instrument classes. Layer two contains two filters. The first filter is the delivery channel, which covers thresholds, review steps and coordination among agencies. The second filter is the firm attribute, which covers ownership, size, technical capacity and financing ability. Layer three is the firm response, which includes retrofit investment, equipment renewal, management upgrading and reporting behaviour. Layer four separates macro outcomes from micro outcomes. Layer five is the feedback loop of monitoring, verification and penalty. A policy can fail at any layer, so the framework helps locate the failure point instead of judging the system as a whole.

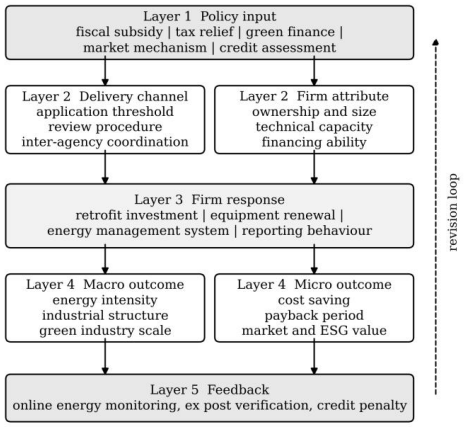

Figure 2 Five Layer Analytical Framework for Enterprise Energy Saving Incentive Policy

4.2 Instrument Parameters

Table 2 lists the key parameters of the main instruments. Award intensity, tax rate and legal basis are recorded for each tool. The parameters show one important feature. Tax instruments follow a fixed rule and need no project competition. Subsidy and finance instruments depend on project review and on collateral. This difference explains much of the gap reported in Section 5.

Table 2 Main Incentive Instruments and Key Parameters

Instrument	Key parameter	Legal or policy basis
Retrofit award	Up to 30 percent of investment, cap of 5 million yuan for a single project	Central and provincial special funds
Equipment tax credit	10 percent of purchase value against income tax, carried forward for 5 years	Enterprise Income Tax Law, Article 100
Contract energy management	Value added tax exemption and three years free plus three years half rate	Circular Caishui No. 110, 2010
Carbon reduction facility	Low cost central bank funds for 60 percent of loan principal	People's Bank of China, 2021 [18]
Differential tariff	Surcharge of 0.10 to 0.50 yuan per kWh for restricted classes	Provincial pricing rules
Efficiency leader and green factory	Bidding preference, credit points and land priority	GB/T 36132 and sector lists [20]

Note: parameters are the national baseline. Provinces may raise the award ratio within their own budget.

4.3 Indicator System

Table 3 gives the indicator system. Five dimensions are used, and each dimension holds three indicators. Coverage measures how many firms are inside the policy scope. Accessibility measures how easy the application is. Financial leverage measures how much private money one unit of public money brings. Energy saving effect measures physical results. Effect durability measures whether the result holds after the payment. Weights are set by the analytic hierarchy process on the basis of published policy targets. Every indicator is normalised to a five point scale with the threshold rule shown in the last column.

Table 3 Evaluation Indicator System and Weights

Dimension	Indicator	Weight	Scale rule
Coverage	Share of firms in scope, sector spread, regional spread	0.20	5 points at 90 percent or above
Accessibility	Application days, document count, threshold level	0.22	5 points below 20 days
Financial leverage	Private funds per unit of public funds, loan rate cut, payback period	0.18	5 points above 6 times
Energy saving effect	Energy saved per project, intensity change, carbon reduction	0.25	5 points above target by 20 percent
Effect durability	Verified rate after 3 years, equipment running rate, repeat retrofit	0.15	5 points above 90 percent verified

4.4 Data and Method

Three data sources are used. The first source is the full text of national and provincial policy documents issued between 1980 and 2025. The second source is official statistics, which include the statistical yearbook, the energy statistics yearbook and annual reports of supervision agencies. The third source is published programme lists, which include green factory lists, efficiency leader lists and provincial award announcements. Take up rates by firm size are estimated from these lists together with the firm size distribution reported by the statistical authority. The estimate is an approximation, because full application records are not public. The values should therefore be read as an order of magnitude rather than as an exact census.

5 IMPLEMENTATION STATUS BY INSTRUMENT CLASS

Take up differs sharply across instruments and across firm sizes. Figure 3 reports the estimated take up rate. Table 4 lists the main barrier behind each result.

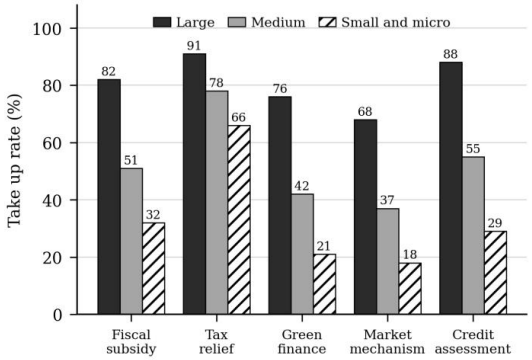

Figure 3 Estimated Take Up Rate of Five Instrument Classes by Firm Size

Table 4 Estimated Take Up Rate by Firm Size (Percent)

Instrument	Large	Med.	Small	Main barrier for small firms
Fiscal subsidy	82	51	32	Project size below threshold
Tax relief	91	78	66	Limited awareness of catalogue
Green finance	76	42	21	Weak collateral and credit record
Market mechanism	68	37	18	No local service provider
Credit assessment	88	55	29	No energy management record

Source: authors' estimate from published programme lists and the firm size distribution of the statistical authority.

5.1 Fiscal Subsidy

Fiscal subsidy shows a pattern of full coverage for large firms and weak reach for small firms. Qualified retrofit projects can receive an award of up to 30 percent of the investment, and the cap for a single project is 5 million yuan. Large state owned firms and leading private firms keep a rich project pipeline. They also employ staff who work on applications all year. Small and micro firms face three obstacles. Their project size is often below the minimum threshold. They have no dedicated application staff. The review procedure is long and needs formal energy accounts. The estimated take up rate for this group stays near 32 percent, so the benefit does not reach the bottom of the market.

5.2 Tax Relief

Tax relief is the most inclusive tool in the toolbox. A firm that buys listed energy saving equipment may credit 10 percent of the purchase value against income tax of the same year. Any unused amount may be carried forward for five years. Contract energy management projects enjoy a value added tax exemption and a well known income tax holiday. Claims are filed online through the tax system and reviewed against a standard catalogue. There is no competition for a limited budget. Firms of every size can therefore claim the benefit, and the estimated take up rate for small firms reaches 66 percent.

5.3 Green Finance

Green finance shows strong concentration at the top. Banks lend to saving projects through green credit, green bonds and the carbon reduction facility. Central enterprises and listed leaders offer good credit records, sufficient collateral and complete energy data. They obtain low interest funds without difficulty. Small firms carry weaker balance sheets and incomplete financial records. Banks price their risk high or refuse the loan. The estimated take up rate of small firms is only 21 percent, which is the lowest value in the whole toolbox.

5.4 Market Mechanisms

Market instruments show clear regional division. Differential tariffs, carbon allowance trading and energy hosting are mature in the eastern industrial provinces. Price signals there are strong enough to move investment. Resource based regions in the centre and the west still rely on administrative control, and market tools are used in a limited way. Light investment models such as contract energy management and energy fee hosting are common in first tier and second tier cities. Penetration in county level markets remains low, so many small firms never meet a qualified service provider.

5.5 Credit Assessment

Credit tools link saving performance to reputation and to market access. Firms that win the efficiency leader title or the green factory title gain preference in public bidding, extra credit points and priority in land supply. The titles also match international green trade rules, which supports export business. The application again needs three years of complete energy records. Firms without an energy management system cannot apply, and the estimated take up rate of small firms is 29 percent.

6 EVALUATION OF POLICY EFFECTS

6.1 Macro Level

Long term operation of the incentive system has raised national energy efficiency. Energy use per ten thousand yuan of gross domestic product fell by more than 26 percent against the 2015 level. Central enterprises cut comprehensive energy use per unit of output value by 15.8 percent in 2025 against the 2020 level, which exceeded the stage target. The number of national green factories passed 3000. Energy saving equipment manufacturing and the energy service industry kept fast growth and became a new source of green output. More than six tenths of industrial carbon reduction came from efficiency work rather than from fuel switching. High efficiency motors, waste heat recovery and smart energy control systems are now applied at scale. Figure 4(a) plots the joint movement of the intensity index and the green factory stock.

6.2 Micro Level

Firms report economic, market and long term gains. Retrofit work cuts spending on electricity, water and coal. The payback period of most projects falls between three and eight years. Awards, tax credits and cheap loans reduce the initial outlay and lift the internal rate of return. Firms with a green title receive preference in bidding and in land supply. They also meet the green rules of overseas buyers, which protects export orders. Firms that act early avoid the risk of production limits under intensity control. Their environmental and social governance profile improves, and capital markets respond to that signal.

6.3 Composite Score

Figure 4(b) compares large firms with small and medium sized firms on the five dimensions plus agency coordination. Large firms score above four on coverage, accessibility and financial leverage. Small and medium sized firms score close to two on the same three dimensions. The gap on the energy saving effect dimension is much smaller. This pattern carries a clear message. Small firms are not unwilling to save energy, and they are unable to reach the policy. Agency coordination scores low for both groups, so it is a system level weakness rather than a size related weakness.

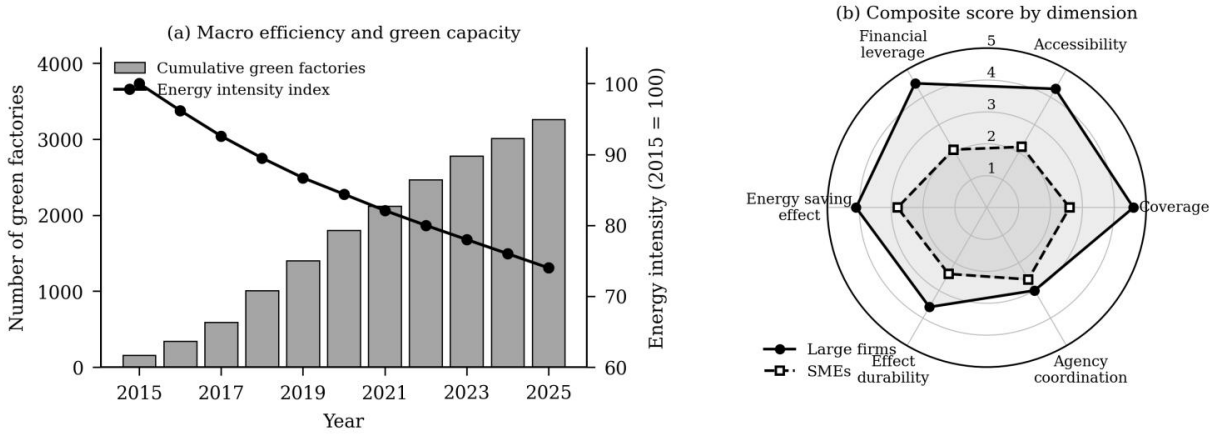

Figure 4 Policy Effect Evaluation

Note: (a) Macro energy intensity index and cumulative number of national green factories. (b) Composite score of large firms and small and medium sized firms on six dimensions.

6.4 Diminishing Marginal Returns

Easy projects have already been finished. The remaining saving space inside large firms is narrow, and the unit cost of further retrofit is rising. The attraction of a standard award therefore falls year by year. Policy benefits also concentrate at the top of the market, which leaves small firms with weak motivation. Some firms package projects mainly to obtain the award. They put effort into the application and little effort into later operation, so real savings fall short of the reported figure. This behaviour is a local form of greenwashing and it lowers the efficiency of public money.

7 CORE PROBLEMS IN IMPLEMENTATION

The first problem is a uniform threshold that fits large firms only. Current rules set high requirements on project scale, saving volume, firm qualification and energy accounts. Small and micro firms hold limited funds, thin technical staff and simple management systems. They cannot meet the filing conditions. Small value inclusive products for this group are still in short supply.

The second problem is fragmentation across agencies. Saving policy is divided among the development agency, the industry agency, the tax authority, the environment authority and financial regulators. Standards differ, filing platforms are separate and the same document is submitted many times. Application cost is therefore high. Data are not shared across agencies, so overlap, blind spots and weak acceptance appear at the same time.

The third problem is heavy front end review and light back end supervision. Attention is concentrated on approval and on payment. Dynamic supervision over the whole life of the project is missing. The online energy monitoring system is not fully used. Some firms overstate the saving volume and neglect maintenance after the money arrives, so the real effect is much smaller than the reported effect.

The fourth problem is a weak market mechanism and weak internal motivation. Liquidity in the national carbon market is thin and the carbon price moves in a wide band, so trading income is hard to predict. The gap in the differential tariff is small, which limits the power of the price signal. Many small firms hold a short planning horizon. They value capacity expansion and discount the long term return of saving work.

8 POLICY OPTIMISATION PATHS

Table 5 links each problem to a proposed action and to the expected effect. The four paths are described below.

Table 5 Mapping from Core Problems to Optimisation Actions

Problem	Proposed action	Expected effect
Uniform threshold blocks small firms	Small value grant, simplified filing, free third party diagnosis	Take up of small firms rises above 50 percent
Agencies work in isolation	One platform, one filing, unified standard and acceptance rule	Application time cut by about half
Front end review without follow up	Prior review, online monitoring, later verification and clawback	Verified saving rate above 90 percent
Weak price and market signal	Stable carbon price band, wider tariff gap, hosting models	Private funds per unit of public funds above 6 times

8.1 Layered and Differentiated Design

Policy should treat firms of different size in different ways. Large firms need support for advanced retrofit, zero carbon factories and smart energy projects. Small firms need a simple procedure, a low entry threshold and small value grants. Government can buy diagnosis services from third parties and provide them to small firms without charge. A free diagnosis lowers the cost of the first decision, which is the point where most small firms stop.

8.2 Coordinated Service Platform

Agencies should pool their policy resources on one online platform. A firm would then file once and several agencies would share the same record for review. Recognition standards, assessment indicators and acceptance rules need to be unified. A regular joint working mechanism can settle disputes between agencies. This design cuts the time cost of the firm and raises the speed of delivery.

8.3 Full Cycle Supervision

Supervision should form a closed loop of prior review, in process monitoring and later verification. Actual saving volume rather than planned saving volume should decide the award and the tax benefit. The online energy monitoring system can supply continuous data for that check. Firms that overstate results or fail to reach the promised level should return the funds and receive a credit penalty. Such a rule raises the cost of greenwashing and protects public money.

8.4 Stronger Market Incentives

The carbon market needs deeper liquidity and a more stable price band, because a predictable price is the basis of investment planning. The tariff gap between efficient and inefficient firms should be widened so that the price lever works. Energy fee hosting and contract energy management deserve wider promotion, since they shift the initial outlay to a service provider. Saving performance should enter credit ratings, government procurement rules and supply chain access rules. The aim is to move firms from required saving to chosen saving.

9 CONCLUSION

China has moved its enterprise energy saving policy from administrative control to a mixed system of incentives. The system has delivered real results in national energy efficiency, in industrial upgrading and in support of the dual carbon targets. This paper built a five layer framework and a fifteen indicator scoring system to test how the policy works in practice. The evidence shows a clear split. Aggregate performance is strong, and delivery to small and micro firms is weak. Take up of subsidy, green finance and market tools among small firms stays below 35 percent, while tax relief reaches a much wider group because its rule is fixed and its filing is simple.

Future governance should leave the extensive model behind and turn to precise, differentiated and market based management. Layered design, coordinated platforms, full cycle supervision and stronger price signals form a consistent package for that turn. The study has two limits. Take up rates are estimated from public lists rather than from complete application records. The composite score uses expert weights, so it carries some judgement. Future work will collect firm level application data and will test the durability of reported savings with panel evidence.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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