REVISED STAP SCREENING TEMPLATE, OCTOBER 2022

GEF ID	**11271**
Project title	**Green hydrogen energy integrated demonstration application project in China**
Date of screen	**14 June 2023**
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1. Summary of STAP's views of the project

This project aims to catalyze green hydrogen production and application to decarbonize and support the energy transition in hard-to-abate sectors in three regions in China. The proposal seeks to build on past GEF investment supporting China in the green hydrogen sector.

While the project has good merit because it can help catalyze and scale up an emerging energy technology that can lead to significant GEBs, the project document in its current form requires substantial improvement before the project can proceed. Some issues with the proposal include:

- Lack of system-based analysis of the issues and consideration of how drivers can affect the project.
- Lack of clarity on the project's niche, given some of China's recent advancements in green hydrogen.
- Lack of adequate analysis of benefits and trade-off of diverting renewable energy from other uses to green hydrogen
- Need to improve the theory of change and provide more information on project components.
- Need to provide clarity on the estimation of expected GEBs.

The project proponents also need to reflect on possible scenarios related to changes in the price of renewables, demand and markets for renewables, and investor interest in green hydrogen over other renewable energy sources. STAP has provided specific recommendations on how to improve the proposal.

STAP's assessment*

Concur - STAP acknowledges that the concept has scientific and technical merit.

✓ **Minor - STAP has identified some scientific and technical points to be addressed in project design**

Major - STAP has identified significant concerns to be addressed in project design

Please contact the STAP Secretariat if you would like to discuss.

2. Project rationale, and project description – are they sound?

- The proposal focuses on demonstrating green hydrogen production and utilization in three regions in China. While the project has good merit because it can help catalyze and possibly scale up an emerging energy technology, the project document in its current form is poorly prepared. Great effort went into telling (with repetition across the proposal) the story of green hydrogen in China, including past GEF investments (which GEF evaluations seem to have concerns about their success – as noted on p18 of the PIF). But little was done to analyze the issues from a systems perspective or discuss the drivers of change that could influence project success.

- Further to the above, while the proposal discussed some barriers, it fails to address the underlying drivers influencing green hydrogen outside of the project influence, which could determine how the future could unfold. Drivers and challenges such as the price of renewable energy, growth of industries, new technologies, change in political priorities, the Chinese economy, sociocultural acceptance among critical actors, etc., will influence how green hydrogen technology plays out in the future (e.g., Hoyland et al., 2023; Eljack and Kazi, 2021; IEA, 2022, PWC, and Kane and Gil, 2022) and need to be considered in project design.

Hence, the project needs to consider some plausible narratives of how these drivers may unfold as part of the baseline scenario and test proposed interventions against these futures to ensure the interventions will work (i.e., are robust to future changes).

- It is good that the proposal will build on previous GEF projects on hydrogen technology in China and is incorporating lessons from these projects. The proposal noted on p18 that issues were raised during the GEF evaluation of these projects but did not provide details of these issues, their relevance to this project, or how the concerns will be prevented, if relevant. Further on lessons that could apply to this project, China is already building significant capacity on green hydrogen, including over 120 green projects underway[1] and the world's largest green hydrogen project by Sinopec;[2] what lessons can be learned from these efforts that can benefit this project? How will this project connect with these efforts? And what is the niche and added benefits of GEF investments? (The PIF indicates that the project will be the first to apply green hydrogen in hard to abate coal chemical industry. However, Sinopec's green hydrogen project will already use green hydrogen for making chemicals from coal, so this project will not be the first).[3]

- While supporting the scaling of green hydrogen could be essential in the fight against climate change, the proposal seems not to consider other relevant factors to justify the project. For example, the proposal narrowly focuses on comparing green and grey hydrogen but not the cost-benefit (or opportunity cost) of whether renewable energy will be diverted from other needs to green hydrogen. For example, the proposal indicated that Dalian (one of the project demonstration regions) has 58.6% non-fossil fuel power capacity (16.6% of this being renewable and the rest nuclear). Hence, 41.4% of its energy is fossil fuel-based. Would the project divert the limited renewable energy in this region to green hydrogen? Would it build new renewable capacities? These details were not clear in the proposal. Even if new renewables are installed for this project, what are the benefits and trade-offs of diverting new renewable energy from other uses to green hydrogen? As the proposal is further developed, these questions and others need to be asked.

- It will be good to review the proposal to ensure accuracy as some sections of the PIF need clarification; for example, p13 indicated that Liaoning province will install 30 million kW by 2025, and among the newly installed, renewable will be 16 million kW. This is unclear. Is there part of the new installations that would not be renewable?

- The proponent needs to clarify if the green hydrogen demonstration component of the project will be mainly research or demonstration of technological solutions already available. The table on barriers and solutions (p11-12) seems to suggest that the proposal will focus on "developing" innovative technologies working with national and international research institutions.

- The project is aligned with current government policy and emission reduction targets and intends to address imperfect policies and regulatory frameworks to support the green hydrogen economy. The proposal, however, falls short of discussing the imperfections, gaps, or what needs to be improved in current policies and regulations. Also, policy and regulatory interventions should go beyond addressing gaps to address any incoherencies across the energy sector and any form of antagonistic policies or laws in other economic sectors that can hinder the project objective –ensuring policy coherence. Doing this may help accelerate the decline in the cost of green hydrogen production. There is a need to benchmark the current production cost of all energy sources in the targeted sectors to enable transparent monitoring of the competitiveness of green hydrogen compared to other energy sources.

[1] https://merics.org/en/report/chinas-nascent-green-hydrogen-sector-how-policy-research-and-business-are-forging-new
[2] See: https://cen.acs.org/energy/renewables/Chinas-Sinopec-marches-green-hydrogen/101/web/2023/03; https://www.reuters.com/business/sustainable-business/sinopec-build-china-west-to-east-green-hydrogen-transmission-pipeline-xinhua-2023-04-10/; https://www.rechargenews.com/energy-transition/inside-china-s-260mw-behemoth-how-green-is-the-worlds-biggest-green-hydrogen-project-/2-1-1229052
[3] https://cen.acs.org/energy/renewables/Chinas-Sinopec-marches-green-hydrogen/101/web/2023/03

- A theory of change showing the planned activities, outputs, outcomes, and impact was provided. It also includes two underlying assumptions related to implementing central and local government policies on green hydrogen and the share of green hydrogen in China's energy profile increasing to 10% by 2050. However, the theory of change is deficient as follows:
  - The two assumptions are insufficient. There should be assumptions underlying the different pathways to the project impact. For example, what is the assumption or basis for expecting that establishing a business model will reduce GHG emissions? Or that building capacity leads to an improved enabling environment?
  - The assumptions need to acknowledge the uncertainties associated with green hydrogen technology, including technical, economic, and sociocultural acceptance among key actors. Hence, the assumptions must be strengthened to acknowledge these challenges and include measures to address them.
  - Doing the above will help strengthen the causal pathway and the logical chain.
  - While the solutions indicated in the barriers/solutions table (p11-12) suggest that the project will involve research, the theory of change does not reflect this and seem to suggest that green hydrogen solution are already mature, and the project would demonstrate this.
  - The current "impact" in the theory of change is phrased as an assumption between the outcomes and impact. The impact box should only contain the expected overarching impact of the project, and the assumption should be between the outcomes and impact.
  - Consider splitting outcomes into intermediate and long-term outcomes; that way improved enabling environment will not be at the same level as some of the outcomes because it is the enabling environment that leads to them, e.g., GHG emissions reduction.
  - The co-benefits should acknowledge other possible ones (the paragraph on SDGs on p25 can serve as a guide).

- The proposal provides some details of the project components but could also be improved:
  - Outcome 1.1: add some narratives on what the key outputs are supposed to achieve. Currently just a long list of outputs. Provided narrative to understand the causal pathway.
  - Clarify what energy source will be used for demonstration in Ningdong. This information was provided for Dalian and Shenyang.
  - Provide narratives for Outcome 2.2 on green hydrogen production, storage, and fuel cell application to understand what will be done. Storage was raised as an important issue pertinent to green hydrogen, so it would be helpful to provide information on what the project intends to do about it.
  - Component 4. Who is the targeted audience for social media activities? Provide some information on the logic.
  - Be explicit on actions to promote and foster the acceptance of green hydrogen as an energy source among key actors and stakeholders.

- The proposal noted key strategies to help promote green hydrogen with central and local governments, including government offering financial incentives (e.g., subsidies, tax credits), government investing in infrastructure, and government requiring a certain percentage of fuel be derived from green hydrogen. It is, however, unclear if these are strategies the government has already agreed to implement (or is already implementing) or if this will be part of the policy interventions of the project.

- The main GEBs from the project is GHG emission reduction linked to the switch from grey to green hydrogen. The proposal also identified local environmental and socioeconomic co-benefits, including air pollution reduction, improved health, enhanced resilience, improved energy access, etc. However, the calculation of the GEB is unclear:
  - What is the basis for the assumption that "the synergy of the project will increase the share of green hydrogen in industry and transport to 2%"? (p32)
  - How was the 17 million tCO2 in 5 years estimated? What were the assumptions?

- The indirect GHG reduction of 130 million tCO2 was based on the 2% share for green hydrogen in industry and transport. But 1% of this already exists (first two sentences on p32); hence the project will only be responsible for 1%. Thus, only 1% can be attributed to the project. Please clarify.
- Provide the basis (and assumptions, if applicable) for the methodology used in calculating the number of people benefiting.

- Some of the risks identified in the risk table (e.g., change in government priorities and economic risks) are risks to the durability of GEBs and ought to be dealt with in the fundamental design of the response to the problem by the project rather than in a post hoc risk assessment about implementation. This further emphasizes the need for developing a simple narrative of the future.

3. Specific points to be addressed, and suggestions

This proposal requires significant revision and improvements in line with STAP's recommendations below. (see Section 2 above for the basis for the recommendations.

1. The summary is supposed to capture the whole essence of the project. Currently, it does not include information on the specific components and activities through which the objectives will be achieved. Kindly add that.
2. Analyze the issues from a systems perspective or consider the drivers of change that could influence project success based on the expectations of the new GEF PIF template. See GEF PIF training and associated materials for guidance.
3. Develop a narrative of plausible futures that considers the potential effects drivers of change and their associated uncertainties on achieving the project's goal and use this to inform intervention options. See STAP's primer on future narratives for more guidance.
4. Consider past projects and other ongoing efforts on green hydrogen in China in further developing the project, ensuring to incorporate lessons, reflecting on how to connect with these efforts, and ensuring there is a niche for, and added benefits from, GEF's investments.
5. Undertake an analysis of the benefits and trade-offs of diverting renewable energy from other uses to green hydrogen?
6. Review the proposal for the accuracy of the information provided.
7. Clarify if demonstration activities would be research or the implementation of tested and tried green hydrogen solutions.
8. Provide information on policies and regulatory imperfections, gaps, or needed improvements, and undertake a policy coherence analysis to understand where conflicting policies can hinder the achievement of the expected outcomes and ensure these are addressed appropriately. See STAP's paper on policy coherence for more guidance.
9. Address issues raised in Section 2 regarding the theory of change.
10. Address issues raised in Section 2 regarding the project components.
11. Provide information on the basis and assumptions for the GEB estimates and recalculate the GEBs if appropriate.
12. Put provisions to track, measure and report these and the socioeconomic co-benefits in place. Please see STAP's recent paper on incorporating co-benefits in GEF's investments for guidance.

*categories under review, subject to future revision

ANNEX: STAP'S SCREENING GUIDELINES

1. How well does the proposal explain the problem and issues to be addressed in the context of the **system** within which the problem sits and its drivers (e.g., population growth, economic development, climate change, sociocultural and political factors, and technological changes), including how the various components of the system interact?

2. Does the project indicate how **uncertain futures** could unfold (e.g. using simple **narratives)**, based on an understanding of the trends and interactions between the key elements of the system and its drivers?

3. Does the project describe the **baseline** problem and how it may evolve in the future in the absence of the project; and then identify the outcomes that the project seeks to achieve, how these outcomes will change the baseline, and what the key **barriers** and **enablers** are to achieving those outcomes?

4. Are the project's **objectives** well formulated and justified in relation to this system context? Is there a convincing explanation as to **why this particular project** has been selected in preference to other options, in the light of how the future may unfold?

5. How well does the **theory of change** provide an "explicit account of how and why the proposed interventions would achieve their intended outcomes and goal, based on outlining a set of key causal pathways arising from the activities and outputs of the interventions and the assumptions underlying these causal connections".

   - Does the project logic show how the project would ensure that expected outcomes are **enduring** and resilient to possible future changes identified in question 2 above, and to the effects of any conflicting policies (see question 9 below).
   - Is the theory of change grounded on a solid scientific foundation, and is it aligned with current scientific knowledge?
   - Does it explicitly consider how any necessary **institutional and behavioral** changes are to be achieved?
   - Does the theory of change diagram convincingly show the overall project logic, including causal pathways and outcomes?

6. Are the project **components** (interventions and activities) identified in the theory of change each described in sufficient detail to discern the main thrust and basis (including scientific) of the proposed solutions, how they address the problem, their justification as a robust solution, and the critical assumptions and risks to achieving them?

7. How likely is the project to generate global environmental benefits which would not have accrued without the GEF project (**additionality**)?

8. Does the project convincingly identify the relevant **stakeholders**, and their anticipated roles and responsibilities? is there an adequate explanation of how stakeholders will contribute to

the development and implementation of the project, and how they will benefit from the project to ensure enduring global environmental benefits, e.g. through co-benefits?

9. Does the description adequately explain:

   - how the project will build on prior investments and complement current investments, both GEF and non-GEF,
   - how the project incorporates **lessons learned** from previous projects in the country and region, and more widely from projects addressing similar issues elsewhere; and
   - how country policies that are contradictory to the intended outcomes of the project (identified in section C) will be addressed (**policy coherence**)?

10. How adequate is the project's approach to generating, managing and exchanging **knowledge**, and how will lessons learned be captured for adaptive management and for the benefit of future projects?

11. Innovation and transformation:

   - If the project is intended to be **innovative:** to what degree is it innovative, how will this ambition be achieved, how will barriers and enablers be addressed, and how might scaling be achieved?
   - If the project is intended to be **transformative:** how well do the project's objectives contribute to transformative change, and are they sufficient to contribute to enduring, transformational change at a sufficient scale to deliver a step improvement in one or more GEBs? Is the proposed logic to achieve the goal credible, addressing necessary changes in institutions, social or cultural norms? Are barriers and enablers to scaling be addressed? And how will enduring scaling be achieved?

12. Have **risks** to the project design and implementation been identified appropriately in the risk table in section B, and have suitable mitigation measures been incorporated? (NB: risks to the durability of project outcomes from future changes in drivers should have been reflected in the theory of change and in project design, not in this table.)