



Project NovA! Whitepaper

Monetary Authority of Singapore
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MAS



Contents

1	Introduction	3
1.1	NovA! - Financial Services as a lever to drive sustainability through AI and Data Analytics	3
1.2	Accelerating the transition to Net-Zero in Singapore and beyond	5
<hr/>		
2	Expected business value and impact the NovA! MVP will drive	7
2.1	Incentivising sustainability within the real estate sector	7
2.2	Overcoming challenges within the real estate-SLL market	9
2.3	Unlocking value through the NovA! MVP	15
<hr/>		
3	NovA! MVP	17
3.1	Under the hood	17
3.2	What we have learnt	29
<hr/>		
4	The path forward	33
<hr/>		
5	Appendices	35
<hr/>		

1 Introduction

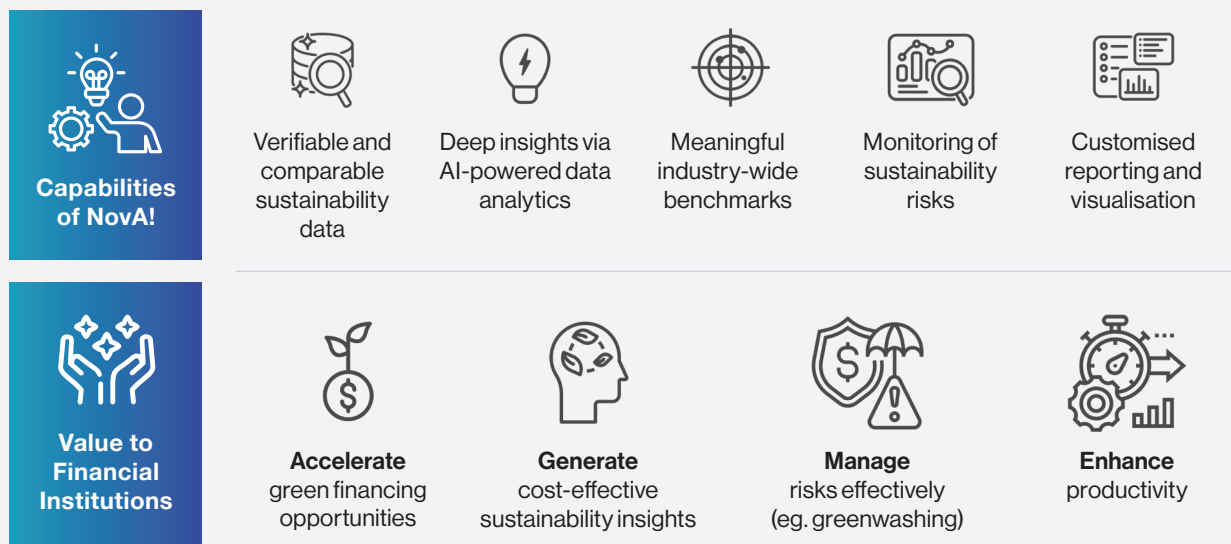
1.1. NovA! – Financial Services as a lever to drive sustainability through AI and Data Analytics

NovA! was launched in 2021 as a part of Singapore’s National AI Programme in Finance, with the ambitious vision of becoming a global utility platform that uses AI and data analytics to drive sustainability through financial services. Its primary goals are to unlock opportunities for sustainable financing, combat greenwashing, manage climate risks and accelerate the transition to a net zero future.

Led by the Monetary Authority of Singapore (MAS) and the Smart Nation Digital Government Office (SNDGO), NovA! envisions a paradigm shift where AI and data analytics play pivotal roles in driving sustainability across the real economy. This is envisioned by empowering the financial services sector with rich sustainability insights that power effective decision making.

Figure 1a. Introduction to NovA!

NovA! is an industry-wide platform using data intelligence and AI analytics to support financial institutions and companies on their sustainability journey.



NovA! has forged partnerships with leading industry experts spanning financial services, real estate, technology and academia to ensure the platform’s relevance and applicability to business users. Since inception in November 2021, the initiative has garnered substantial interest, attracting participation from 11 financial institutions who have joined the NovA! Consortium. We have highlighted NovA!’s key members in the Figure 1b:

Figure 1b. Key NovA! Members

Project owner	Project sponsor
	
Core development team	Member banks
 	  
 	  
	  
Project consultant	Advisors
	   

1.2. Accelerating the transition to Net-Zero in Singapore and beyond

Accelerating the net zero transition is of utmost importance to ensure that global warming remains within the critical threshold of 1.5°C. Keeping within this boundary is vital because exceeding it risks triggering a series of tipping points that could irreversibly disrupt the climate system, exacerbate warming and result in far reaching consequences. Such a scenario could lead to mass species extinctions, prolonged droughts, and devastating wildfires.¹ To limit global warming to 1.5°C, an annual decarbonisation rate of 15.2% is required until 2030.² Unfortunately, global carbon intensity fell by an average of only 1.4% per year between 2000 and 2021, with 2021 seeing a decade low decrease of 0.5%. To avert this trajectory, businesses and investors must play a leading role in driving decarbonisation efforts.

Singapore is demonstrating a steadfast commitment to accelerating its transition to net-zero emissions and driving sustainability efforts across multiple fronts. The introduction of the Singapore Green Plan 2030 signifies an ambitious roadmap with aggressive sustainability targets for the next 7 years. This strategic plan positions Singapore to achieve its long term goal to transition to net zero emissions by 2050.³ In addition to this, the Singapore Green Building Master Plan aims to green 80% of Singapore's buildings by 2030.⁴ These two initiatives are clear evidence of Singapore's commitment to driving a nation-wide sustainability agenda. NovA! is well positioned to benefit from this supportive national context where the Singapore government actively promotes and advocates for sustainability measures.

NovA! strives to achieve its goals by engendering integrity, transparency and trust. This initiative has the potential to accelerate the decarbonisation agenda not only within Singapore but also globally. By establishing a solid foundation for a thriving sustainability ecosystem, NovA! sets the stage for a greener and more sustainable future.

Following rigorous product and business model testing and refinement in Singapore, the objective is to scale NovA! globally, tailoring the platform to address the unique characteristics and challenges of each market it expands into. This ambitious endeavour will expedite our journey towards a future where NovA!'s innovative solutions not only tackle Singapore's challenges, but also transcend borders, making a positive impact on a global scale.

1 [Yale e360 - As 1.5 Degrees Looms, Scientists See Growing Risk of Runaway Warming. Urgent Need to Slash Emissions](#)

2 [PwC UK - Net Zero Economy Index 2022](#)

3 [Green Plan - A City of Green Possibilities](#)

4 [BCA - Green Building Masterplans](#)



“NovA! will provide a valuable tool to help financial institutions generate prompt and actionable insights using structured and unstructured datasets and advanced computing. This will better enable financial institutions to direct financing towards sustainable projects and companies that meet sustainability performance targets.”

— Sopnendu Mohanty, Chief FinTech Officer, Monetary Authority of Singapore (MAS)

2 Expected business value and impact the NovA! MVP will drive

2.1. Incentivising sustainability within the real-estate sector

The building and construction industry holds significant importance, contributing to approximately 37% of global CO₂ emissions and consumes around 34% of the world's energy.⁵ These staggering figures emphasise the urgent need to promote sustainability and accelerate the transition to a net-zero future within the real-estate sector, making it a fitting target for the NovA! MVP.

Further, we observe that Sustainability-Linked Loans (SLLs) have surged in popularity among borrowers, growing at a CAGR of more than 50% over the past 5 years to reach USD 362 billion in 2022.⁶ These loans are structured in a way that ties borrowers' interest rates to their achievement of pre-determined sustainability performance targets (SPTs).⁷ These targets are validated by independent ESG rating agencies or verification parties. By setting ambitious sustainability targets, these loans incentivise borrowers to focus on being environmentally responsible, promoting sustainable economic activities, and improving their ESG evaluation.⁸ SLLs contribute to global environmental conservation by reducing greenhouse gas emissions and address social and economic issues by incentivising business decisions that foster a more sustainable landscape.

5 [Global Alliance for Building and Construction- 2022 Global Status Report](#)

6 [Economist Intelligence Unit - Sustainable finance set for a recovery in 2023](#)

7 [DBS Bank - Sustainability-linked Transactions](#)

8 [Ministry of the Environment, Japan - What are Sustainability Linked Loans?](#)

However, our research reveals key challenges in the sustainability financing landscape:



Lack of Sustainability Data

Banks and lenders face difficulties in assessing borrowers due to the scarcity of sustainability-related data in the SLL market. This hampers their ability to make informed decisions.⁹



Greenwashing Concerns

Despite the substantial growth of SLLs, our analysis suggests that around 50% of these loans could be susceptible to greenwashing.¹⁰ This highlights the need for transparency and trust in sustainable financing.

The convergence of sustainability financing for real estate as a focal point for NovAI's MVP presents a compelling opportunity to drive meaningful change in Singapore. By targeting this industry, we can pave the way for a greener and more sustainable future in Singapore.

9 [Refinitive - Growth and Challenges in Sustainability Finance](#)











10 [Baringa - Sustainability-linked finance has a transparency problem](#)

2.2. Overcoming Challenges within the Real Estate-SLL market

Sustainable finance acts as a vital catalyst in the world’s journey towards achieving net-zero emissions by channelling funds into green initiatives and low-carbon projects. According to the Glasgow Financial Alliance for Net Zero (GFANZ), an estimated investment of US\$13.6 trillion is required in the Asia Pacific (APAC) region alone during this decade to drive the global net-zero transition and mitigate the most severe impacts of climate change.¹¹

To bridge the sustainable financing gap, various financial products have emerged, including green loans/bonds, sustainability-linked loans/bonds, and general-purpose Sustainable Development Goals (SDG) loans/bonds. These instruments play a vital role in supporting sustainable initiatives. However, the financial services industry faces five key challenges in offering SLLs to the real estate sector.

Figure 2a. Mapping of Industry Challenges, NovA! Solutions and Business Value

Industry Challenges	NovA! Solutions
 <p>Availability and coverage of environmental data</p>	 <p>At-source utility data</p>
 <p>Inconsistent ESG scoring</p>	 <p>Peer-benchmarking</p>
 <p>Lack of industry benchmarks and guidelines on setting ambitious sustainability targets</p>	 <p>Industry-benchmarking and historical SLL transactions</p>
 <p>Increasing regulatory requirements on carbon disclosure</p>	 <p>Scope 2 emissions data</p>
 <p>Burden to manually monitor SLL borrowers</p>	 <p>Near real-time monitoring of borrower performance against SPTs</p>

11 [GFANZ - GFANZ Launches Asia-Pacific Network to Support Asia-Pacific Financial Institutions' Move to Net Zero](#)

Challenge #1: Availability and coverage of environmental data

Despite the growing traction and popularity of ESG, the availability of comprehensive ESG data remains limited, posing a significant challenge for organisations. Banks often rely on independently verified self disclosures from clients, complemented by ESG data from 3rd party providers like Sustainalytics, Refinitiv, etc. However, there is a noticeable gap in company coverage for private companies as sustainability disclosures are voluntary.

Private companies constitute a substantial portion of the global business landscape, accounting for around 90% of businesses, and over 50% of employment worldwide.¹² In Singapore, private companies are the most common type of business. These private companies face additional challenges in obtaining bank loans compared to public companies, particularly in the realm of sustainable financing, where they are often unrated and have limited access to ESG data.



Solution

NovA! provides industry specific insights, covering both public and private companies by leveraging at-source (data provided by government utilities that are tracked by meters, IoT-enabled devices and sensors), country-wide utility data, provided by government agencies.



How does it address the challenge?

The gap in environmental data coverage is addressed through collaboration with government agencies like Building and Construction Authority of Singapore (BCA), MAS initiatives like Project Greenprint, and others.

12 [The World Bank - Small and Medium Enterprises \(SMEs\) Finance](#)

Challenge #2: Inconsistent ESG scoring

A significant challenge in the ESG landscape is the inconsistency in ESG scores across various rating agencies. With multiple ESG rating providers operating globally, it becomes challenging to determine which provider can be relied upon for the most reliable and accurate data. The lack of transparency in the methodologies adopted by each provider further exacerbates this issue.

Research indicates that there is an average correlation of 0.61 among six prominent rating agencies (KLD, MSCI, Sustainalytics, Moody's, S&P Global and Refinitiv)¹³. This finding highlights significant discrepancies in the ESG ratings assigned to companies depending on the rating provider, making it difficult to consistently measure and compare companies against each other, especially when identifying medium or average performers within an industry. The research paper further identifies three factors contributing to the divergence of ratings:

1. **Scope divergence**, where ratings are based on different attributes, such as the inclusion or exclusion of carbon emissions
2. **Measurement divergence**, where providers use different raw data for the same attributes
3. **Weights divergence**, where providers have differing views on the relative importance of attributes



Solution

NovA! can address this challenge through access to at-source environmental data and by its peer benchmarking feature.



How does it address the challenge?

This benchmarking mechanism powered by at-source data provides an accurate assessment of the environmental performance of a borrower and provides relative comparison to industry peers, enhancing transparency and integrity.

13 [Aggregate Confusion: The Divergence of ESG Ratings](#)

Challenge #3: Lack of transparency surrounding sustainability targets

One of the key challenges in the realm of SLLs is the absence of industry benchmarks and guidelines when it comes to setting ambitious Sustainability Performance Targets (SPTs). The process of determining these targets is highly customised and collaborative between the lender and the borrower. However, the lack of regulations mandating the disclosure of SLL details means that such information is often not publicly available, resulting in an opaque landscape.

This opacity opens the door to potential greenwashing practices, where companies may portray themselves as environmentally progressive so as to receive easily achievable SPTs that are only marginally impactful.



Solution

NovA! aims to address this challenge through its industry benchmarking feature and its repository of SLL transactions. These features of NovA! will enhance transparency and provide a comprehensive view of SLLs within the industry.



How does it address the challenge?

This solution helps mitigate against the risk of greenwashing, whether voluntary or involuntary, by ensuring that SPTs are measurable, ambitious, and aligned with industry standards. Moreover, a give-to-get model (premium NovA! access granted to participating FIs) can enable banks to anonymously share and contribute information on SPTs associated with their past SLLs to provide insights on trends in the SLL market.

Challenge #4: Increasing regulatory requirements on carbon disclosure

The financial industry is facing a growing challenge as regulators worldwide, including Singapore, are moving towards mandating climate risk-related data disclosures. The U.S. Securities and Exchange Commission (SEC)¹⁴ and the Singapore Exchange (SGX)¹⁵ are among the regulatory bodies that have mandated climate risk and emissions disclosures aligned to global standards such as the Task Force on Climate-related Financial Disclosures (TCFD).

According to TCFD guidance, banks are expected to disclose greenhouse gas (GHG) emissions resulting from their lending and financial activities, using recognized methodologies such as the Global GHG Accounting and Reporting Standard for the Financial Industry developed by the Partnership for Carbon Accounting Financials (PCAF)¹⁶.

However, calculating emissions across numerous clients in various lending portfolios is a complex task for banks, given the limited understanding of borrowers' carbon profiles and the diversity of sectors they operate in. While the Sustainability Reporting Advisory Committee (SRAC) in Singapore has recently recommended mandatory climate reporting across all industries from FY2025 from listed issuers and from FY2027 from large non-listed companies,¹⁷ currently, less accurate country-wide and sector-wide proxy data is being used, potentially misrepresenting the bank's actual financed emissions profile.



Solution

NovA! can address a part of this challenge by focusing on calculating Scope 2 emissions data based on electricity consumption of building owners, which represents a substantial portion of their overall emissions¹⁸.



How does it address the challenge?

By calculating Scope 2 emissions data of building owners through at-source data, NovA! can ensure an accurate representation of emissions data.

14 [SEC - Statement on Proposed Mandatory Climate Risk Disclosures](#)

15 [SGX - Response Paper on Climate and Diversity](#)

16 [TCFD - Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures](#)

17 [ACRA - Public Consultation on Turning Climate Ambition into Action in Singapore - Recommendations by the Sustainability Reporting Advisory Committee](#)

18 [US EPA - Sources of Greenhouse Gas Emissions](#)

Challenge #5: Lack of real-time monitoring of SLL borrowers

One of the challenges with SLLs is the need for borrowers to consistently provide lenders with timely information and make it publicly available when required¹⁹. However, our interviews with banks have revealed a noticeable challenge in obtaining up-to-date data from private companies' sustainability metrics. Without it, banks are unable to assess whether borrowers are meeting the agreed-upon sustainability targets.

Additionally, the verification process through audits or Second Party Opinion (SPO) providers adds friction to the process and further slows down effective monitoring of SLLs, resulting in data gaps and the risk of greenwashing driven by inaccurate or false information submitted by borrowers.



Solution

NovA! provides banks with the ability to monitor and track performance against SPTs in near real-time, reducing their dependence on secondary data and self-reported information.



How does it address the challenge?

By leveraging near real-time monitoring capabilities, NovA! ensures transparency, accuracy, and proactive management of SLLs. This empowers banks to effectively assess and address sustainability performance, minimising the risk of greenwashing and promoting responsible lending practices.

19





[LSTA - Sustainability-Linked Loan Principles](#)

2.3 Unlocking value through the NovA! MVP

NovA! allows financial institutions to assess and monitor potential borrowers of SLLs throughout the lifecycle of the loan, from origination and underwriting to loan servicing. The MVP was designed to reduce the amount of time required for financial institutions to collect, process, and analyse data by leveraging Natural Language Processing (“NLP”), to enable automatic extraction of relevant information from unstructured disclosure documents such as sustainability reports.

The MVP was designed to deliver value for stakeholders across the sustainability financing value chain covering banks, companies, citizens and the Singapore government. Figure 2b highlights NovA!’s value to its key stakeholders.

Figure 2b. NovA!’s value to key stakeholders

Stakeholders	Value
 Banks	Enable banks to perform peer-to-peer comparison and tackle greenwashing in a cost effective manner
 Businesses	Supporting compaies with easier access to sustainability linked loans for real estate investments
 Citizens	Companies are incentivised to get more sustainable in order to unlock access to funding, resulting in more sustainable and cleaner Singapore
 Regulators and the Singapore Government	Driving the country towards sustainability and carbon neutrality one sector at a time



“We support Project NovA! due to the growing need to ‘make Sustainable Finance easier and impactful’ for borrowers and lenders via independent, verifiable, data and benchmarks to assess the environmental performance of companies. Our race towards Paris and net-zero necessitates an ecosystem-centred approach, requiring not just the public and private sectors to partner but also peers in the private sector to collaborate. Industry utilities such as Project Greenprint / NovA! will help meaningfully facilitate this.”

— Mr. Rajeev Kannan, Managing Executive Officer,
Co-Head of Asia Pacific, Sumitomo Mitsui Banking
Corporation (SMBC)

3 NovA MVP

3.1 Under the hood

The NovA! MVP was designed to empower financial institutions (FIs) at various stages of the SLL issuance process:



At loan origination, NovA! enables FIs to identify Real Estate corporate borrowers whose sustainability metrics can be enhanced. By comparing their historical environmental performance with that of their peers, FIs gain valuable insights into areas where improvements can be made.



During the underwriting phase, NovA! becomes an invaluable asset for FIs in setting appropriate and ambitious Sustainability Performance Targets (SPTs) for borrowers. By leveraging the SPT Industry Benchmark generated by NovA!, FIs can ensure that borrowers' SPTs align with industry standards and minimise the risk of greenwashing.



For the servicing of SLLs, NovA! plays a pivotal role in scrutinising the actual sustainability performance indicators. By utilising data reported, NovA! compares these indicators against borrowers' self-declared performance, effectively detecting any potential instances of greenwashing.²⁰

NovA! was designed to help banks navigate the complexities of SLL issuance with confidence, ensuring transparency, trust, and genuine progress towards a more sustainable future.

Core Feature #1

Peer and Industry Benchmarking

A key pain point faced by banks is the complex process of setting and negotiating sustainability performance targets (SPTs) for SLLs. Due to data availability, transparency and domain expertise challenges, banks struggle to assess and propose SPTs that are sufficiently ambitious but plausible for their customers (i.e., borrowers). Balancing the need for ambition with the risk of loans becoming unattractive or the potential for greenwashing poses a significant challenge to banks.

- **Collaboration with utility providers**

To address this issue, NovA!'s MVP aims to integrate data directly from the source through strategic partnerships with government bodies like Building and Construction Authority (BCA), Public Utilities Board (PUB) and Energy Market Authority (EMA). Such collaborations will enable access consumption data and establish an industry benchmark mechanism.

- **Peer benchmarking based on property type**

The MVP's peer benchmarking feature facilitates an accurate and fair comparison by categorising benchmarks based on property characteristics such as type, usage, and age. This enables banks to evaluate their clients' performance against comparable peers effectively. The NovA! MVP screenshot in Figure 3a, indicates electricity-use intensity targets set for a selected company and how they compare to their peer group targets.

- **Tiering of borrowers based on performance**

In addition, the MVP provides flexibility by allowing inclusion of best, medium, and low-performing peers in the graph, enhancing the comprehensiveness of the comparison.

- **Facilitating discussions on KPIs and SPTs between RMs and borrowers**

The peer and industry benchmarking feature facilitates discussions between the bank's relationship manager (RM) and the borrower in setting ambitious but plausible KPI targets. Through NovA!, banks can leverage peer benchmarking insights to identify prospective borrowers and prevent against the risk of greenwashing.

- **Enabling transparency through a repository of SLL transactions**

Aims to create a repository of SLL transactions and their associated SPTs, enhancing transparency and providing a comprehensive industry view. This reference data empowers banks to set robust standards for SPTs, eliminating involuntary greenwashing and reducing reputational risks.

Figure 3a. Peer-Benchmarking Screenshot

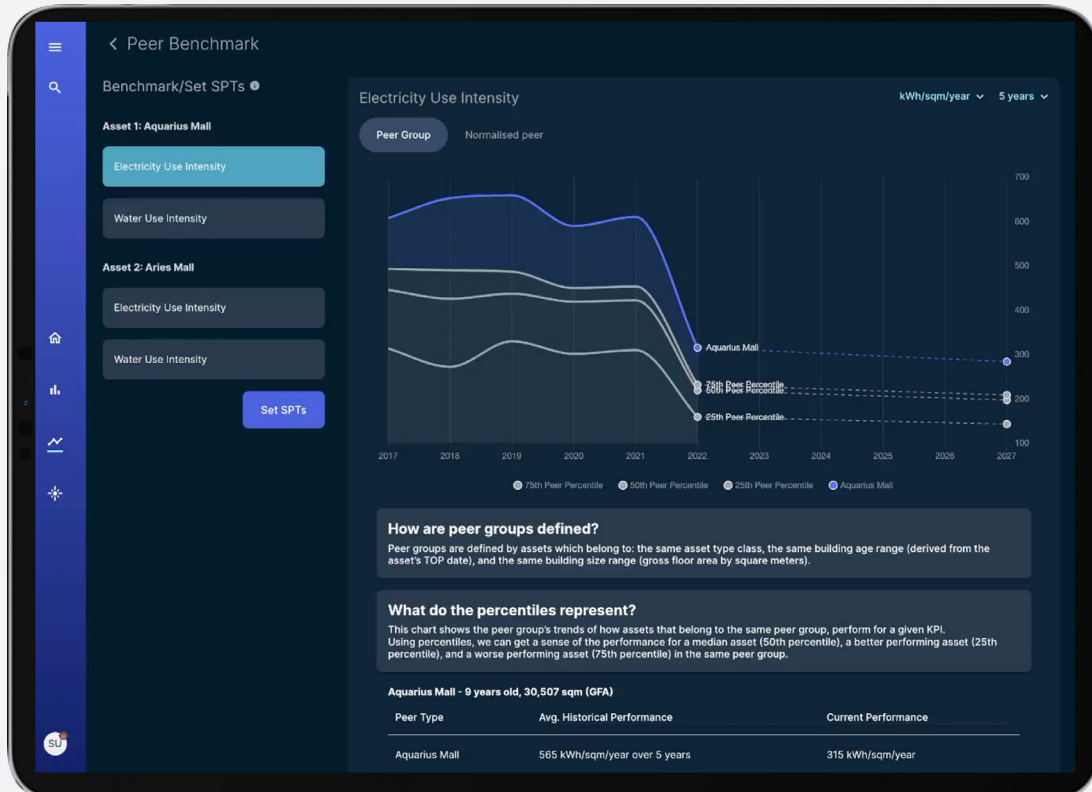
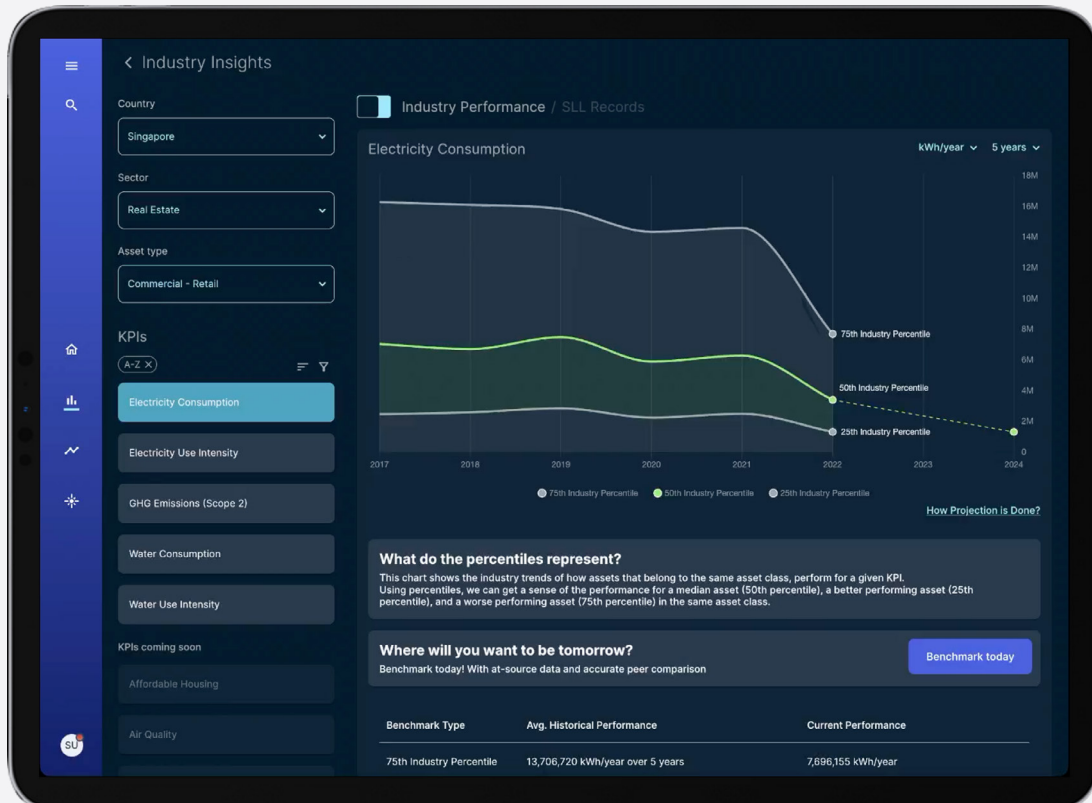


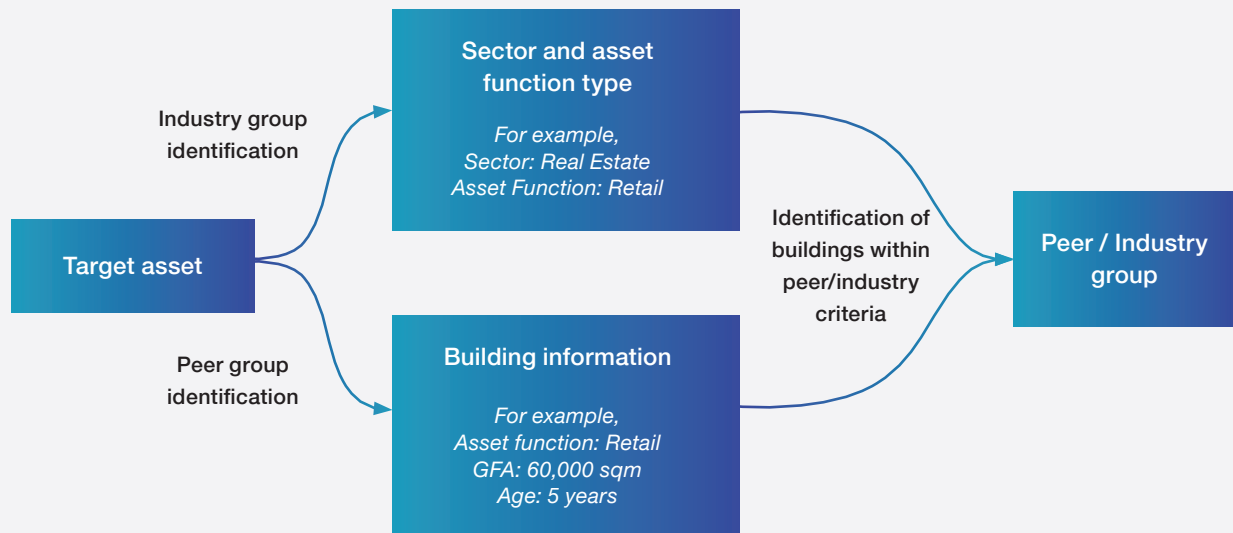
Figure 3b. Industry Insights Screenshot



The peer and industry benchmarking feature comprises the following steps:

- 1. Identification of peer and industry group per asset:** Industry groups are clustered based on sector and asset function type; while peer groups are clustered based on building information such as asset function type, gross floor area (GFA), and age. Peer groups are presently tabulated via a pre-determined threshold due to data insufficiency preventing any reliable AI approaches.
However, once enough sustainability performance data has been obtained, exploration into AI clustering approaches can be done to implement dynamic peer group identification and clustering that adjusts with the ever-changing markets.
- 2. Retrieval of peer and industry at-source data per sustainability performance metrics:** A data pulling pipeline will be integrated via strategic partnerships with government bodies to retrieve reliable, monthly, at-source sustainability performance data
- 3. Aggregation of peer and industry data to generate benchmarks:** Data aggregation scripts will be integrated as part of the data pulling pipeline to calculate peer and industry benchmarks based on 25th, 50th, and 75th percentile performers. Ensuring reliable real-time peer and industry benchmarks while preserving data privacy of individual buildings that make up the peer/industry group.
- 4. Export peer and industry benchmarks:** Peer and industry benchmarks can be exported to facilitate SPTs negotiations between banks and borrowers, empowering banks to set realistic yet sufficiently ambitious data-driven SPTs

Figure 3c. Peer and industry benchmarking logic



The peer and industry benchmarking features serve to start a discussion between RMs and borrowers on how the borrower’s industry is trending on sustainability metrics. With these features, banks can make informed decisions, select the right KPIs, set meaningful SPTs, and promote sustainability within the industry, while minimising risks and driving positive change.

Core Feature #2

Monitoring against selected KPIs/SPTs

In accordance with the Sustainability Linked Loan Principles (SLLP) defined by the Loan Syndication and Trading Association (LSTA), borrowers are responsible for providing lenders with up-to-date information to monitor their performance against defined SPTs²¹. Annual independent verification of performance against SPTs is also encouraged. However, banks have expressed the need for an additional layer of verification using primary data to combat greenwashing effectively, while making it easier to validate.

- **Monitoring of progress against SPTs in near real-time**

The MVP addresses this need by empowering banks to monitor and track borrowers' performance against SPTs on a monthly basis. This reduces reliance on secondary data and self-reported information that is typically provided on an annual basis. Figure 3d illustrates the real-time monitoring of sustainability performance accessible to both lenders and borrowers throughout the loan tenure.

- **Identifying opportunities for intervention**

With real-time performance monitoring, the MVP offers early warnings for intervention opportunities and corrective actions if a borrower's performance deviates from their SPTs.

- **Prediction of future performance against SPTs**

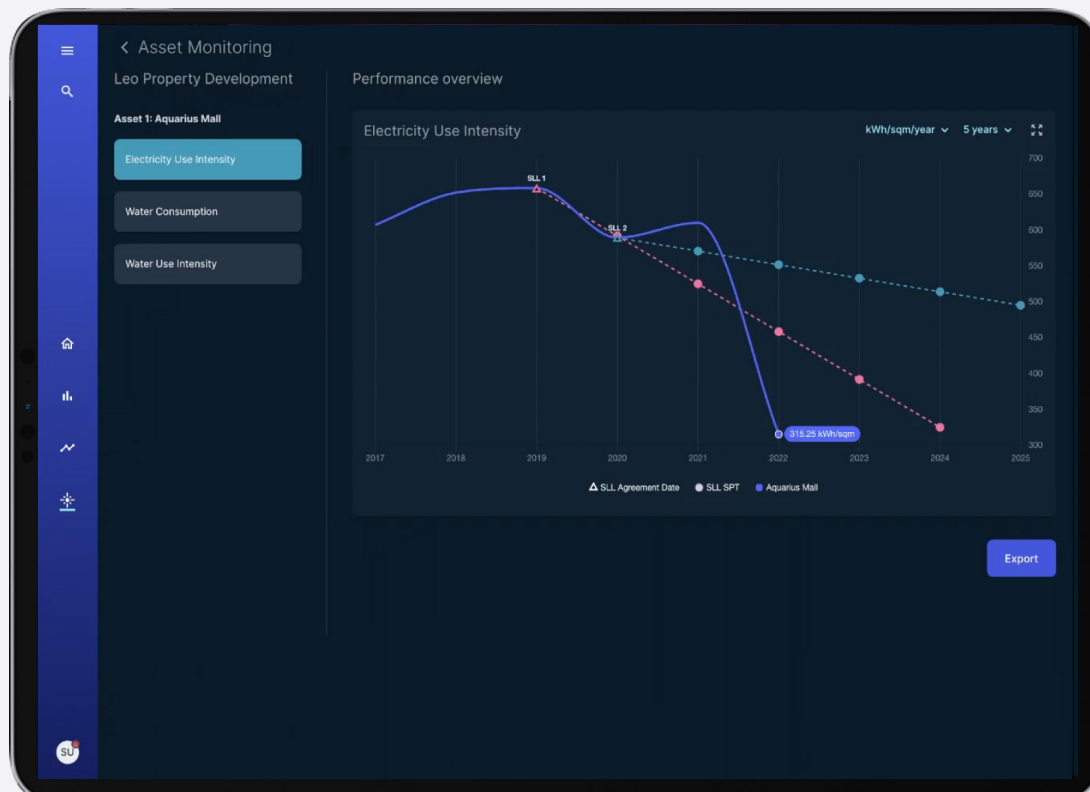
Further, the MVP also offers the ability to forecast future performance against SPTs using AI-powered forecasts to ensure timely interventions.

- **Consolidated view of SLLs and progress against SPTs**

The MVP provides comprehensive information about companies with multiple SLLs, allowing for a consolidated view of their performance against set SPTs.

21 [LSTA - Sustainability Linked Loan Principles \(Sllp\)](#)

Figure 3d. Asset Monitoring Screenshot



The monitoring feature comprises the following steps:

- 1. Retrieval of real-time at-source data per sustainability performance metrics:** A data pulling pipeline will be integrated via strategic partnerships with government bodies to retrieve reliable, monthly, at-source, sustainability performance data. In addition to this, a consent provisioning pipeline will be integrated to allow access to building specific sustainability performance data with prior consent from borrowers, ensuring data reliability while maintaining data privacy.
- 2. Time-series forecasting on sustainability performance data:** Forecasts of up to 5 years will be generated using AutoRegressive Integrated Moving Average (ARIMA) time-series forecasting, adjusted to account for seasonality, and validated using the past 6 years of sustainability performance data of all buildings available in open-source BCA datasets. However, as NovA! gets access to more sustainability performance data, exploration of other ML forecasting techniques can be considered to ensure maximum accuracy of sustainability performance forecasts.

- 3. Early warning system:** Forecasts are compared against SPTs set across SLLs, allowing banks to identify borrowers likely to default on agreed upon SPTs. This provides banks the insights to anticipate potential defaulters, allowing them to begin planning their risk mitigation and early intervention strategies with borrowers early.

Figure 3e. KPI and SPT monitoring diagram



This feature enables RMs and Risk Assessment Teams throughout the loan term to track and monitor whether the agreed targets are being met. With these capabilities, banks can ensure ongoing monitoring of sustainability performance, detect deviations, and take prompt actions, strengthening the integrity and effectiveness of SLLs while combating greenwashing risks.

Core Feature #3

Autonomous Documentation Insights Engine

A significant challenge faced by banks is the limited availability of sustainability data, especially for private companies. The data currently used for application of SLLs primarily consists of self-disclosure documents provided by borrowers, making it a time-consuming process for the bank's Relationship Managers (RMs) and onboarding staff to extract meaningful insights on sustainability performance.

- **Onboarding optimisation using NLP**

To streamline this process, the MVP leverages NovA!'s proprietary NLP engine, Autonomous Documentation Insights Engine (ADIE). During the bank onboarding process, bank staff can upload disclosure documents to the NovA! platform. The ADIE engine analyses the uploaded documents and presents insights in a question and answer format. Figure 3f showcases the MVP's NLP-powered capabilities that extract information from disclosure documents to answer a pre-defined set of questions identified.

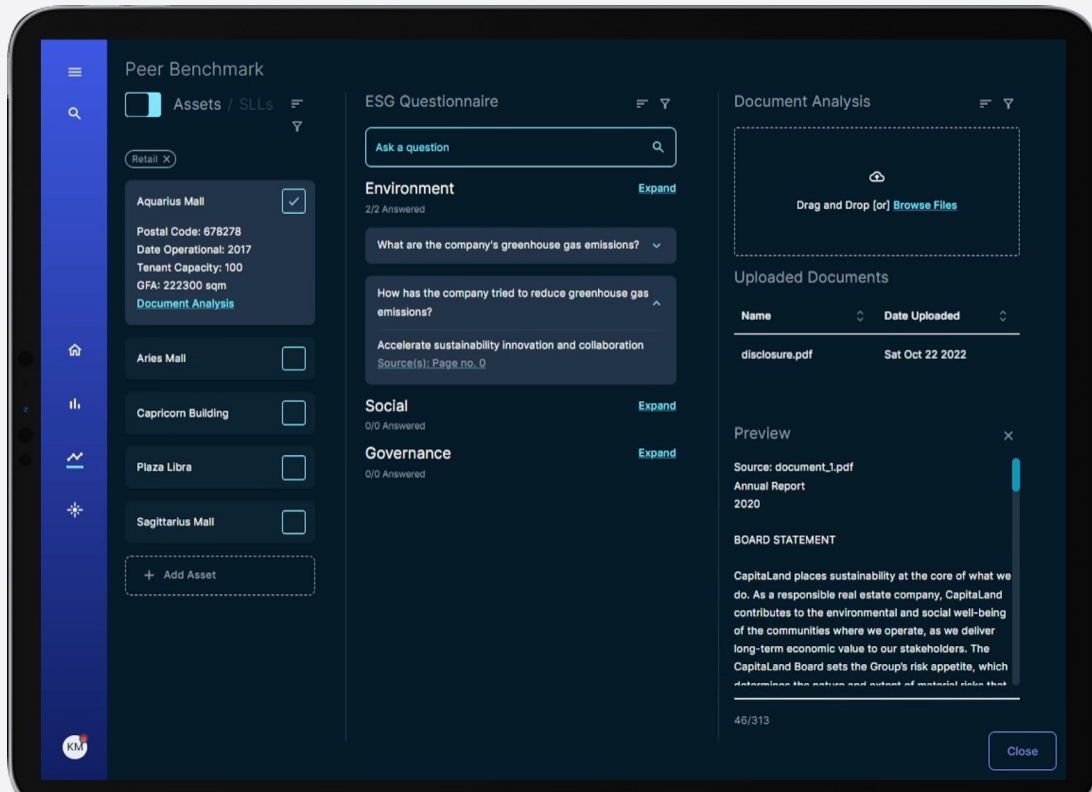
- **Onboarding questions curated by industry experts**

These questions cover the key aspects that banks typically seek in disclosure documents. If the answers are found within the documents, a green mark is displayed. However, if certain information is missing, a red mark indicates the gaps, prompting users to request additional documents from potential borrowers. This significantly reduces the time required for banks to review multiple disclosure documents and facilitates effective collaboration between banks and borrowers in obtaining complete disclosure. Further NovA!'s ADIE NLP engine is powered by self-tuning ML models that get more accurate over time.

- **Automated document classification**

NovA!'s NLP engine also enables document type classification, ensuring efficient categorization of different types of documents.

Figure 3f. Peer Benchmarking using NLP Screenshot



The NLP information retrieval feature comprises the following steps:

- 1. Extraction of textual and diagrammatic content from PDF documents:** Autonomous Documentation Insights Engine (ADIE) identifies portions of diagrammatic content within the document and extracts these diagrams along with their surrounding context such as figure descriptions and legends. ADIE then extracts textual information while excluding content from diagram context.
- 2. Categorisation and identification of document types:** Using state-of-the-art transformer-based BERT model²², ADIE converts information into embeddings and categorises documents to determine the kinds of information the document may provide. The BERT model has been pre-trained on a large corpus of English text (3.3 billion words) for language understanding, and further fine-tuned on a repository of SGX reports (26,489 documents) to conceive an ESG domain-specific document classification model with an accuracy of 97.3%.

²² Kamath, U., Graham, K.L. and Emara, W. (2022) 'Bidirectional encoder representations from Transformers (Bert)', *Transformers for Machine Learning*, pp. 43–70. doi:10.1201/9781003170082-3.

- 3. Querying extracted information from a specially curated set of questions:** Through detailed discussions with domain experts, a set of questions representing the types of information that banks look out for when analysing disclosure documents are distilled. Based on the categorisation of document type, the set of questions are adjusted accordingly and used to query extracted information. Using state-of-the-art transformer-based RoBERTa model,²³ ADIE converts information into embeddings and searches through disclosure documents for both textual and diagrammatic answers to the set of questions identified. The RoBERTa model has been pre-trained on a large corpus of question-answer pairs from SQuAD dataset (107,785 question-answer pairs), and further fine-tuned on a custom annotated ESG report dataset (2,036 question-answer pairs) to conceive an ESG domain-specific question-answering model with an accuracy of 75.5%.

The NLP functionality of our MVP empowers Relationship Managers, KYC teams, and sustainable finance teams to extract precise sustainability information from multiple sources in a fraction of the time compared to manual efforts. This feature significantly enhances the efficiency of data extraction, enabling banks to make more informed decisions and expedite the onboarding process.

²³ Yu, P. and Liu, Y. (2021) 'Roberta-based encoder-decoder model for question answering system', 2021 International Conference on Intelligent Computing, Automation and Applications (ICAA) [Preprint], doi:10.1109/icaa53760.2021.00070.

Core Feature #4

360° Insights on Borrowers

Building upon the key challenge of limited sustainability data available and insufficient coverage on private company borrowers, it is evident that banks expose themselves to the risk of making lending decisions based on inaccurate data derived from borrower's self-disclosures. Moreover, significant gaps exist in publicly available data and primary-source data concerning private companies.

- **Aggregation of data from multiple sources into a central repository**
To bridge this gap, the NovA! MVP aims to create a platform that integrates data from several external data providers. By leveraging sources like Criat and Sustainalytics, the MVP addresses gaps in private-data and offers banks a unified platform through which they can provide SLLs to both public and private companies.
- **Driving inclusion through lowering the cost of data**
The data aggregation feature allows the costs associated with the various data-sets to be shared by NovA! consumers leading to substantial economies of scale and driving inclusion and accessibility to smaller players.

NovA! has partnered with key third-party credit risk and ESG risk rating providers, specifically CriAT and Sustainalytics, as identified through detailed discussions with the lead banks. NovA! ensures that banks have access to a repository of risk rating data, while allowing third-party risk rating providers to expand their outreach. As more pivotal third-party data sources are identified, NovA! is able to employ the same approach for pulling and aggregating more sources of risk rating data.

The data aggregation feature comprises the following steps:

1. **Integration with CriAT:** NovA! has partnered with CriAT to provide up-to-date credit risk rating scores and probability of default in the next 1 to 3 years for each borrower through APIs.
2. **Integration with Sustainalytics:** NovA! has partnered with Sustainalytics to provide up-to-date ESG risk rating reports for each borrower through APIs.
3. **Access to third-party risk rating data:** Upon adding a new borrower to the NovA! platform, third-party risk rating data is automatically retrieved using the borrowers' name and UEN. As NovA! has partnered with key third-party risk rating providers, no consent is required from borrowers for the banks to access this data.

3.2 What have we learnt

The NovA! MVP seeks data from two sources:

- **Public sources**, such as public utilities and government bodies, and
- **Private sources**, including banks

However, the challenge of data sharing and sourcing stems from various legislative barriers and internal policies that restrict or prohibit the exchange of data. This obstacle poses a significant hurdle for the development of NovA!, as data is the essential foundation for analytics and AI technologies. Nonetheless, there are approaches to overcome these legislative barriers, including anonymising personal data and obtaining explicit consent. Additionally, implementing a give-to-get model with banks can help bridge data gaps and foster collaboration.

Further, it is important to address concerns related to the compatibility of NovA!'s technology stack with banks and the need to maintain data anonymity. These considerations have been recognised during the NovA! MVP phase. In this section, we will delve into the key insights gained from the NovA! MVP and explore how we can integrate them into the future development of the NovA! platform:



Access to data

Accessing underlying data is a pivotal factor in advancing sustainability initiatives. In this context, Singapore stands as an exemplar with robust government data reporting, with initiatives like Project Greenprint (Project Greenprint is a multi-geographical digital utility powering the origination, access and orchestration of verified ESG data²⁴). However, legislative barriers currently prevent access to and free sharing of government agency owned data with private parties.

The Banking Act 1970 prevents the free sharing of customer data and restrictions imposed by the electricity and water act prevent private sector access to utility consumption data.²⁵ To address this challenge, NovA! adopted a decentralised approach to access industry benchmark data from the Trusted Center for Sensors Data (TCS), a GovTech platform with data on electricity and water consumption. On a monthly basis,

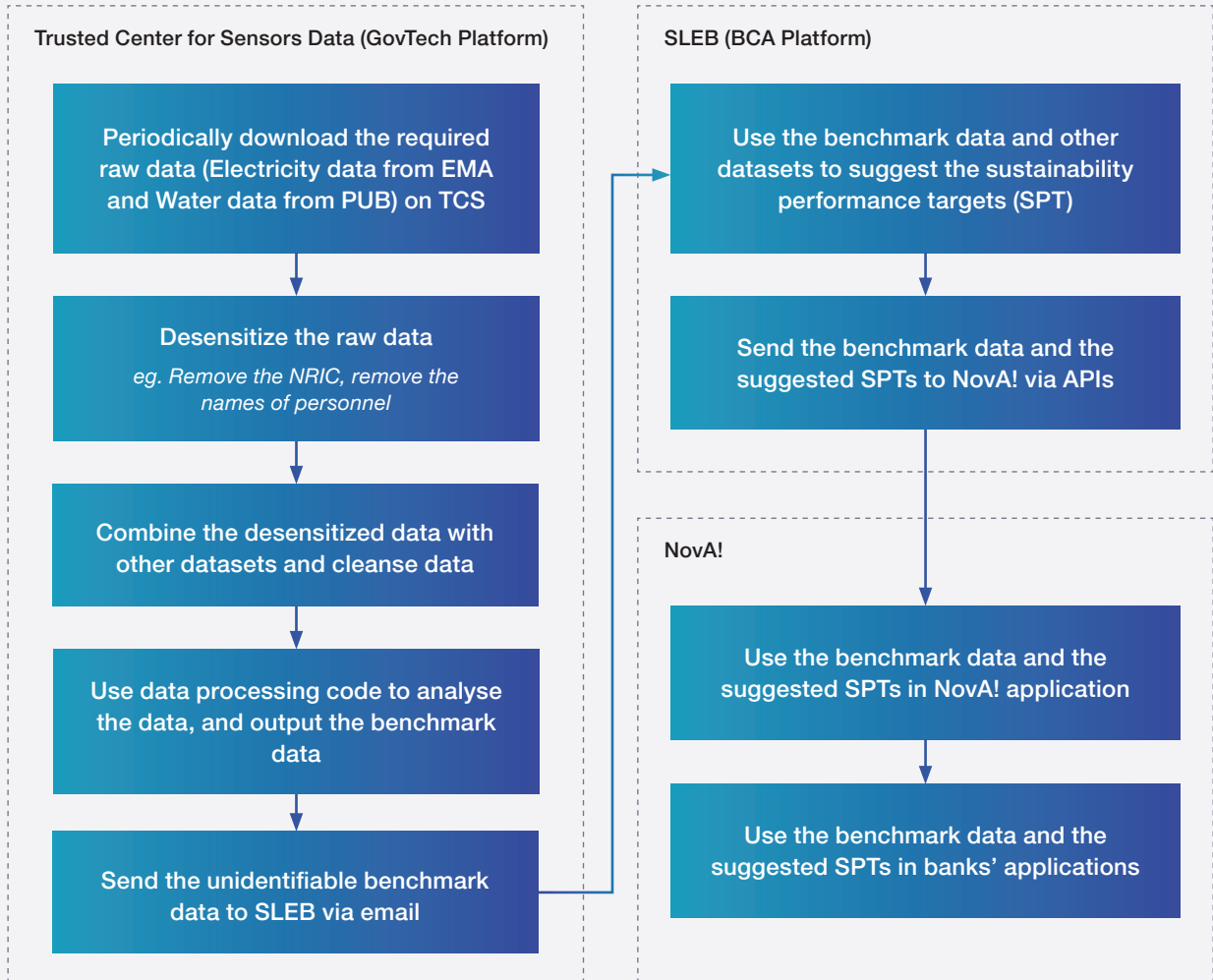
24 [MAS - Green Fintech](#)

25 [Singapore Statutes Online - Banking Act 1970](#)

calculations of industry benchmarks are conducted within TCS's technology environment. These results are then shared with BCA who use this data to provide insights on building environmental performance, benchmarked against peers and the industry through the national digital platform - Super Low Energy Building (SLEB) Smart Hub. NovA! shares this information with banks who in-turn use this information as the basis to identify prospective borrowers, set ambitious SLL SPTs, and monitor SLLs. Figure 3g illustrates this data sharing between TCS, BCA and NovA!. Our key takeaway is that insights from government agencies can be leveraged within the confines of the current legislative landscape if the right partnerships are made and if data stays within the control of agencies that collect it.

In the long term, it is important that legislative barriers around access to data are addressed. To do so the value of driving sustainability objectives and transition to net zero need to be assessed in the context of loosened data privacy legislations. Collaboration with government agencies like GovTech is crucial to drive freer access to government data and although there are ongoing discussions to extend access to the private sector, it is imperative that this access is accelerated. This will equip Singapore as a nation with the data needed to make decisions that solve sustainability related challenges. That said, it is important that enabling freer access to data is done so with the necessary safeguards in place to ensure that data is not exploited.

Figure 3g. Data Sharing between TCS, BCA, and NovA!



Give-to-get model

Establishing a give-to-get model with banks involves gathering information from participating banks so as to create an ecosystem where valuable information on SLLs is available to ensure the right KPIs are selected and ambitious SPTs are set. It is crucial to note that banks with a greater wealth of information hold a competitive advantage, particularly in niche areas like SLLs for real estate. By sharing anonymised SLL data (example: KPI and SPT data), banks can effectively leverage insights to drive their sustainability initiatives while fostering a collaborative environment that benefits all stakeholders involved.



Consent mechanism

When developing a consent mechanism, it is imperative to prioritise ease of use. We acknowledge the legislative challenges surrounding data access and sharing, as well as the compliance concerns faced by banks. Therefore, it is crucial to design a mechanism that aligns with regulatory requirements. Privacy-preserving technologies, such as data anonymisation and data tokenisation, can play a vital role in addressing these concerns. By employing these techniques, banks can maintain data anonymity while still deriving valuable insights.

4 The path forward

During the initial phase, we conceptualised NovA!'s Minimum Viable Product (MVP), with a specific emphasis on SLLs in the real estate sector (SLLs). Strong progress has been made, resulting in advanced discussions to formalise collaborations with government agencies like the Building and Construction Authority (BCA), amongst others.

Expanding on the MVP with the SLEB X NovA! Collaboration

A formal collaboration between the Building and Construction Authority of Singapore (BCA) and NovA! will connect the NovA! platform with BCA's SLEB platform. Through this collaboration, country-wide data for commercial, industrial and residential buildings will be unlocked and this serves to further accelerate green financing opportunities in the real estate sector. This collaboration also extends the coverage of NovA! where it will be able to support a wider array of buildings, stakeholders and financial products for banks.

The insights and data sourced from the SLEB platform, Greenprint and other sources will be processed by NovA! to generate a more comprehensive set of sustainability benchmark insights and analytics including asset to entity level mapping of buildings, tenant to building mapping (supporting Scope 3 emissions calculations of building owners), return-on-investment for green initiatives and uptake of sustainable building technologies (for green loans).

In the coming months we will host a workshop that brings together building owners and banks to share the latest developments on the SLEB x NovA! collaboration. During this workshop, URA will give an update on the launch of the Jurong Lake District tender and share how NovA! can be utilised to obtain sustainable financing.

Further, for the upcoming Singapore Fintech Festival 2023, we will showcase how the SLEB x NovA! collaboration can enable access to SLL financing for an energy in-efficient building. We will do this through a live demonstration by bringing together a bank and a borrower. NovA! will illustrate how multiple energy inefficient buildings that require sustainable financing can be matched with selected banks that demonstrate the use of NovA! in availing sustainable financing in the form of an SLL or a green loan.

Industry Study

In addition to seeking opportunities to broaden the MVP's scope, we will actively explore opportunities for NovA! to drive sustainability beyond the real estate sector. To do this, we will conduct an industry study, focused on identifying sustainability-related use cases that will drive business value for Financial Institutions. Based on our research and discussions with financial institutions we have shortlisted 2 use cases, Climate Risk Assessment and SME Financing. To ensure the feasibility of these use cases, we will test data accessibility and assess technical feasibility. Additionally, we will evaluate the commercialisation model and test market demand for these initiatives. As we develop and refine the selected use cases our goal is for NovA! to emerge as a global utility platform that integrates AI and sustainability, to empower financial institutions with capabilities that enable them to drive widespread adoption of sustainable practices.

Next Steps

As we successfully establish and grow NovA!, we will then explore opportunities to further incentivise market participants through policy levers that will help NovA! scale in Singapore. NovA! offers Singapore an opportunity to develop a decarbonisation blueprint that leverages effective policies, collaboration among businesses, FIs and investors, and technology powered by AI and data intelligence to accelerate the transition to a net zero world. This NovA! decarbonisation blueprint can then be cascaded to other countries, creating an impact on a global scale.

We are keen to collaborate with governments, financial institutions, sustainability experts and innovative technology companies who have similar objectives and invite interested parties to reach out at danielle_jiang@mas.com.sg.

5 Appendices

Appendix A: Acronyms and Abbreviations

ADIE	Autonomous Documentation Insights Engine
AI	Artificial Intelligence
APAC	Asia Pacific
API	Application Programming Interface
ARIMA	AutoRegressive Integrated Moving Average
BCA	Building and Construction Authority
BERT	Bidirectional Encoder Representations from Transformers
CAGR	Compounded Annual Growth Rate
CO ₂	Carbon Dioxide
DBS	Development Bank of Singapore
EMA	Energy Market Authority
EPA	United States Environmental Protection Agency
ESG	Environmental, Social, and Governance
FI	Financial Institution
GFA	Gross Floor Area
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse Gases
HSBC	Hongkong & Shanghai Banking Corporation Limited
JLL	Jones Lang LaSalle
KPI	Key Performance Indicator
KYC	Know Your Customer
LSTA	Loan Syndications and Trading Association
MAS	Monetary Authority of Singapore
ML	Machine Learning
MSCI	Morgan Stanley Capital International
MUFG	Mitsubishi UFJ Financial Group
MVP	Minimum Viable Product
NLP	Natural Language Processing
NRIC	National Registration Identity Card
NUS	National University of Singapore
OCBC	Oversea-Chinese Banking Corporation
PCAF	Partnership for Carbon Accounting Financials
PUB	Public Utilities Board
PwC	PriceWaterhouseCoopers
RM	Relationship Manager
RoBERTa	Robustly Optimised BERT Pretraining Approach
SDG	Sustainable Development Goals
SEC	Securities and Exchange Commission
SGX	Singapore Exchange
SLEB	Super Low Energy Building
SLL	Sustainability-Linked Loan
SLLP	Sustainability-Linked Loan Principles
SMBC	Sumitomo Mitsui Banking Corporation
SME	Small and Medium Enterprise

SNDGO	Smart Nation and Digital Government Office
SPD	Shanghai Pudong Development Bank
SPO	Second Party Opinion
SPT	Sustainability Performance Target
TCFD	Task Force on Climate-related Financial Disclosures
TCS	Trusted Centre for Sensors Data
UEN	Unique Entity Number
UOB	United Overseas Bank
USD	United States Dollar