WEST COAST GREEN HYDROGEN MASTER PLAN

Summary for Policymakers

PHASE 1

FREEPORT SALDANHA INDUSTRIAL DEVELOPMENT ZONE

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WEST COAST GREEN HYDROGEN MASTER PLAN
PHASE 1

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A Summary for Policymakers (SPM) is a concise synthesis of the key findings which emerge from sophisticated science-policy processes. SPMs are used to communicate and disseminate the current state of knowledge, based on the best available evidence, in an accessible style and language. While the primary target audience of an SPM is traditionally '*policymakers*', in other words, those with a mandate to effect policy change, the contents of this SPM have been made available to a wider audience of '*decisionmakers*', in other words, those with a stake or interest in the development of a nascent green hydrogen (GH_2) and Power-to-X (PtX) economy on the West Coast of South Africa.

The West Coast region of South Africa, anchored by Saldanha Bay, could become a strategic hub in the realisation of such an economy. Strong renewable resources, existing industrial and port infrastructure, and Special Economic Zone (SEZ) incentives position the Saldanha Hydrogen Hub to drive decarbonisation, green export development, and regional economic growth, an opportunity already recognised through global initiatives such as the World Economic Forum's Transitioning Industrial Clusters Programme.

In the short term, the Saldanha Hydrogen Hub could leverage competitive renewable resources to produce green Direct Reduced Iron (DRI) and green ammonia for maritime bunkering and fertiliser markets. Over the medium term, technology readiness and market maturation are expected to unlock further PtX opportunities including green methanol, Sustainable Aviation Fuels (SAF), domestic mobility applications, and green cement among them. Realising these opportunities will require major new technology, infrastructure, and investment. Over and above current renewable energy roll out trends, extensive deployment of additional wind and solar generation, large-scale seawater desalination, port and terminal upgrades, new storage and bunkering facilities, electrolyser installations, and significantly expanded linear infrastructure such as roads, pipelines, and transmission lines, would be required. Given the potential speed and scale of development in the region, proactive and integrated planning is essential to mitigate risk and prevent unintended consequences while attracting high quality projects and funders.

The Master Plan for the Saldanha Hydrogen Hub and broader West Coast regions consists of a multi-year, multi-disciplinary research collaboration between Provincial Government Western Cape, Freeport Saldanha and the Council for Scientific and Industrial Research (CSIR). Phase 1 of the Master Plan (2023-2025) applied a multi-method approach combining stakeholder engagement, literature reviews, Geographic Information Systems (GIS) modelling, and technical assessments. Three disciplinary assessments were undertaken for Phase 1: *Social and Ecological Sustainability*; *Infrastructure and Land-use Planning*; and *Transportation*. The study area was assessed at two spatial scales: the port and SEZ (fine scale) and the broader West Coast region (coarser scale). Future work to be completed in Phase 2 (2026-2028) of the Master Plan is identified in Table SPM2.

To evaluate potential futures, Phase 1 of Master Plan adopted an explorative scenarios approach spanning a 25-year horizon. The approach examined multiple plausible futures under differing levels of GH_2/PtX ambition, as well as socio-political and market contexts. The methodology combined a top-down assessment, drawing on national GH_2/PtX policy targets, market trends, and literature, with a bottom-up calibration grounded in five mature project proposals around Saldanha Bay. Scenario 0 ("Dirt Track") assumed no GH_2/PtX development in the region, while existing regional trends continue. Scenario 1 ("Provincial Road") represents moderate-growth pathway reaching 0.51 mtpa GH_2-equivalent (requiring 10 GW renewable energy input). Scenario 2 ("National Highway") reflects a higher-ambition future achieving 1.52 mtpa GH_2-equivalent (requiring 30 GW renewable energy input), supported by integrated infrastructure and strong export capacity. Infrastructure quantifications and surface area footprints were calculated for each of the two development scenarios (Table SPM1). A notional representation (not to scale) what the region might look like under the two GH_2/PtX infrastructure scenarios is depicted in Figure SPM1.

Table SPM1: Scenario infrastructure and resource input/output quantifications for the Provincial Road and National Highway.

Key Aspect	Unit	Provincial Road	National Highway
GH_2–equivalent volume	mtpa	0.51	1.52
Electrolyser capacity[1]	GW	5	15
Seawater desalination volume (GH_2 production)[2]	Ml/day	36	109
Seawater desalination volume (+oversizing)[3]	Ml/day	40	125
Water surplus for local users[4]	Ml/day	4	16
Renewable energy capacity total[5]	GW	10	30
Renewable energy physical footprint[6]	ha	17 340	51 680

<u>Assumptions</u>

[1] 10 GW electrolyser = 1 mpta GH_2.

[2] 25 kg water per 1 kg GH_2 (considering electrolysis and cooling). 1Mtpa GH_2 output required 25 Mtpa (=25000 MLpa) water / 350 days. (350 days per year operational, to allow some maintenance time and/or shut down of intake due to unsuitable intake water quality).

[3] Desalination facilities oversized by 10% (Provincial Road) and 15 % (National Highway).

[4] Assume surplus water from oversized desalination facilities is made available for other water users such as local municipalities, agriculture, other industrial users.

[5] 1 mtpa of GH_2 needs 10 GW electrolyser, that is powered by 20 GW of renewable energy.

[6] Energy mix: 70 % solar-30% wind; footprint requirement: 0.5 MW/ha solar; 1MW/ha wind.

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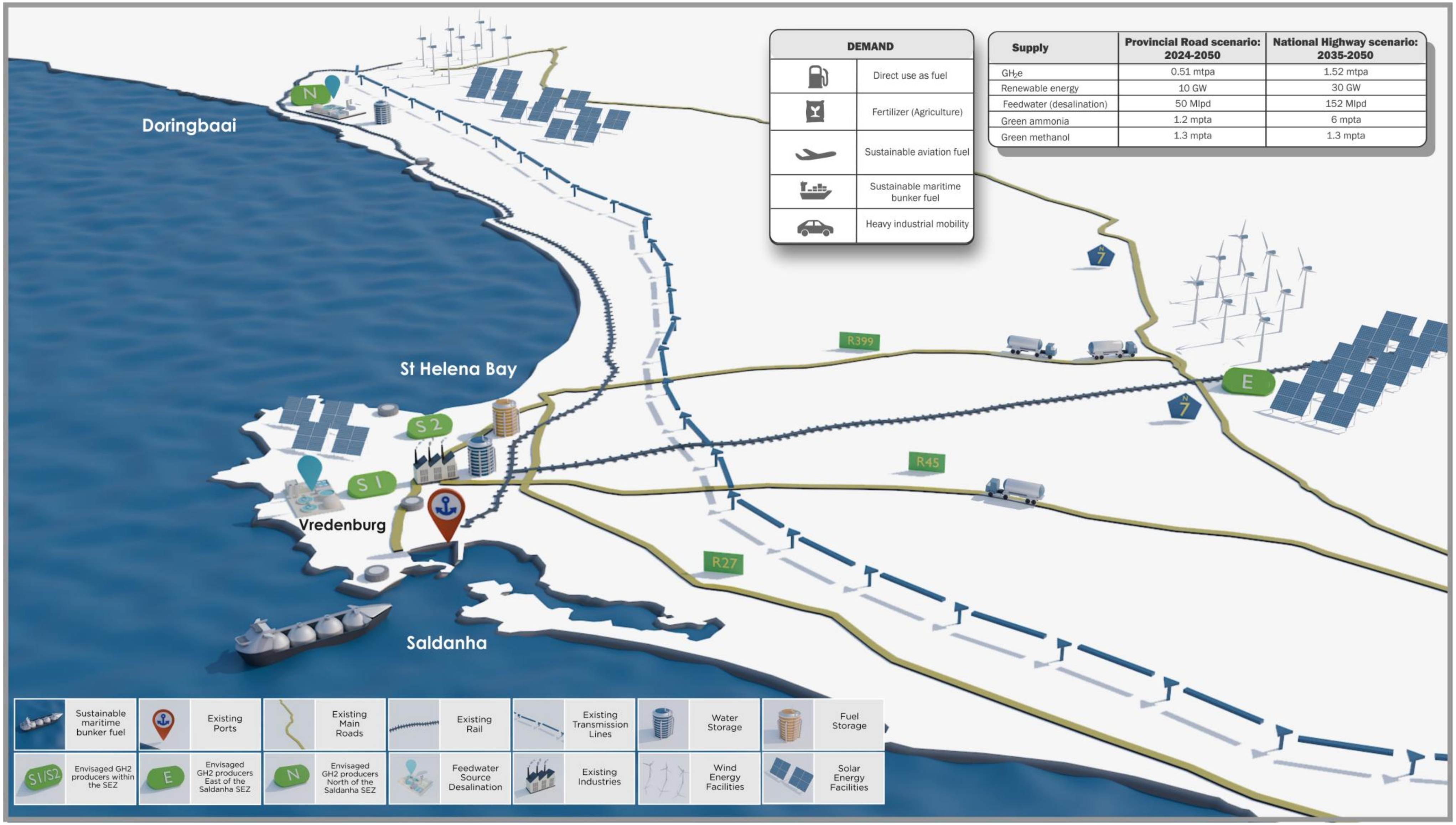


Figure SPM1: Schematic notionally illustrating what the West Coast region might look like assuming the manifestation of the Provincial Road and National Highway scenarios.

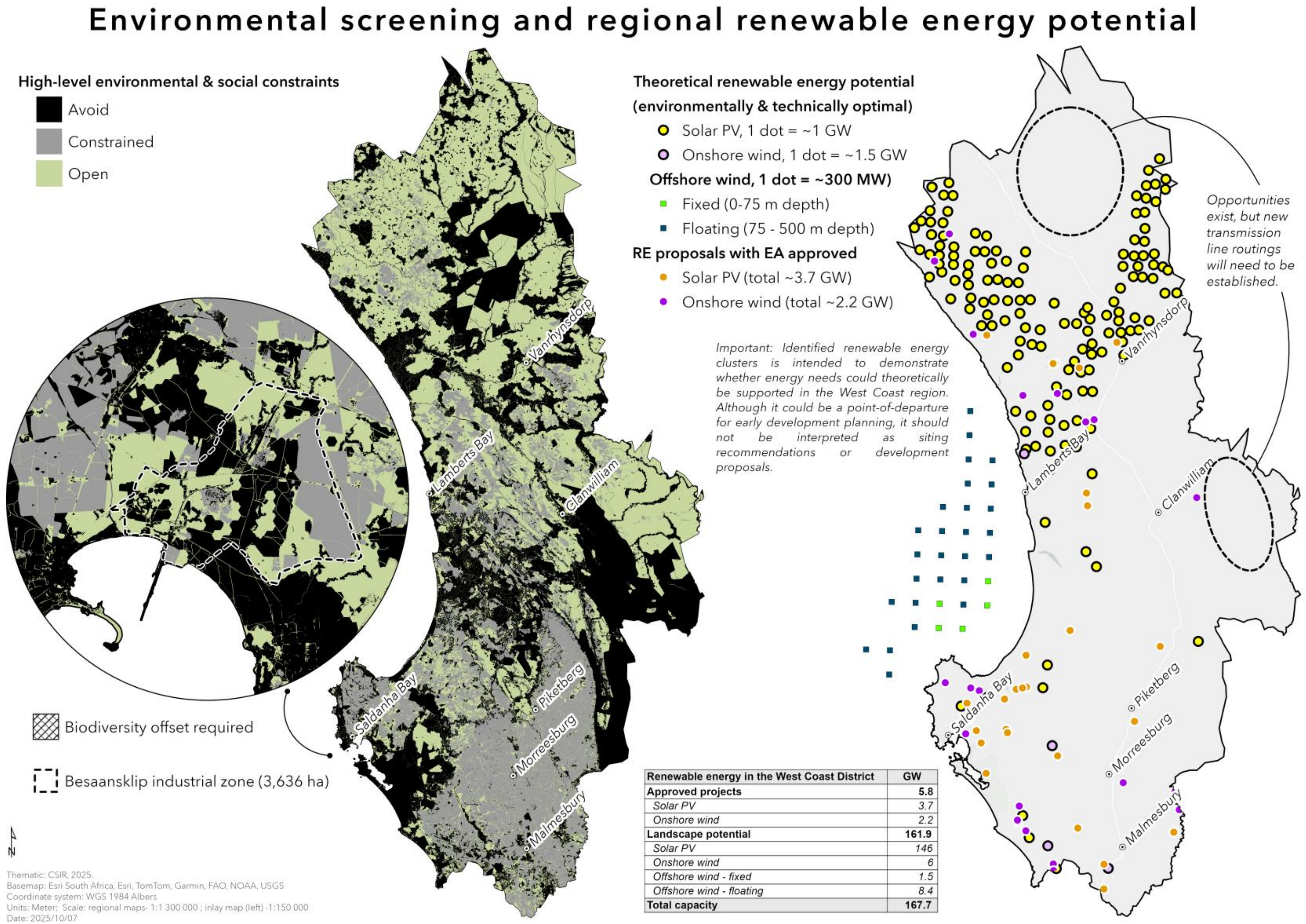
A cross-disciplinary Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis was undertaken across the three assessments. Strengths (internal) and opportunities (external) include good renewable energy resource potential, strong municipal planning capacity, and existing infrastructure like a deep-water port, mothballed steel plant and iron ore railway line in immediate proximity of a functional, incentivized SEZ. There also exist several regional projects planned well into maturity which have already received Environmental Authorisation (EA) and are ready to be constructed, such as several wind and solar PV projects (which could supply 5.8 GW electricity), and a bulk seawater desalination plant planned for construction near Saldanha Bay. It is likely that any desalination plant designed to meet GH_2/PtX electrolysis needs would be oversized, potentially in the region of 10-15%, so that excess water could be made available for local community needs.

Opportunities include the rising global demand for green fuels, and the development of new socio-economic pathways. These could attract foreign direct investment and public-private partnerships to accelerate infrastructure rollout. A continued decarbonisation of industry and transport through low-carbon product manufacturing, hydrogen refuelling infrastructure, and emission reductions in hard-to-abate sectors (e.g., steel, chemicals, aviation, and shipping) could further accelerate these opportunities.

At the same time, the proposed Hydrogen Hub, and wider region, faces important weaknesses and threats which need to be addressed through proactive planning. Weaknesses (internal) include severe grid constraints, increasing pressure on road infrastructure, regulatory, safety and permitting uncertainties, and limited land availability within the SEZ. Within the Besaansklip Industrial Area (BIA) (~6 400 ha), ~14% has already been developed. A further

23% falls into areas where no biodiversity offset is required, while 22% of the BIA is considered “not developable”. The largest share, 39%, consists of land where biodiversity offsets would be needed to enable development. The Freeport Area, which represents 5.7% of the total BIA footprint, shows a similar distribution: 11% is already developed, 37% requires no offsets, and 52% would require offsets for future development. Development is constrained by sensitive ecological, social and agricultural landscapes. Even so, GIS modelling reveals that the region, theoretically, could supply as much as 168 GW to the Saldanha Hydrogen Hub, more than sufficient to meet GH_2/PtX production needs at the scales envisaged in the scenarios (Figure SPM2).

High wheeling tariffs, fragmented transmission expansion planning and implementation, and cumulative ecological pressures from regional development trends pose constraints. As do other external threats such as competition from other international, regional and national industrial clusters, the non-materialisation of global demand, investment uncertainties, socio-economic challenges such as land-ownership complexities, and the potential for project opposition by highly mobilized, highly competent community organisations. Collectively, the SWOT reveals a region with strong natural and infrastructural advantages, but also one facing some challenges which need to be carefully coordinated and planned for in a manner that produces long-term, win-win outcomes across a diversity of stakeholders. Immediate priority actions (0-5 years) to address these SWOT issues, and initiate GH_2/PtX development in the region are presented in Table SPM2.



Renewable energy in the West Coast District	GW
Approved projects	**5.8**
Solar PV	*3.7*
Onshore wind	*2.2*
Landscape potential	**161.9**
Solar PV	*146*
Onshore wind	*6*
Offshore wind - fixed	*1.5*
Offshore wind - floating	*8.4*
Total capacity	**167.7**

Figure SPM2: Environmental, agricultural and social features that may constrain new energy development in the West Coast region (left). Solar PV, onshore wind and offshore wind renewable energy potential of the West Coast region which could, theorectically, produce around 168 GW (right).

Table SPM2: Leading SWOT issues with correlating priority actions (0-5 years), responsible parties and the envisaged outcomes necessary to support the phased development of the Saldanha Hydrogen Hub and broader West Coast region.

	SWOT issue	Priority action (0-5 years)	Responsible party	Outcome	Included in Phase 2 Scope
1	Understanding and managing cumulative ecological, resource and social impacts	Ensure that Phase 2 of the Master Plan includes cumulative socio-ecological impact assessments and Life Cycle Assessments.	Freeport Saldanha	Integrative systems models that facilitate sustainable and compliant hub development and inform trade-offs and decision-making on thresholds and sustainable resource use.	✓
2	Limited land available within the SEZ to accommodate GH_2/PtX development.	Investigate multi-nodal SEZ planning, enabling expansion of hydrogen-linked industrial activities beyond the current SEZ boundaries.	Freeport Saldanha	Identification of one or more feasible candidate land parcels for SEZ node designation for the location of an (at least) ammonia tank farm (suitably far from human settlements) linked by pipeline to the port berth, and subsequent SEZ designation feasibility analysis for each such parcel.	✓
3	The BIA remains very environmentally sensitive that restrict development or require offsets. A non-development conservation corridor further divides the area.	Establish a land banking mechanism/action plan to strategically secure land for industrial development and offset receiving requirements. This should also include the identification and possible establishment of servitudes across the region to accommodate linear infrastructure such as pipelines and transmission lines.	Western Cape Government	Investment-ready sites, stronger investor confidence in "bankable" sites. Spatial readiness and reduced project permitting delays, while safeguarding the pathways for infrastructure across land. A detailed outlook on future distribution and transport needs, support the planning of infrastructure to meet expected inbound and outbound flows, and enable evidence-based decisions on shared versus dedicated transport assets.	✓
4	Developing efficient land-based transport of hydrogen and derivatives is critical to cost competitiveness.	Assess current and future hydrogen-related transport patterns, evaluate the performance and suitability of different hydrogen transport modes, and model lowest-cost supply chain options across key sectors. Develop analytical tools to compare transport modes and identify priority infrastructure corridors linking production hubs with demand centres.	Freeport Saldanha	A detailed outlook on future distribution and transport needs, support the planning of infrastructure to meet expected inbound and outbound flows, and enable evidence-based decisions on shared versus dedicated transport assets.	✓
5	Planning for opportunities in maritime shipping fuels, especially under Fuel EU	Following successful identification of an offsite ammonia tank farm (Issue 2 above), it will be necessary to determine the optimal routing for a pressurised ammonia pipeline (operating ≥5 °C and ≥5.2 bar	Freeport Saldanha	Planning for export infrastructure and ways for WC to realise the emerging opportunities in hard-to-abate sectors like maritime fuels and green steel.	✓

		absolute) between the offsite tank farm and the port berth, considering all engineering, environmental, and land-use constraints and the need for a dedicated servitude. Assess the feasibility of co-locating methanol and below-ground hydrogen storage at the same tank farm so that methanol and ammonia pipelines can share the servitude and operate as common-user infrastructure. At the berth, define suitable loading facilities for both ammonia and methanol, and evaluate the potential use of offshore bunker barges to refuel vessels and minimise berth congestion.			
6	Planning for opportunities in the green steel, aluminium, cements and fertilizer sectors especially under Fuel EU and Carbon Border Adjustment Mechanism (CBAM)	Assess the common-user infrastructure needed to safely store, handle, and transport Direct Reduced Iron (DRI). This includes ensuring a mandatory 24-hour passivation period in dedicated silos, developing loading systems that differ from iron-ore handling to prevent moisture contact and hydrogen generation, and providing safe skip-based transfer systems to move passivated DRI from storage silos to vessels.	Freeport Saldanha	Safe, compliant DRI export capability. Fit-for-purpose common-user infrastructure that supports green steel value chains and enables efficient, CBAM-aligned market access.	✕
7	Need for GH_2/PtX planning to inform national Transmission Development Plan prepared by National Transmission Company South Africa (NTCSA). Constrained grid capacity and fragmented grid proposals. Developers currently mostly pursuing grid connection on a project-by-project basis	Engage proactively with NTCSA and Eskom to integrate regional hydrogen demand into the National Transmission Development Plan (NTDP). Support scenario-based electrical flow modelling to test where grid upgrades or shared substations will be needed and identify possible transmission line corridors.	Freeport Saldanha	Grid-aligned GH_2 rollout Informed grid investment decisions; reduced future bottlenecks for hydrogen producers. Accelerated grid upgrades and new construction. Safe, compliant DRI export capability. Fit-for-purpose common-user infrastructure that supports green steel value chains and enables efficient, CBAM-aligned market access.	✓
8	Current planning frameworks don't consider, or plan for, GH_2/PtX ambitions and associated safety requirements	Establish a West Coast Hydrogen Coordination Taskforce linking WCG, Saldanha Bay IDZ, NTCSA, Transnet, NERSA, and private developers to align land, grid, and logistics decisions. Develop knowledge platforms ▪ Support Phase 2 scenario modelling that simulates hydrogen production, infrastructure capacity, and cost phasing to guide investment sequencing.	Western Cape Government	Coherent cross-sector coordination to speed up decisions on development applications. Grid-aligned GH_2 rollout Informed grid investment decisions; reduced future bottlenecks for hydrogen producers. Accelerated grid upgrades and new construction.	✓ The actions outlined will commence in Phase 2 and continue through Phase 3.

		▪ Build a dynamic provincial data portal for hydrogen-related spatial, environmental, and infrastructure data. This will support transparency and investor due diligence. ▪ Develop guidelines for planners (on MHI and safety distances to support land use planning)			
9	Town Planning – The need for an overarching entity to support planning for this sector.	Establishing an entity that can address the ongoing planning and technical issues emerging across various sectors. It is also critical for alignment across the region and across levels of government.	Western Cape Government	Established entity that deal with cross-sectoral issues. - with representation of all key institutions, entities and the ability to fastrack and prioritise decisions. (Possible linkage to Green Hydrogen Task force mentioned above)	✓
10	Misalignment between port planning timelines and timelines from developers requiring Port access	Draft port plans for the Port of Saldanha which feature GH_2/PtX infrastructure needs to avoid 'stranded assets' or delays in anticipated export target dates.	Transnet National Ports Authority	Port planning is aligned to the planning pathways of projects across the region to enable the operationalisation of GH_2/PtX production.	✕
11	Various Competent Authorities required for projects that need separate Environmental Authorisations, resulting in more onerous and differing permitting processes and requirements.	Engage with the National DFFE and Western Cape DEA&DP to discuss potentially having one Competent Authority for all the projects forming part of the Saldanha Hydrogen Hub. This is catered for under Section 24C(3) of NEMA.	Freeport Saldanha, Western Cape Government	A streamlined approach to the EA process by ensuring that all relevant projects are decided by one Competent Authority, which will ensure that the EAP is familiar with a consolidated set of CA requirements, and it will improve EAP efficiency overall.	✓
12	The establishment of the South African Wholesale Energy Market (SAWEM) will increase private sector participation in the energy sector. The implications for the development of the West Coast Green Hydrogen hub are unclear.	Undertake a targeted assessment of the SAWEM design and implementation timeline to determine its implications for electricity access, pricing mechanisms, and risk allocation for GH_2/PtX projects.	Freeport Saldanha, Western Cape Government	The SAWEM is likely to create a competitive, transparent, and flexible electricity market that helps enable the large-scale deployment of renewable energy required for green hydrogen production. Investigation on SAWEM would provide clarity and inform a range of stakeholders (including investors) on the options and opportunities available in the energy space, particularly those to form part of the GH_2/PtX development space.	✓

Table SPM2 reveals a need for coordinated long-term planning across land use, regulation, infrastructure, and socio-economic development. Sustainable land-use and infrastructure planning is essential to avoid fragmented development, protect critical biodiversity areas, and ensure efficient siting of energy and industrial facilities; this requires strategic land banking, multi-nodal SEZ design, and shared corridors for pipelines, storage, and transmission to improve flexibility and minimise cumulative impacts. Equally important is regulatory clarity and adaptive permitting, with harmonised guidance across environmental, energy, port, and municipal systems, streamlined approval pathways aligned with global best practice, and strengthened intergovernmental coordination to support timely infrastructure delivery.

Scenario-based planning tools are needed to model grid, transport, and water requirements. These should be supported by a dynamic infrastructure map that tracks electricity, feedstock, and PtX derivative flows to guide investment and prevent bottlenecks, while closely monitoring developments in the emerging Wholesale Energy Market. Advancing socio-economic readiness and a just transition will require early focus on employment and skills development, conservation-linked economic opportunities, community engagement, benefit-sharing mechanisms, and the protection of ecological assets to ensure equitable and sustainable outcomes from green hydrogen development on the West Coast.

Phase 2 (2026-2028) will shift the Master Plan from high-level strategic framing to full implementation readiness through four interconnected workstreams. First, a comprehensive cumulative impact assessment and life-cycle planning framework is required to quantify the combined footprints of energy, water, storage, and transport systems, define sustainability thresholds, and guide trade-offs between cost-optimal and environmentally optimal development pathways. Second, provincial and municipal planning instruments, such as Municipal Spatial Development Frameworks (MSDFs), Integrated Development Plans (IDPs), and zoning overlays, must be aligned with the infrastructure needs of the emerging GH_2/PtX economy, supported by actions to consolidate strategic land and assess options for multi-nodal SEZ expansion. Third, regulatory clarity and governance structures must be strengthened by diagnosing approval bottlenecks, establishing adaptive permitting pathways, and creating coordination mechanisms to oversee infrastructure delivery and common-user investments. Fourth, Phase 2 should advance scenario-based infrastructure modelling, including simulation tools for electricity, water, transport, storage, and port-capacity planning, underpinned by a dynamic map tracking supply chains for green steel, ammonia, methanol, and other PtX products.