Project Title: Hydrogen Economy Pilot in China

Project Number: *00096939*

Implementing Partner: China International Center for Economic and Technical Exchanges

Start Date: August 2016 **End Date:** July 2020 **PAC Meeting date:** May 2016

Brief Description

This project aims to demonstrate the application of hydrogen production and technology in the field of manufacturing and consumer, and build the first "Hydrogen City" to demonstrate the hydrogen economy, with the goal of promoting the sustainable development of China and mitigate the adverse impacts of climate change. The strategy will consist of component covering the areas of (1) Development Hydrogen Economy Development Roadmap in Rugao; (2 demonstration of feasibility of hydrogen production, including generation of hydrogen through renewable energy, industry recycling and reusing, improving production methods and developing related technical standards; (3)demonstration of hydrogen energy storage and refilling, including new hydrogen storage and transporting technology and new hydrogen refilling station built; (4) demonstration of the application of hydrogen energy in the field of transportation and domestic uses, and development of related technical standards; (5) Hydrogen Policy framework and carbon emission trading potential explored based on the hydrogen economy, including the carbon emission reduction methodology development in the area of industry by-product, transportation and home-used distributed heat and electricity generation; (6) Increasing the awareness and knowledge among general public and key stakeholders about hydrogen.

Contributing Outcome (UNDAF/CPD, RPD or GPD):

Outcome 2: More People enjoy a cleaner, healthier and safer environment as a result of improved environmental protection and sustainable green growth.

Indicative Output(s): *Output 2.1: China's actions on climate change mitigation, biodiversity and chemicals across sectors are scale up, funded and implemented.*

Total resources required:	USD 10 Million	
Total resources allocated:		
	UNDP TRAC:	
	Donor:	
	Government:	USD 10 Million
	In-Kind:	
Unfunded:		

Agreed by (signatures)[1]:

Government	UNDP	Implementing Partner
Print Name:	Print Name:	Print Name:
Date:	Date:	Date: 2016.7.28

[1] Note: Adjust signatures as needed

I. DEVELOPMENT CHALLENGE

China is an emerging country experiencing unprecedented economic boost in the last two decades in particular. With a population of 1.35 billion, China recently became the second largest economy in the world and is playing an increasingly influential role in the global economy (WB, 2012). With rapid industrialization, urbanization and growth since the 1990s, China has become the world's largest producer and consumer of energy, and the largest emitter of greenhouse gases (GHGs) (FCV Issue Brief).

However, rapid economic ascendance has brought many challenges, in particular to China's energy industry. In an environment of a rapidly expanding economy, the energy industry is confronted with dual pressures from fast economic development and environmental and ecosystem degradation. Among other things, there exists a big and further enlarging gap between energy supply and demand. Forecasts indicate that China's oil consumption will grow substantially over the next 20 years, from roughly 6 million barrels per day in 2013 to 13 million in 2035. This will make China as the world's largest oil importer. By 2035, 75 percent of the oil China consumes will be imported.

Another challenge is that China's energy supply structure is largely depending on mineral oil and coal, with coal consumption amounting to 60% of total energy consumption. As a consequence of fast increasing mineral energy consumption, large quantities of pollutants and greenhouse gases are emitted, resulting in serious air pollution and climate change.

China is taking actions to address this. In the China-USA joint announcement on climate change in November 2014, China pledged to reach its emissions peak around 2030. As the world's largest investor in clean energy technologies, China also set a target for non-fossil fuels consumption to account for 15 percent of primary energy consumption by 2020 and 20 percent by 2030. The need for using alternative energy to substitute non-renewable energy in China hence becomes increasingly urgent and paramount.

Hydrogen: A way out for China's energy Demand

As the most abundant element in the universe, hydrogen is a colourless, odourless, tasteless, non-toxic and highly combustible gas. Its density is only 1/14 of air density which results in its fast diffusion and higher combustion velocity and lower energy needed for ignition. It is mainly generated through stream formations of hydrocarbons, water electrolysis or by other means in order to be used as fuel at a later date. Hydrogen has been applied in numerous industries, as it is an important industrial gas and raw material for electronics, chemical, pharmaceutical, fertilizer and food industry. Combustion or reaction of hydrogen with oxygen results in pure steam, which makes it become secondary energy with zero CO2 emission. Hydrogen can be an environmentally cleaner source of energy to end-users.

Hydrogen can be used in any application in which fossil fuels are being used today. It can be used as a fuel in furnaces, internal and natural gas. Automobiles, buses, trains, ships, submarines, airplanes and rockets can run on hydrogen. Hydrogen can also be converted directly to electricity by the fuel cells, without release of pollutants (such as particulate matter) or carbon dioxide at the point of end use, has a variety of applications in transportation and stationary power generation, i.e. fuel cell technology, referring to Fig 1 for details [1].

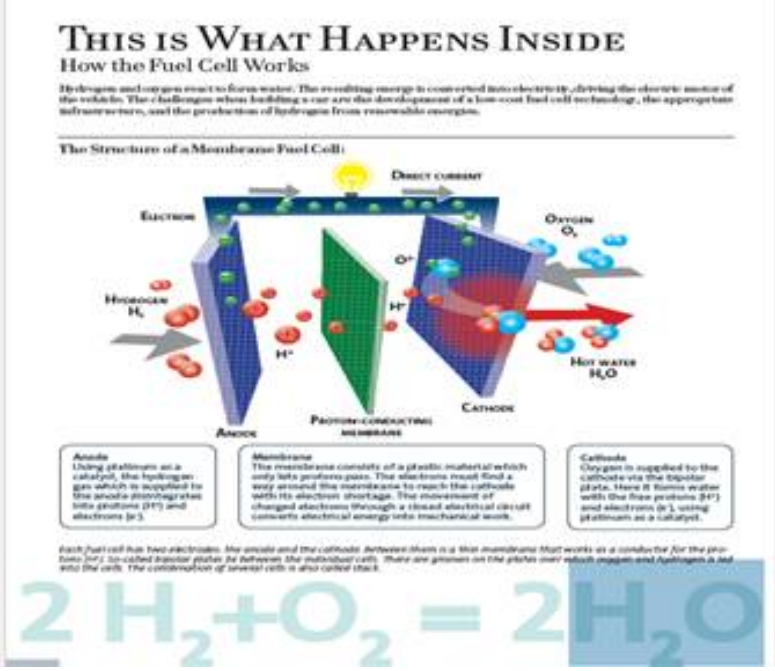
The production of hydrogen is a large and growing industry. Globally, some 57 million metric tons of hydrogen, equal to about 170 million tons of oil equivalent, were produced in 2004. The growth rate is around 10% per year[2] Hydrogen production in certain areas of China, such as Shanghai and Jiangsu Province etc, is considered to be at world class levels, with prices that are reasonable by world standards (e.g. about US6/kg in Shanghai). By 2012, the annual production of hydrogen reached 20 million tons and ranked No.1 in the world.

The concept of hydrogen economy was first proposed by geneticist J.B.S. Haldane and coined by John Bockris during a talk he gave in 1970 at General Motors (GM) Technical Center. It was envisioned as a

[2]. Wikipedia_ Hydrogen Economy, Current Hydrogen Market

system of delivering energy using hydrogen. A hydrogen economy advocates hydrogen as a potential fuel for motive power, including cars and boats, and on-board auxiliary power, stationary power generation, (e.g. for the energy needs of buildings), and as an energy storage medium (e.g. for inter-conversion from excess electric power generated off-peak). With the increasing amount of hydrogen produced as well as the demand of sustainable development powered by clean, renewable energy, the feasibility to realize hydrogen economy is getting increasing prominent.

Fig 1: How Fuel Cell Works



China has been leading the world in the production of renewable energy since 2013, with a total capacity of 378 GW, mainly from hydroelectric and wind power. As of 2014, China leads the worlds in the production and use of wind power, solar photovoltaic power and smart grid technologies, generating almost as much water, wind and solar energy as all of France and Germany's power plant combined. As the renewable manufacturing has grown, the cost of renewable energy technologies has dropped dramatically; with market expansion being the main driver of reduced costs as well as increased innovation[3].

Unlike oil, coal and gas the traditional energy, the supplies of which are finite and subject to geopolitical tensions, renewable energy systems can be built and used wherever there is sufficient water, wind and sun. However, one of the key caveats of utilization of renewable energy is that the intermittent energy source is unable to be continuously available due to the factors outside director control. Renewable energy, such as hydro, wind and solar power, are largely restricted by geographic locations, seasons and subjected to climate and environment change with less stability than the traditional energy. Therefore, with the limited capacity to utilize and distribute the power generated by renewable energy, China has been suffering resources loss.

The data from China's National Energy Administration (NEA) showed that although the electricity generated through wind power has increased 20.7% compared with last year for the first half of 2015, the amount of abandoned wind power has increased 6.8% and the average rate of abandoned wind power has reached 15.2%, which caused nearly CNY 8.7 billion losses. At the same time, the other kind of new energy that has been applied to generate electricity at a large scale is facing the same situation: the photo voltaic(PV) has been used to generated 19 billion kWh electricity in the first half year of 2015, however, 1.8 billion kWh of the electricity were not used[4].

[3] https://en.wikipedia.org/wiki/Renewable energy in China

[4] (http://www.chinanews.com/ny/2015/08-31/7498814.shtml)

To solve the above-mentioned problem, it is critically important to have a structural reform in the supply of and distribution of electricity. At the same time, exploring the solutions for energy storage should be emphasized as a way to help better utilize the resources.

Hydrogen gas has the storable property, making it a very good 'vehicle' for holding and distributing energy. With the ability to hold 120MJ/kg，a relatively small amount of hydrogen is needed to store significant amounts of energy. The stable chemistry of hydrogen also means storing energy longer than any other medium[5]. At the same time, hydrogen energy storage is scalable.

Hydrogen is also available by electrolysis (use of electricity to produce hydrogen and oxygen from water splitting,). Yet, using coal or fossil powered electricity to power electrolysis would not reduce the carbon footprint. While the majority of China's electricity is coal-powered, electrolysis presents the opportunity to use excess wind power or solar panels to generate hydrogen whose carbon footprint is zero or low, except its transport to the refueling station.

Given hydrogen has great prosper as a clean energy alternative for China's sustainable development, it is important to find out the feasibility, methodologies of developing Hydrogen industry and economy in China. Yet it is discovered that the following barriers ant their root causes, which hindered the establishment of hydrogen economy and need to be strategically addressed to facilitate the development process.

Hydrogen Production Barriers

The key barrier to a large scale utilization of hydrogen is related to its production.

Industrial by-product hydrogen is one of the most common forms of hydrogen that is becoming available on the commercial market in China. It has a very limited carbon footprint, making it an attractive transitional form of hydrogen for FCVs. By-product hydrogen production from industries and discarded hydrogen in certain areas of China, such as Shanghai and Jiangsu etc, is considered to be enormous, with prices that are relatively cheap. Locations with less industrial activity, however, face a challenge in procuring hydrogen and may need to pay significantly higher prices. Other methods of hydrogen production include natural gas or methanol reforming. When such hydrogen is used in FCVs, it has a lower carbon footprint than natural gas vehicles.

Hydrogen is also available by electrolysis (use of electricity to make hydrogen and oxygen from water). Yet, using coal powered electricity to power electrolysis would greatly increase the carbon footprint. Electrolysis using excess wind power or solar panels to generate hydrogen is a good way to reduce carbon footprint, except is its transport to the refuelling station.

As mentioned earlier, China is facing the issue of wasting the solar and wind power sources due to its limited capacity in utilization and distributing the electricity generated through the renewable energy. Hydrogen is proved to be great energy storage medium for better utilization of those resources. At present, however, there is no large-scale wind or solar based hydrogen production in China. China manufactures large-scale water electrolysis units, which can perform the electrolysis function. The quality is considered good and the price reasonable, with Chinese-made water electrolysis devices being exported to other countries, as well as being sold domestically.

An alternative form of clean energy based hydrogen production would be similar natural gas reforming from biogas or landfill methane. This method has not been used on a substantial scale in China to date, though there have been some small-scale experiments.

Lack of availability of low-cost, low-carbon hydrogen presents a basic challenge to formulate the hydrogen economy. At present, the cost of hydrogen in some areas is considered relatively higher than gasoline, although which would fluctuates widely. This is true even of hydrogen that is not produced by renewable

5.http://www.renewableenergyworld.com/articles/2014/07/hydrogen-energy-storage-a-new-solution-to-the-renewable-energy-intermittency-problem.html

energy. (Hydrogen produced by renewable energy tends to have even higher production costs.) Prices in Beijing in Jan. 2015 for hydrogen produced by natural gas reforming were USD 8 per kg, is still above international levels. Yet, there is also a lack of methodologies and technical standards to reduce costs by producing hydrogen produced by renewable energy.

Hydrogen Storage, transportation and Refilling Barriers

Hydrogen gas has great energy density by weight but relatively low energy density by volume, therefore to store the hydrogen; effective hydrogen storage is needed. With the advancement of compressing technique, fuel cell vehicle manufacturers such as Honda or Toyota were able to compress the hydrogen into the hydrogen tanks at 700 bars, which has been used for hydrogen tanks in the FCVs. About 2kWh/kg energy will be required to power compress hydrogen from ambient pressure to 35Mpa or 70Mpa.

Another common practice for hydrogen storage is to liquefy the hydrogen, as liquid hydrogen has been used in the space shuttle. However, liquid hydrogen requires cryogenic storage and would boil around −252.882 °C. The liquefaction process would cost a large amount of energy, about 15--20kWh/kg required since it needs energy to cool down the gas to that temperature6.As mentioned above, those two methods have their major limitation. However, both high pressure storage and liquefaction are used around the worldwide. More advanced technologies are under research and development now.

To promote the utilization of hydrogen, it is important to bring down the barriers that hindered the commercialization hydrogen at a large scale, which are hydrogen storage, transportation and delivery as well as hydrogen infrastructure. The issue of hydrogen infrastructure, to a large extend, is a problem that closes related to hydrogen storage technology. To store, delivery and transport hydrogen at ambient temperature could help reduce the cost with greater reliability and efficiency. Furthermore, barriers including high-pressure hydrogen storage equipment for mass-production, tube trailers, hydrogen transportation pipelines construction and related standards etc.

Hydrogen Application Barriers

To realize the hydrogen economy model, it is important to broaden the range and increase the scale of hydrogen application. However, currently hydrogen only become the key starting materials for the chemical industry and is on its way to become one of the most important fuels for vehicles, as the advancement in the fuel cell technology made this possible.

Fuel cell is conventionally defined as an “electrochemical cell which can continuously convert the chemical energy of a fuel and an oxidant to electrical energy by a process involving an essentially invariant electrode-electrolyte system”. To realize the mass manufacturing of fuel cell, it is important to expand the application of fuel cells. Although nowadays, with the advancement in the development of fuel cell vehicles and increasing possibility of large deployment, the possibilities to use the fuel cells in other areas should be explored. Utilization of hydrogen could be extended to fuel cell fork lift, fuel cell trains, fuel cell ferries and boats as well as aircrafts. In addition, more ways to apply hydrogen as power station, small off-grid power station, for domestic use is waited to be explored in China. However, there is a lack of technical standards to secure the smooth implementation of the technologies, and demonstrations are in shortage to show the feasibility for such application.

Rugao’s Hydrogen Economy Development Roadmap Barriers

The pertinent support policy and development planning frameworks for economy and FC technologies in Rugao are inadequate. The local government’s rather unclear to date have made it difficult for the local economy and FC technologies industry and market to develop. While China has developed clear plans and

[6] https://en.wikipedia.org/wiki/Hydrogen/storage/Compressed/hydrogen

targets for other areas requiring technology development and demonstration roll-out (notably EVs), for economy and FC technologies, there is no such official plan. This impedes progress and reduces the confidence of localities and potential investors in pursuing economy and FC technologies development in Rugao.

Add-Value of Policy Framework for hydrogen industry chain and Carbon Trading

The pertinent support policy and regulatory frameworks for hydrogen economy in China are inadequate. Areas in which policy and regulatory frameworks are lacking include: development roadmap, standards and codes, approval processes, and incentive policies. This impedes progress and reduces the confidence of localities and potential investors in pursuing hydrogen economy development.

And there is no systematic policy evaluation for hydrogen industry chain including hydrogen production, storage, transportation and application in China. Thus national and local policy planers and decision makers may have difficulty in developing and enforcing relevant policies and plans to promote and facilitate hydrogen & FC development and commercialization.

In its 12th five-year plan (2011-2015), the government has set the goal to reduce 17% carbon emission, and actively taken various kinds of efforts to reduce emissions and increase the carbon sinks, including promoting the development of nationwide voluntary carbon market. The Work Program of Controlling Greenhouse Gas Emissions in the 12th Five-Year Plan Period issued in November 2011 by the State Council explicitly proposed to explore and establish a carbon emissions trading market. The Notice regarding the Pilot of Development of Carbon Emissions Trading published in the same year by the National Development and Reform Commission (NDRC) announced that seven provinces and cities including Beijing and Shanghai would be the first batch of pilot provinces and cities in the development of carbon emissions trading, and they have been requested to officially launch their pilot of carbon trading in 2013.

Aside from the great environment benefit and energy efficiency came along with the utilization of hydrogen, it is also important to explore the potentials for the marketable opportunity for the carbon that reduced from the use of hydrogen as an incentive to boost the adaptation of this model. However, there is a lack of methodologies for the hydrogen carbon trading available in China, which creates barriers to effectively linking up the carbon market and the hydrogen economy as the carbon benefits from adopting the new modality of energy source and supply cannot be verified and therefore become a product in the carbon trading market.

Public awareness and knowledge sharing Barriers

A key barrier to broader adoption of Hydrogen is lack of awareness about hydrogen and lack of information about them, as well as lack of substantial proof on the roads in China to stimulate this awareness and information provision. People are either unaware or unclear about hydrogen's utilization as energy.

Further, there is fear and lack of understanding among the public about hydrogen-related safety issues. Policy makers, managers, and experts also lack the awareness and information needed to give them the confidence to develop plans for the use of hydrogen in their locales. They will continue to be hesitant to pursue products powered by hydrogen in the absence of solid results of hydrogen economy development in China. Further, these groups lack information on the latest progress and results internationally with hydrogen utilization. Finally, there is lack of a good, reliable information source within China to inform public and investors on the hydrogen market and technological developments.

Safety Concern regarding Hydrogen

The only safety risks of hydrogen, then, are fire caught, burning and explosion. In the case of FCVs, international vehicle manufacturers producing such vehicles pay special attention to the design of components and the whole system architecture to avoid and mitigate these risks. Extensive testing is performed. There have been many tests (e.g. massive tank damage, shooting at tanks, etc.) that confirm the low impact of potential incidents. Further, the impact of a hydrogen fire is lower than that of a gasoline or natural gas fire: Spatially it will be very limited; and the fire will be out in short time. Comparative tests have been done to prove this. In case of an incident, only the directly involved people will be affected. Even bystanders at a certain distance won't be affected. Safety of FCVs is at least as good as for natural gas

vehicles – and nobody is really concerned about the safety risk of natural gas vehicles these days. Much of the standards work for FCVs and their associated value chain is particularly targeted at safety aspects. As for hydrogen refuelling stations, because of the pressure-tight connection of the hose with pump and vehicle, hydrogen leaks/spills are excluded by design. Should components fail, installed hydrogen sensors and the control system shut the system off immediately.

Table 1 below summarizes the potential impact, probability of occurrence, type of incidents, and countermeasures taken with regard to FCV, HRS, hydrogen production, and hydrogen transport safety, respectively.

Table 1: Hydrogen Safety Risks and Countermeasures[7]

Topic	Impact	Probability	Potential Incidents	Countermeasures Taken
hydrogen refueling station	minor	slight	Hydrogen leaks (due to part failure or misuse) could lead to fire or explosion.	station design, safety/shutoff mechanisms, control of station, and location of pump and equipment
hydrogen production	negligible	slight	Hydrogen leaks (due to part failure) could lead to fire or explosion.	design, shutoff mechanisms, and operator training
hydrogen storage, transport	minor	slight	Hydrogen leak at tanker truck (due to part failure or accident) could lead to fire or explosion.	tanker and component design, safety/shutoff mechanisms, and operator training

During its early days, the California Fuel Cell Partnership did a great deal of work on safety and developed full sets of standards for fuel storage, fuelling stations, etc. It even simulated the total release of a vehicle's hydrogen in a partially enclosed space (a parking garage) and a partial release in a completely enclosed space (a residential garage). Both incidents were easily contained, and were certainly no worse than a gasoline fire would have been.

Also, there has been a real life failure on a very large hydrogen storage tank at Ballard that has been thoroughly studied and used as an example. A fitting failed during a fill exercise and a very large plume of hydrogen ignited and burned for some time. This caused a lot of excitement, but no damage. Turning off a valve put out the leak and fire. This is an example of a massive leak. Although it was certainly dangerous, there was not much damage.

II. STRATEGY

There is still a long way to promote and achieve the better utilization of hydrogen. A feasible solution is to establish a hydrogen economy demonstration city in China, which can be a place and platform to demonstrate various hydrogen relevant technologies and products addressing the above-mentioned barriers and promote the hydrogen economy forward in China.

Based on the analysis of the above mentioned barriers, the project was designed as composed of the two sections of activities to address the above mentioned barriers: Knowledge & Information Development Section and Technology Demonstration Section, with the hope of achieving the sustainability of the project's impact and establish a replicable model to be shared to other places in China. Yet given the nature of project execution, the two parts of activities would be re-organized to contribute to the project's outputs.

The "Brain": Knowledge and Information Development Section

The knowledge and information development section of the project aims to ensure the knowledge, lessons learned and good practices generated through the project will be well managed and distributed to the

[7] UNDP-GEF Project Document (draft) for *Accelerating Commercialization of FCV in China*

targeted audiences and key stakeholders with the goal of ensuring the sustainability of the project and expanding the project's impact in the development of hydrogen economy.

The main function of this section is to serve as the "brain" of the project, which would also contribute its knowledge products towards the China Hydrogen Economy Umbrella Programme as well as the hydrogen alliance.

The activities planned to contribute to the knowledge and information development of the project mainly are the research and knowledge generating and dissemination related activities, with the technical assistant from the experts in the field, universities/research institutions as well as the industry. Those activities include but not limited to policy study, technical standard/mythology development, business model feasibility study as well and collect the lessons learned and best practices from the project to contribute to the replication and scaling-up of the project.

The detailed activities under the Knowledge and Information Development section of the project are explained below:

It will be in charge of the map out of the available options and evaluate the methods, to develop the initial industrial development roadmaps (which can feed back to the Rugao municipal government for their Rugao Hydrogen Economy Roadmap development). (Activity 1.1, Activity 1.2).

It will manage the feasibility and business model studies regarding the hydrogen production (Activity 2.5), gap analysis in the standards and codes of hydrogen production and application (Activity 2.3, Activity 2.4, Activity 4.5),economic viable methods for hydrogen storage and refilling stations (Activity 3.1;3.2). It will conduct gap analysis in the current policy and regulatory framework (Activity 5.1; 5.2) and provide policy recommendations (Activity 5.3). It will help develop methodologies regarding hydrogen production (Activity 2.1; 2.2), carbon trading (Activity 5.4).

Aside from providing policy and technical recommendation, it will also be in charge of collecting and preparation for the lessons' learned through the projects, which would contribute to the replication of this model in other parts of China and in the world (Activity 6.5, 6.6, 6.7). In addition, it will establish the online platform (websites) for information distribution and serve as a hub of the knowledge and news regarding the development of hydrogen industry. In addition, it will design the materials and advocacy program to increase the key stakeholders and general public (Activity 6.1-6.4).

The "Brain" will combine the knowledge product produced through project activities as well as the lessons learned from the project' demonstration pilot to formulate a valid and feasible long-term development roadmap for the hydrogen industry.

The "Body": Technology Demonstration Section

The technical demonstration section of the project aims to demonstrate the low cost, low carbon hydrogen production, hydrogen refilling station as well as hydrogen (FC) application in the transportation sectors and domestic use, with the goal to gain the knowledge of the technology adaptation and provide good reference for the related policy and business model development.

It will focus on establishing pilots to demonstrate low cost, low carbon hydrogen production (Activity 2.1), hydrogen refilling station Activity 3.2) as well as hydrogen (FC) application in the transportation sectors and domestic use (Activity 4.2,4.3,4.4)

III. RESULTS AND PARTNERSHIPS (1.5 - 5 PAGES RECOMMENDED)

Expected Results

The project will contribute to the UNDAF (2016-2020) and UNDP Country Programme (2016-2020) under Outcome 2, more people enjoy a cleaner, healthier environment as a result of improved environmental protection and sustainable green growth. UNDP CPD Output 2.1: China's actions on climate change mitigation, biodiversity and chemicals across sectors are scale up, funded and implemented. The project will

work towards indicator 2.1: National carbon dioxide emission per unit GDP as the project is promoting the wide application of hydrogen as the main power source for the entire city.

The project will help build a city powered by hydrogen and facilitate sustainable development in China through demonstration of the feasibility and application of hydrogen in the field of industry, transportation, community/family and carbon finance, to promote the sustainable development by showcasing the reduced GHG emissions through adaptation of hydrogen.

The above mentioned objectives will be achieved through the following 6 components:

Component 1: Development of Rugao's Hydrogen Economy Development Roadmap

This component will focus on developing a 2016-2025 hydrogen development plan in Rugao, which will guide Rugao city in the relevant hydrogen and FC technology demonstration and application. The roadmap will be proposed based on substantially reviewing the hydrogen resources, hydrogen supply chain, FCV technology status. It will address the barrier in lacking of hydrogen economy roadmap and development pathway in Rugao, as well as key steps and measures taken to realize the roadmap. And the roadmap will lay a foundation and provide strategic guidance for the activities under other 5 components.

Output 1: Adoption and enforcement of Hydrogen Economy Development Roadmap in Rugao

Activity 1.1 Provision of technical assistance in developing Rugao's Hydrogen Economy Development Roadmap. The roadmap will focus on relevant hydrogen and FC technology demonstration and application during timeframe from 2016 to 2025, including hydrogen and FC application related industry development arrangement, technology pathway etc. International (desk review) and national (field activities) will play an important role in assisting developing and reviewing the roadmap development. Subcontractors may respectively be designated in developing hydrogen economy roadmap in the field of hydrogen production, hydrogen refilling station, FC technology demonstration in transportation and stationary etc.

Activity 1.2 Roadmap is finalized by incorporating elements from various channels. Conduct case studies and study tours with counterparts or projects in Japan, USA, Europe, Korea, Canada etc. Knowledge and information can be thoroughly exchanged and team members will learn the state-of art hydrogen technology development in the world. The experience and lessons learned from cases and tours will be incorporated in the draft proposals. Workshops will be held to attract attendance of key policymakers and consultants, and substantial discussions will be hold that will lead to consensus building on and implementation of the Roadmap. In the end, the adopted Roadmap may incorporate elements of attendees' draft proposals.

Component 2: Demonstration the hydrogen production technology

This component will focus on the successful demonstration of hydrogen production at a large scale, especially the realization of low-cost and no carbon and low-carbon hydrogen production. It will address the barriers of lacking of demonstration for hydrogen production, as well as renewable energy based hydrogen production**,** the cost of hydrogen production can be reduced through mass production by learning the experience of the demonstration site.

Output 2: Reduced costs and improved quality of advanced hydrogen production worldwide applied in the field of FC industry through renewable energy by the demonstration of small scale renewable energy based hydrogen production, the development of technical standards and guidelines and methodologies for hydrogen production and the study on business model for different hydrogen production.

Activity 2.1 Demonstration of hydrogen production from renewable resources based on roadmap developed. Based on the roadmap suggested, hydrogen production from renewable resources including solar and wastes will be demonstrated. Technical assistance will be provided in identifying suppliers in designing technical requirement, equipment procurement and installation and operation.

Activity 2.2 Provision of technical assistance in demonstration of solar based and waste based hydrogen. Provision of technical assistance in technology improvement and cost reduction in terms of demonstration of solar/waste based hydrogen production.

Activity 2.3 Summary and identify gaps between China's existing hydrogen production, storage, transportation and refill standards and guidelines and international standards and guidelines. Based on data and experience of Rugao' demonstration of hydrogen production, revision recommendations will be made in terms of the relevant standards, codes and guidelines.

Activity 2.4 Propose revisions and recommendations on updating the relevant standards and guidelines, deliver draft proposals to relevant committees for reference standard development and enforcement, technical assistance will be provided accordingly.

Activity 2.5 Conduct a comparative economic and technical analysis including investment, technical requirement, production, operation, CO2 emission of hydrogen production models (by-product hydrogen, natural gas reforming, solar and wind based hydrogen, methane reforming hydrogen, waste based hydrogen, methanol reforming etc.). Prepare and propose the business model for future hydrogen mass-production and application in China. Technical assistance will be provided in developing these business models.

Component 3: Establishment and pilot the hydrogen storage, transportation and refilling

This component will work on the piloting the application of hydrogen storage technologies, and facilitating and expediting the hydrogen refilling station construction. It will address the barriers of lack of pilots and improving the application of these technologies from the demonstration.

Output 3: Improved technology and expanded application of advanced hydrogen storage, transportation and refilling technology worldwide through constructing and operating hydrogen refilling station in Rugao

Activity 3.1 Conduct a technical feasibility study of hydrogen refilling station, site selection and equipment procurement and installation. Technical assistance will be provided in hydrogen refilling station design, engineering, approval procedure and safety issues, equipment selection and installation etc.

Activity 3.2 Continuous operation of hydrogen refilling station in Rugao. Technical assistance will be provided in designing data collection plan and templates and conducting data collection/monitoring and related standards research for hydrogen storage, transportation and refilling stations, and also failure analysis, trouble-shooting etc. Preparation and finalization of annual reports on findings will be done by local staff and technical consultants.

Component 4: Demonstration of FC application

This component will focus on expanding the areas that can apply hydrogen power technologies, mainly fuel cell, as the major power source. It will address the barriers of lack of technical standards and methodologies to secure the smooth application of the technologies in more broaden areas, with demonstrations of feasibility of those applications.

Output 4: Application of advanced FC technology worldwide in the transportation and cogeneration through demonstrating FC technology application in the transportation and FC cogeneration system.

Activity 4.1 Production and purchase of up to 5 demo FC buses, 2 demo FC autos according to the specifications of the RFPs. Technical assistance will be provided in developing all RFPs and FCV operation plans development. Preparation the operation plan of demo vehicles including bus route selection that will achieve both high visibility and desirable testing situation for the buses, designate a certain number of sites and days for consumer test driving of the FCV autos, 2-year operation and maintenance of all vehicles. The FCVs numbers may change in accordance with Rugao’s Hydrogen Economy Development Roadmap as specified and achieved in Activity 1.2.

Activity 4.2 Operation of all the planned demo vehicles according to the FCV operation plans in Rugao. The operations will be continuous during the project timeframe and routine maintenance will be carried out at regular intervals. Data collection plan and templates are designed and data collection/monitoring for FC and FCV are conducted. Technical assistance will be provided in preparing and completing of annual reports on FCV operation, failures/problems, and findings by technical consultants. Recommendations on FCVs operation failure analysis, root causes shooting and needed technology/design/engineering improvement will be proposed by technical consultants. Preparation and finalization of annual reports on findings will be done by local staff and technical consultants.

Activity 4.3 Demonstration FC cogeneration system. They can provide power for public lighting in selected Boai Hospital, the office building in Rugao Industrial Development District, newly built apartments developed by Zenhe Real Estate Company and Bing Energy Company' show rooms. Technical assistance will be provided in designing technical requirement, equipment procurement, installation and operation, etc.

Activity 4.4 Continuous operation of FC cogeneration system for 2-3 years. During the project period, FC cogeneration system operation and output data is collected and analyzed. A comparative economic and technical analysis about FC stationary and traditional energy is conducted.

Activity 4.5 Revisions and recommendations will be proposed to relevant standards committees on updating or developing the relevant standards and guidelines about FCVs, FC cogeneration system demonstration.

Component 5: Policy framework and carbon trading for hydrogen economy

The component will focus on hydrogen economy policy development and its industry chain evaluation and also aims to explore the possibility of introducing the reduced carbon from adopting the hydrogen economy model into the carbon trading market, with the goal to promote the wide application. It will address the barriers of lack of systematic policy framework and methodologies and guidelines of measurement and management of trading carbon reduced from adopting hydrogen economy, as well as limited capacity of local professional personnel in this area.

Output 5: Completed policy framework and carbon trading market for hydrogen economy through developing hydrogen economy incentive policy, analyzing hydrogen industry chain technology and economy, as well as developing the carbon trading methodologies

Activity 5.1 Design and reach consensus on policy priority in field of hydrogen produced from low carbon sources and hydrogen refilling infrastructures. Consultants will provide technical assistance in designing and drafting these incentives policies. Detailed incentive policy proposals will then be carried out and conveyed to relevant authorities. Workshops and seminars are good channels to disseminate these findings and results.

Activity 5.2 Design and reach consensus on policy priorities in field of transportation and co-generation. Consultants will provide technical assistance in designing and drafting these incentives policies. Design will first involve liaison with local and national government reaching of consensus on incentive policy for FC application. Detailed incentive policy proposals will then be carried out and conveyed to relevant authorities. Workshops and seminars are good ways to disseminate these findings and results.

Activity 5.3 Conduct of a comparative techno-economic life cycle analysis and evaluation of hydrogen economy. It will include technical pathway, investment, operation, maintenance, emission and environmental effects etc. of hydrogen production, storage, transportation and refilling and application in the field of transportation and co-generation. Different hydrogen production models includes natural gas reforming, hydrogen recovery from industrial waste gas streams, wind and solar, or other industrial hydrogen production processes, renewable energy based power generation.

Activity 5.4 Develop carbon trading methodologies for carbon reduction from application of FC technologies in industrial by-product gas/renewable energy based hydrogen production, FCVs operation, FC

co-generation, etc. Propose carbon trading methodologies, which could be reference for national carbon trading market development.

Component 6: Enhancement of Information Dissemination and awareness about hydrogen utilization in different sectors and hydrogen economy

This component will enhance awareness of hydrogen utilization by and achieve related information dissemination to the public, national-level and local-level officials, companies that are end users of hydrogen, experts, manufacturers, and other relevant stakeholders. Key barriers to be addressed include: the public's lack of awareness of hydrogen and (in cases they are aware) concerns about hydrogen safety; government officials' lack of awareness of hydrogen and lack of access to information that will increase their confidence in pursuing demonstration programs and enable them to implement such programs effectively; and lack of easy access by experts and hydrogen manufacturers to information on China's hydrogen market and on developments of hydrogen application around the world.

Output 6: Enhanced acceptance of hydrogen utilization for both public and private uses via increased knowledge and awareness through knowledge and information dissemination, project replication plans and designing hydrogen economy innovation mechanism.

Activity 6.1 Provision of information and cooperation channels by inviting more interested stakeholders (investors, national and international enterprisers etc) engaged in Rugao hydrogen economy demonstration. Information and knowledge sharing and exchange are conducted with international hydrogen organizations, hydrogen supply chain related enterprisers and demonstration projects through conferences (in relation to the Hydrogen Alliance to be set up by UNDP), seminars, field tours, etc.

Activity 6.2 Workshops and international study tours held. Consultants will play an important role in designing and coordinating technical workshops and tours. The purposes of these are to learn the updated international hydrogen technology development, conduct technical and information exchange among counterparts and to strengthen influence on the development of hydrogen economy project. Rugao officials, PMO staff, UNDP China, consultants etc are proposed to attend the study tours. During the project lifetime, four Hydrogen and FCV workshops will be organized in Rugao. Outreach for workshop attendance will be conducted with officials, enterprises, academic institutions, experts, investors and media etc.

Activity 6.3 Conduct campaign in Rugao as well as nationally. Media campaign will highlight the hydrogen economy progress and achievements represented by the demos while also address the public's safety concern regarding hydrogen. The online platform (websites) will be established for information distribution and serve as a hub of the knowledge and news sharing.

Activity 6.4 Organize field visits for leaders and officials from UN and national and provincial and local government when the project demo milestones are achieved.

Activity 6.5 Implement project advocacy program and experience dissemination to engage interested cities and city officials. And efforts will be made to promote the cooperation between interested enterprises， financial investors and local governments. The activity will be basis for the follow-up project replication. Consultants will provide technical provision in designing follow-up project replication plans.

Activity 6.6 Design of a sustainable follow-up plan. Consultation with relevant national and city officials, a sustainable follow-up plan will be completed by consultants to replicate the hydrogen economy demos in other cities and scale it up in participating cities. Plan will include strategies for demo technology selection and for effective operation, and data and lessons learned from the project demos has been obtained. This program will be instrumental in achieving replication of project demos in other cities.

Activity 6.7 Compile summary reports of demo city experience, fruits and demo business models. New hydrogen economy innovation mechanism will be proposed with the purpose of facilitating and promoting mass production of hydrogen production, application, and then hydrogen society development in China.

Output 7: Project management and implementation including Project Management Office operation, Project Monitoring and Evaluation, and communication.

As the project plans to implement two sections of activities: Knowledge & Information Development Section and Technology Demonstration Section to achieve the project's goals and ensure its suitability, the Project Management Office will in charge of the activity management and coordination.

For the Knowledge and Information Development section, the PMO will in charge of the management and distribution of the knowledge, lessons learned and good practices generated through the project will be well-recorded and distributed to the target audiences and key stakeholders with the goal of ensuring the sustainability of the project and expanding the project's impact in the development of hydrogen economy.

For the Technology Demonstration Section, the PMO will facilitate the demonstration of demonstrate the low cost, low carbon hydrogen production, hydrogen refilling station as well as hydrogen (FC) application in the transportation sectors and domestic use, with the goal to gain the knowledge of the technology adaptation and provide good reference for the related policy and business model development.

The detailed activities are listed below:

Activity 7.1: Recruitment of PMO staff and national consultants before the project inception workshops.

Activity 7.2: Annual Tripartite Review will be conducted by UNDP, CICETE and Rugao.

Activity 7.3: Auditing will be conducted annually according UNDP rules.

Activity 7.4: Project Progress Reporting, including quarterly, annual and final reports will be finalized according to UNDP reporting requirements.

Activity 7.5: Project Inception Workshop will be held in the 2nd part of 2016.

Activity 7.6: Hydrogen Alliance Annual Conference will be held annually.

Activity 7.7: Project Final Workshop will be held before July 2020 .

Activity 7.8: Advocacy of project results at international conferences, including the COP of UNFCCC

Activity 7.9: Advocacy of project results to other cities in China through workshops and/or local study tours will be organized.

Resources Required to Achieve the Expected Results

- *Describe what resources are required to achieve the expected results. Thinking about the change pathway in your theory of change, state the key inputs (people, purchases, partnerships, etc.) that are required to deliver the outputs. This should include UNDP staff time from the country, region or HQ level, which must be adequately estimated, costed, and included in the project budget.*

Staff from UNDP China will be involved in the project implementation providing supervision on project implementation and financial management. They will be part of the project steering committee to keep the project's progressing on the right track, and participate in the project's consultation meetings and technical workshops to provide inputs and support.

Regarding the funding source, Rugao Commission of the National Level Rugao Economic & Technological Development Area, as the project partner, will be responsible for the full funding of the project and its implementation. The Project Management Office will be formulated. The PMO, composed of three staff, is in charge of the day-to-day implementation and regular reporting of the project, which will be based in the Rugao City.

National consultants as well as the contractual service companies will be recruited to help deliver the activities planned under 7 outputs of the projects and help reach the output results. Those consultants will be the Chief Technical Advisor to provide consultation to the overall project as well advisors and consultant on FCV and Hydrogen policy, hydrogen production through renewable energy as well as the application of hydrogen in various sectors etc.

Aside from the human resources that needed to ensure the knowledge outputs and smooth implementation of the project, demonstration on renewable energy-based hydrogen, 5 FCBs, 2 FCVs and FC cogeneration as well as FC cogeneration system will be established to test out the best practices of such technology utilization and gain the knowledge from the field to further promote the hydrogen industry development.

Partnerships

- *Describe how the project will work with partners to achieve results and briefly map what other stakeholders and initiatives are doing to address the development challenge. This should not be simply a list of partners, it should be linked to the theory of change. For example, what are the assumptions and expected results achieved by partners that are critical for the achievement of results of this project?*

UNDP China will be responsible for: (i) providing financial and audit services to the project; (ii) overseeing financial expenditures against project budgets approved; (iii) appointing independent financial auditors and evaluators; and (iv) ensuring that all activities including procurement and financial services are carried out in strict compliance with UNDP procedures.

CICETE will act as Implementing Partner and be responsible for the project management activities.

Rugao will appoint a National Project Director who will direct overall implementation of the project and delegate day-to-day coordination work to the PMO. The project Management Office (PMO) within a team comprised of Project Manager (PM), and additional support staff will be established.

Society of Automotive Engineers China (SAE China) and China Automotive Technology and Research Center (CATARC), institutions, universities, society organizations will provide technical support on the activities on the FCV and hydrogen technologies and their demonstration and verification, as well as policy and standards frameworks development etc.

SAIC, YUTONG, Hyundai, Green Wheel EV etc may join FCV demonstration and provide information for the design of FCV technologies, as well as in the design of technical training programs on the application of FCVs.

Pilot Enterprises on FC production will provide technical assistance and activities for the FC manufacturing demonstrations.

Pilot Enterprises on H2 production and refuelling will provide technical assistance and activities for the H2 production and refuelling demonstrations.

Expected results achieved by partners are based on the assumptions of funds can be transferred to the project bank account designated by UNDP/CICETE.

Risks and Assumptions

- *Specify the key risks that can threaten the achievement of results through the chosen strategy and the assumptions on which the project results depends. Describe how project risks will be mitigated, especially how potential adverse social and environmental impacts will be avoided where possible and otherwise managed. Refer to the full risk log, which should be attached as an annex.*

Table lists both the risks and mitigation strategy in terms of market, economic, environmental, and social and policy perspectives.

Table The risks and mitigation strategies

Types of risks	Risk description	Levels of the risk	Mitigation strategy
Risks in material supply	It is difficult to procure the improved FCV and other hydrogen related equipment.	Low	International and national consultants' expertise in FCV will be recruited to provide technical support in procurement.
Market and economic risks	The level of co-sharing amount may not be transferred into designated account timely and support the project implementation promptly and sufficiently.	Low	Substantial co-sharing commitment has been obtained. During project implementation, the project team will closely monitor and ensure co-sharing is available by project partners and co-financers promptly and at least as per their respective committed amounts.
Environmental risk	Life cycle of hydrogen production may not be environmental friendly because of coal-based electricity.	Low	Hydrogen from renewable energy based is encouraged to used for producing hydrogen.
Social risk	Lack of information	Low	Project information platform

	channel for local citizen to take a ride or drive FCVs		and all kinds of awareness will be conducted to disseminate FCV knowledge to public.
Policy and institutional risks	Recommended policies may not be approved by the relevant authorities, or may be approved but not effectively enforced.	Low	The project will include the piloting of the application of the support policies for hydrogen economy to gauge the effectiveness of said policies. That will help guide the relevant government authorities in the finalization, approval, and effective enforcement of such policies.

The Social and Environment Impact Screening of the project has been conducted and no gender-related risks or potential negative impact have been identified. Due to the technicality nature of the project, it is difficult to design and implement the project following the overall strategy of addressing the gender issues. Yet the project will ensure equal employment opportunities and try to actively engage female participants/stakeholders into the project.

Stakeholder Engagement

- Identify key stakeholders and outline a strategy to ensure stakeholders are engaged throughout, including:

  - *Target Groups:*

The intended beneficiaries of the project will be Rugao municipal government, public and private sectors in transportation, automobile and energy etc.

An efficient project organization management and coordination mechanism will be designed before project inception: the project steering committee will be established and key stakeholders will be engaged through the quarterly-basis committee meeting. In addition, the key stakeholders will be engaged in the project activities including but not limited to the demonstration, policy and standard research, workshops, project dissemination and advocacy activities.

  - *Other Potentially Affected Groups:*

Potentially affected people are local citizen who will benefit from the improved air quality and CO2 emission reduction. They will also take advantage of advanced technology application to improve their living standards. Public awareness raising activities, information sharing and the platform created by the project are good channels to involve the potential groups.

South-South and Triangular Cooperation (SSC/TrC)

The knowledge and lessons learned during the project implementation process can be shared with other developing countries that are facing the same issues in better utilization of renewable energy resources.

Knowledge

- *Describe any specific knowledge products, besides evaluations, that will be produced by the project (e.g., publications, databases, media products, etc.) and how the project will create visibility for knowledge and lessons learned generated by the project so others can benefit.*

Publications like policy research, roadmap and techno-economic research, FCV and FC cogeneration demonstration databases, media products will be produced. Results from the project will be disseminated within and beyond the project intervention areas through existing information sharing networks and forums.

The project will identify and participate, as relevant and appropriate, in scientific, policy-based, and/or any other networks, which may be of benefit to project implementation though lessons learned. The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects.

Sustainability and Scaling Up

- *Describe how the project will use relevant national systems, and specify the transition arrangement to sustain and/or scale-up results, as relevant. Describe how national capacities will be strengthened and monitored as relevant, and how national ownership will be ensured.*

The proposed project will achieve sustainability and replication through a multi-pronged approach that creates an enabling environment for hydrogen economy development in China. The scaling-up efforts of the project will be supported mainly through one of the project's activities, which will devote to the study of the replication of the hydrogen economy pilot. The project will organize information exchange and knowledge sharing with other interested cities and demonstration areas. Studies regarding replication of the hydrogen economy model in other cities/regions will be conducted to help complete the scaling-plans of the project.

China ratified the UNFCCC on January 5, 1993. It has completed and submitted its Second National Communications to the UNFCCC, which highlighted that improvements in the transport sector's specific energy consumption are among the strategies adopted to contribute to the achievement of the country's target GHG emission reductions.

IV. PROJECT MANAGEMENT (1/2 PAGES - 2 PAGES RECOMMENDED)

Cost Efficiency and Effectiveness

- *Identify how the strategy is expected to deliver maximum results with available resources, with reference to evidence on similar approaches in this country or similar contexts. Include measures based on good practices and lessons learned. Explain why the selected pathway is the most efficient and effective of available options. Possible approaches can include:*

  i) Using the theory of change analysis to explore different options to achieve the maximum results with available resources

  ii) Using a portfolio management approach to improve cost effectiveness by leveraging activities and partnerships with other initiatives/projects

  iii) Through joint operations (e.g., monitoring or procurement) with other partners.

A portfolio management approach was adopted by this project to improve the cost effectiveness by leveraging activities and partnership with other initiatives/projects.

UNDP has been a main partner of the Chinese government in its renewable energy development through projects such as Capacity building for policy to Accelerate the Commercialization of Renewable Energy in China, and the China climate change partnership Framework, which promoted the development of renewable energy business in China. Having strong advantages in global network for the technology and management and strategic cooperation with the Chinese government sectors and provinces, UNDP has been assisting the national and provincial governments in building climate change capacities.

Among all the implemented project, with the financial support of the Global Environment Facility (GEF), UNDP China has worked with Ministry of Science and Technology of China (MOST) since 2003 to catalyse the cost-reduction of fuel-cell buses (FCBs) for public transport through a GEF project, Demonstration for Fuel-cell Buses Commercialization in China (Phase I: 2003 – 2006; Phase II: 2007 - 2011). In collaboration with the central and municipal governments and the private sector, UNDP assisted public transit companies in Beijing and Shanghai to operate 9 FCBs. The projects

enabled technology suppliers to identify cost reduction opportunities and also public transit operators to gain the know-how needed to adopt larger fleets of FCBs in the future. In addition, UNDP is about to launch a new phase of the GEF projects to facilitate the commercialization of fuel cell vehicles (FCVs) in China.

This project will utilize the technical expertise and partnership established through the FCV projects to explore the widen application of fuel cell technologies in various areas. In addition, the Hydrogen Economy Pilot will be part of the China Hydrogen Economy Pilot Programme, the project implementation experiences, technology demonstration and lessons generated from the field could provide a good reference for the other demonstration projects to develop.

Project Management

Information on the location(s) where the project will be operationalized, the number and location of physical project offices, arrangements for dedicated or shared operations support, how the project will work with other projects, etc. In this section, also describe the audit arrangements, collaborative arrangements with related projects and UNDP Direct Country Office Support Services and direct project costing, if applicable.

The project Management Office (PMO) will be locally operated in Rugao. A team comprised of Project Manager (PM), and 2 additional support staff will be established.

As the project plan to implement two sections of activities: Knowledge & Information Development Section and Technology Demonstration Section to achieve the project's goals and ensure its suitability, the Project Management Office will in charge of the activity management and coordination.

For the Knowledge and Information Development section, the PMO will in charge of the management and distribution of the knowledge, lessons learned and good practices generated through the project will be well-recorded and distributed to the target audiences and key stakeholders with the goal of ensuring the sustainability of the project and expanding the project's impact in the development of hydrogen economy.

For the Technology Demonstration Section, the PMO will facilitate the demonstration of demonstrate the low cost technologies, low carbon hydrogen production, hydrogen refilling station as well as hydrogen (FC) application in the transportation sectors and domestic use, with the goal to gain the knowledge of the technology adaptation and provide good reference for the related policy and business model development.

The key activities of project management include: project planning, project management and implementation, final project evaluation, project workshops, as well as project information exchanging and sharing. National consultant's panel will also be established for provision of technical support for project operation.

The project is closely linked with the UNDP objective to promote sustainable strategies that supports economic growth, employment and broader societal objectives. UNDP is implementing "Accelerating the Development and Commercialization of Fuel Cell Vehicles in China "project and other sustainable transportation projects. Periodic information sharing platform/meetings can be held for experience and lessons-learned sharing.

Meanwhile, project audit will be conducted annually.

V. RESULTS FRAMEWORK[8]

Intended Outcome as stated in the UNDAF/Country [or Global/Regional] Programme Results and Resource Framework: *Outcome 2, more people enjoy a cleaner, healthier environment as a result of improved environmental protection and sustainable green growth.*										
Outcome indicators as stated in the Country Programme [or Global/Regional] Results and Resources Framework, including baseline and targets: *Outcome 2, more people enjoy a cleaner, healthier environment as a result of improved environmental protection and sustainable green growth.*										
Applicable Output(s) from the UNDP Strategic Plan: 1.4 Coverage of cost-efficient and sustainable energy, disaggregated by rural/urban										
Project title and Atlas Project Number: Hydrogen Economy Pilot in China Atlas Project Number 00092045										
EXPECTED OUTPUTS	**OUTPUT INDICATORS[9]**	**DATA SOURCE**	**BASELINE**		**TARGETS (by frequency of data collection)**					**DATA COLLECTION METHODS & RISKS**
			Value	**Year**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year …**	**FINAL**
Output 1 ***Adoption and enforcement of Hydrogen Economy Development Roadmap in Rugao***	1.1 Number of enforced Hydrogen Economy Development Roadmap in Rugao	Local governme nt bulletin	0	2015	1	0	0	0		1	Desk review through Internet Government publications

[8] UNDP publishes its project information (indicators, baselines, targets and results) to meet the International Aid Transparency Initiative (IATI) standards. Make sure that indicators are S.M.A.R.T. (Specific, Measurable, Attainable, Relevant and Time-bound), provide accurate baselines and targets underpinned by reliable evidence and data, and avoid acronyms so that external audience clearly understand the results of the project.

[9] It is recommended that projects use output indicators from the Strategic Plan IRRF, as relevant, in addition to project-specific results indicators. Indicators should be disaggregated by sex or for other targeted groups where relevant.

Output 2 ***Reduced the costs and improving the quality of hydrogen production applied in the field of FC industry through renewable energy***	2.1 Amount of hydrogen gas (delivered) produced from renewable energy in Rugao by EOP	Hydrogen refilling station	0	2015	0	1000kg	1000kg	1000kg		3000kg	Annual report Records Log at refilling station Interview with staff
Output 3: ***Improved and promoting the application of hydrogen storage and refilling technology***	3.1 Number of application of hydrogen storage and hydrogen refilling stations at EOP in China	Local government bulletin	0	2015	0	1	0	0		1	Site visits
Output 4: Application of FC technology in the transportation and cogeneration.	4.1 FCV numbers and FC cogeneration application in transportation and stationary in Rugao.	Project website	0	2015	0 FCV 1 FC cogeneration system	5 FCBs 2FC cars 1-2 FC cogeneration systems	0	0		5 FCBs, 2FC cars, 2-3 FC cogeneration systems	Annual report Site visits

Output 5 ***Completed policy framework and carbon trading for hydrogen economy***	5.1 Number of incentive policy and carbon trading methodology adopted at EOP	Local government bulletin	0	2015	0policy	1 incentive policy 0 carbon trading methodology	1 incentive policy 2 carbon trading methodologies	1 incentive policies 2 carbon trading methodologies		3 incentive policies 4 carbon trading methodologies	Annual report Government publications
Output 6 ***Enhanced acceptance of hydrogen utilization for both public and private uses via increased knowledge and awareness***	6.1 Number of people who are aware and interested in the application of hydrogen economy by EOP	Project website	0	2015	1000	10,000	100,000	100,000		211,000	Questionnaire and site visits, annual report, bus companies TV programs, interviews

VI. MONITORING AND EVALUATION

In accordance with UNDP's programming policies and procedures, the project will be monitored through the following monitoring and evaluation plans: *[Note: monitoring and evaluation plans should be adapted to project context, as needed]*

Monitoring Plan

Monitoring Activity	Purpose	Frequency	Expected Action	Partners (if joint)	Cost (if any)
Track results progress	Progress data against the results indicators in the RRF will be collected and analysed to assess the progress of the project in achieving the agreed outputs.	Quarterly, or in the frequency required for each indicator.	Slower than expected progress will be addressed by project management.		
Monitor and Manage Risk	Identify specific risks that may threaten achievement of intended results. Identify and monitor risk management actions using a risk log. This includes monitoring measures and plans that may have been required as per UNDP's Social and Environmental Standards. Audits will be conducted in accordance with UNDP's audit policy to manage financial risk.	Quarterly	Risks are identified by project management and actions are taken to manage risk. The risk log is actively maintained to keep track of identified risks and actions taken.		
Learn	Knowledge, good practices and lessons will be captured regularly, as well as actively sourced from other projects and partners and integrated back into the project.	At least annually	Relevant lessons are captured by the project team and used to inform management decision-makers.		
Annual Project Quality Assurance	The quality of the project will be assessed against UNDP's quality standards to identify project strengths and weaknesses and to inform management decision making to improve the project.	Annually	Areas of strength and weakness will be reviewed by project management and used to inform decision-makers to improve project performance.		
Review and Make Course Corrections	Internal review of data and evidence from all monitoring actions to inform decision making.	At least annually	Performance data, risks, lessons and quality will be discussed by the project board and used to make course corrections.		
Project Report	A progress report will be presented to the Project Board and key stakeholders, consisting of	Annually, and at the end of the project			

	progress data showing the results achieved against pre-defined annual targets at the output level, the annual project quality rating summary, an updated risk long with mitigation measures, and any evaluation or review reports prepared over the period.	(final report)			
Project Review (Project Board)	The project's governance mechanism (i.e., project board) will hold regular project reviews to assess the performance of the project and review the Multi-Year Work Plan to ensure realistic budgeting over the life of the project. In the project's final year, the Project Board shall hold an end-of project review to capture lessons learned and discuss opportunities for scaling up and to socialize project results and lessons learned with relevant audiences.	Specify frequency (i.e., at least annually)	Any quality concerns or slower than expected progress should be discussed by the project board and management actions agreed to address the issues identified.		

Evaluation Plan[10]

Evaluation Title	Partners (if joint)	Related Strategic Plan Output	UNDAF/CPD Outcome	Planned Completion Date	Key Evaluation Stakeholders	Cost and Source of Funding
Mid-Term Evaluation		1.4	Outcome 2	Q2. 2018		$5,000 Government Cost-sharing
Terminal Evaluation		1.4	Outcome 2	Q2. 2020		$5,000 Government Cost-sharing

[10] Optional, if needed

VII. MULTI-YEAR WORK PLAN

All anticipated programmatic and operational costs to support the project, including development effectiveness and implementation support arrangements, need to be identified, estimated and fully costed in the project budget under the relevant output(s). This includes activities that directly support the project, such as communication, human resources, procurement, finance, audit, policy advisory, quality assurance, reporting, management, etc. All services which are directly related to the project need to be disclosed transparently in the project document.

EXPECTED OUTPUTS	PLANNED ACTIVITIES	Planned Budget by Year（USD）				RESPONSIBLE PARTY	PLANNED BUDGET（USD）		
		Y1	Y2	Y3	Y4		Funding Source	Budget Description	Amount
Output 1 *Adoption and enforcement of Hydrogen Economy Development Roadmap in Rugao*	1.1 Provision of technical assistance in developing Rugao 2016-2030 Hydrogen Economy Development Roadmap.	12,000	12,000	0	0	Rugao, PMO	Gov't	Local Consultants	24,000
		133,464	133,464	0	0	Rugao, PMO	Gov't	Contractual Services–Company	266,928
	1.2 Roadmap is finalized by incorporating elements from various channels.	30,036	0	0	0	Rugao, PMO	Gov't	Travel	30,036
		15,000	0	0	0	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	15,000
	MONITORING								
	Sub-Total for Output 1								335,964
Output 2 *Reduced costs and improved quality of hydrogen production through renewable energy by small scale demonstration and developing related technical standards, guidelines and methodologies*	2.1 Demonstration of hydrogen production from renewable resources based on roadmap developed	309,999	1,983,000	0	0	Rugao, PMO	Gov't	Equipment and Furniture	2,292,999
		12,500	12,500	12,500	12,500	Rugao, PMO	Gov't	Travel	50,000
		11,250	11,250	11,250	11,250	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	45,000
	2.2 Provision of technical assistance in demonstration of solar or wind based , waste based hydrogen.	10,000	10,000	10,000	10,000	Rugao, PMO	Gov't	Local Consultants	40,000

	2.3 Summary and identification gaps between China's existing hydrogen production standards and guidelines and international standards and guidelines	0	0	8,000	0	Rugao, PMO	Gov't	Local Consultants	8,000
	2,4 Propose revision and recommendations on updating the relevant standards and guidelines	0	7,000	8,000	0	Rugao, PMO	Gov't	Contractual Services– Company	15,000
	2.5 Conduct a comparative economic and technical analysis	0	0	7,500	7,500	Rugao, PMO	Gov't	Miscellaneous Expenses	15,000
		0	61,037	50,000	0	Rugao, PMO	Gov't	Contractual Services– Company	111,037
	MONITORING								
	Sub-Total for Output 2								2,577,036
Output 3 *Improved and promoted the application of hydrogen storage and refilling technology by constructing and operating the hydrogen refilling station in Rugao*	3.1 Conduct a technical feasibility study of hydrogen refilling station, site selection and equipment procurement and installation.	12,500	12,500	12,500	12,500	Rugao, PMO	Gov't	Travel	50,000
		4,000	4,000	4,000	4,000	Rugao, PMO	Gov't	Miscellaneous Expenses	16,000
	3.2 Continuous operation of hydrogen refilling station	6,000	6,000	6,000	6,000	Rugao, PMO	Gov't	Local Consultants	24,000
	Monitoring								
	Sub-Total for Output 3								90,000
Output 4 *Application of hydrogen technology application in the transportation and domestic areas by piloting the hydrogen technology application in transportation and FC cogeneration System.*	4.1 Production and purchase of up to 5 demo FC buses, 2 demo FC autos	15,000	15,000	15,000	15,000	Rugao, PMO	Gov't	Local Consultants	60,000
		500,000	2,820,000	0	0	Rugao, PMO	Gov't	Equipment and Furniture	3,320,000
		20,000	0	0	0	Rugao, PMO	Gov't	Contractual Services– Company	20,000
		2,500	2,500	2,500	2,500	Rugao, PMO	Gov't	Travel	10,000

		25,000	25,000	25,000	25,000	Rugao, PMO	Gov't	International Consultants	100,000
	4.2 Operation of all the planned demo vehicles according to FCV operation plans in Rugao.	100,000	300,000	300,000	300,000	Rugao, PMO	Gov't	Contractual Services–Company	1,000,000
	4.3 Demonstration FC cogeneration system	200,000	300,000	0	0	Rugao, PMO	Gov't	Equipment and Furniture	500,000
	4.4 Continuous operation of FC stationary for 2- 3 years.	11,000	12,000	15,500	13,500	Rugao, PMO	Gov't	Local Consultants	52,000
	4.5 Revisions and recommendations will be proposed on updating or developing the relevant standards and guidelines about FCVs, FC cogeneration system demonstration.	10,500	10,500	10,500	10,500	Rugao, PMO	Gov't	Local Consultants	42,000
	Sub-Total for Output 4								5,104,000
Output 5 *Completed policy framework and carbon trading for hydrogen economy through develop the hydrogen economy incentive policy, analyse and evaluate hydrogen industry chain technology and economy and develop the carbon trading methodology for carbon reduction.*	5.1 Design and reach consensus on policy priority in field of hydrogen produced from low carbon sources and hydrogen refilling infrastructures.	0	0	6000	0	Rugao, PMO	Gov't	Local Consultants	6,000
		12,500	12,500	12,500	12,500	Rugao, PMO	Gov't	Contractual Services–Company	50,000
	5.2 Design and reach consensus on policy priority in field of transportation and co-generation.	11,500	11,500	11,500	11,500	Rugao, PMO	Gov't	Local Consultants	46,000
		15,000	15,000	15,000	15,000	Rugao, PMO	Gov't	Contractual Services–Company	60,000
		5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Travel	20,000
	5.3 Conduct of a comparative techno-economic life cycle analysis and evaluation of hydrogen economy.	0	0	0	6,000	Rugao, PMO	Gov't	Local Consultants	6,000
		0	0	50,000	50,000	Rugao, PMO	Gov't	Contractual Services–Company	100,000

		0	0	0	13,000	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	13,000
		0	0	0	10,000	Rugao, PMO	Gov't	Miscellaneous Expenses	10,000
	5.4 Develop carbon trading methodologies for carbon reduction from application of FC technologies.	0	0	25,000	25,000	Rugao, PMO	Gov't	Contractual Services– Company	50,000
	MONITORING								
	Sub-Total for Output 5								361,000
Output 6 *Enhanced acceptance of hydrogen utilization for both public and private uses via increased knowledge and awareness by completing knowledge and information program, project replication plans and hydrogen economy innovation mechanism.*	6.1 Provision of information and cooperation channels by inviting more interested stakeholders engaged in Rugao hydrogen economy demonstration.	5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Local Consultants	20,000
	6.2 Workshops and international study tours held.	32,500	32,500	32,500	32,500	Rugao, PMO	Gov't	Travel	130,000
		15,000	15,000	15,000	15,000	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	60,000
	6.3 Conduct of media campaign targeting the press in Rugao as well as nationally to promote the hydrogen economy model while address the safety concern regarding hydrogen.	5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Miscellaneous Expenses	20,000
	6.4 Organization field visits from leaders and officials from UN and national and provincial and local government when the project demo milestones are achieved.	5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Local Consultants	20,000
		0	5,000	5,000	5,000	Rugao, PMO	Gov't	Travel	15,000

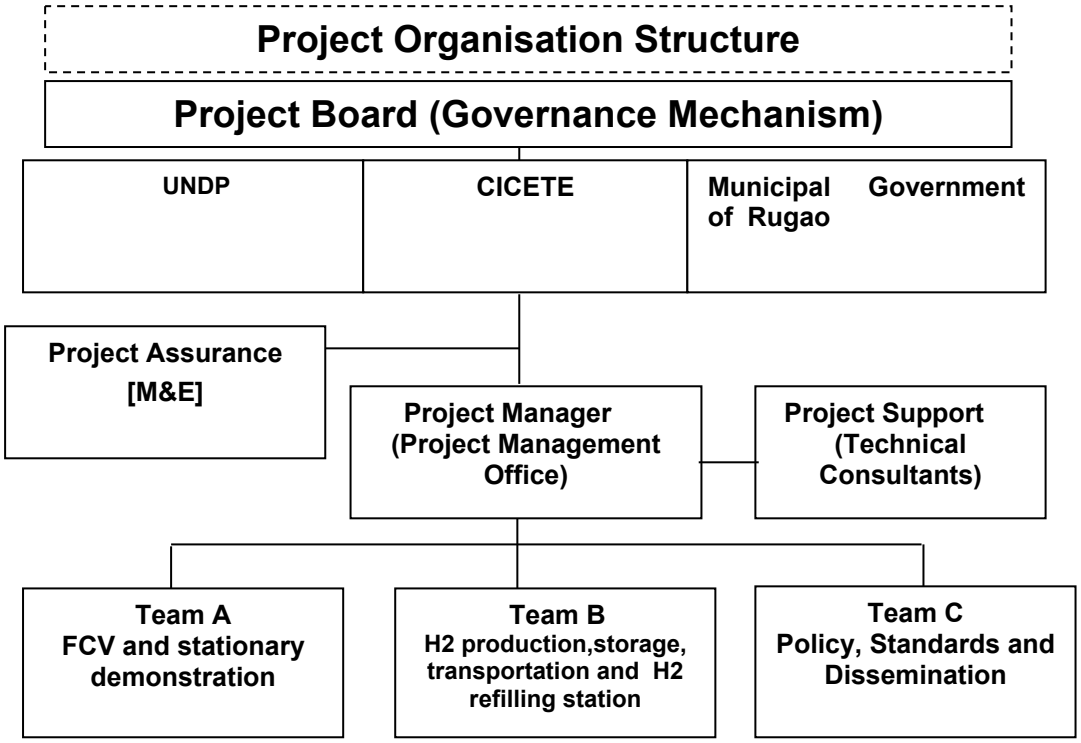
	6.5 Conduct the project advocacy program and experience dissemination by organizing interested cities and city officials.	5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Contractual Services– Company	20,000
	6.6 Design of a sustainable follow-up plan.	0	0	0	4,000	Rugao, PMO	Gov't	Local Consultants	4,000
		0	0	0	5000	Rugao, PMO	Gov't	Travel	5,000
		0	0	0	31,000	Rugao, PMO	Gov't	Contractual Services– Company	31,000
	6.7 Conduct summary of demo city experience, fruits and demo business models.	0	0	0	2,000	Rugao, PMO	Gov't	Local Consultants	2,000
	MONITORING								
	Sub-Total for Output 6								327,000
Output 7 *Project management and implementation including project management office operation, project monitoring and evaluation, and project communication*	7.1 Recruitment of PMO staff, etc	47,500	47,500	47,500	47,500	Rugao, PMO	Gov't	PMO staff	190,000
		5,000	0	0	0	Rugao, PMO	Gov't	Equipment and Furniture	5,000
		5,000	0	0	0	Rugao, PMO	Gov't	Miscellaneous Expenses	5,000
	7.2 Annual Tripartite Review	3,750	3,750	3,750	3,750	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	15,000
	7.3 Auditing	5,000	5,000	5,000	5,000	Rugao, PMO	Gov't	Contractual Services– Company	20,000
	7.4 Project progress reporting, including quarterly, annual and final reports.	0	0	0	0	Rugao, PMO	Gov't		0
	7.5 Project Inception Workshop	10,000	0	0	0	Rugao, PMO	Gov't		10,000

	7.6 Hydrogen Alliance Annual Conference	10,000	10,000	10,000	10,000	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	40,000
	7.7 Project Final Workshop	0	0	0	10,000	Rugao, PMO	Gov't	Trainings, Workshops and Conferences	10,000
	7.8 Advocacy of project results at international conferences, including the COP of UNFCCC	12,500	12,500	12,500	12,500	UNDP	Gov't	Travel	50,000
	7.9 Advocacy of project results to other cities in China through workshops and/or local study tours	12,500	12,500	12,500	12,500	CICETE	Gov't	Travel	50,000
	MONITORING								
	Sub-Total for Output 7								395,000
Evaluation (as relevant)	Mid-term EVALUATION	0	5,000	0	0	Rugao, PMO	Gov't	Local Consultants	5,000
	Terminal Evaluation	0	0	0	5,000	Rugao, PMO	Gov't	Local Consultants	5,000
General Management Support	GMS（UNDP)	60,000	150,000	60,000	30,000	UNDP	Gov't		300,000
	GMS(CICETE)	60,000	150,000	60,000	30,000	CICETE	Gov't		300,000
	DPC(UNDP)	25,000	25,000	25,000	25,000	UNDP	Gov't		100,000
	DPC(CICETE)	25,000	25,000	25,000	25,000	CICETE	Gov't		100,000
TOTAL									**10,000,000**

VIII. GOVERNANCE AND MANAGEMENT ARRANGEMENTS

Explain the roles and responsibilities of the parties involved in governing and managing the project. While an example diagram is below, it is not required to follow this diagram exactly. A project can be jointly governed with other projects, for example, through a national steering sub-committee linked to Results Groups under the UNDG Standard Operating Procedures for countries adopting the Delivering as One approach.

Minimum requirements for a project's governance arrangements include stakeholder representation (i.e., UNDP, Rugao local government, CICETE, Society of Automotive Engineers China (SAE China) and China Automotive Technology and Research Center (CATARC), SAIC, YUTONG, Hyundai, Green Wheel EV, institutions, universities, Pilot Enterprises on FC production and Pilot Enterprises on H2 production and refilling, etc.) with authority to make decisions regarding the project. Describe how target groups will be engaged in decision making for the project, to ensure their voice and participation. The project's management arrangements must include, at minimum, a project manager and project assurance that advises the project governance mechanism. This section should specify the minimum frequency the governance mechanism will convene (i.e., at least annually.). Organization structure is designed as follows.



Following duty and responsibility shall be revised in accordance with the NEX manual and relevant rules.

UNDP China will be responsible for: (i) providing financial and audit services to the project; (ii) overseeing financial expenditures against project budgets approved; (iii) appointing independent financial auditors and evaluators; and (iv) ensuring that all activities including procurement and financial services are carried out in strict compliance with UNDP procedures.

The National Project Director will direct overall implementation of the project and delegate day-to-day coordination work to the PMO. The project Management Office (PMO) within a team comprised of Project Manager (PM), and additional support staff will be established. The key activities of project management include: project planning, project management and implementation, final project evaluation, project workshops, as well as project information exchanging and sharing. Details of the overall management and coordination structures are to be in accordance with the UNDP NEX manual and relevant rules. Project

Management Office (PMO) will be responsible for managing and coordinating the implementation of all project activities, including: (i) preparation/updates of project work and budget plans, record keeping, accounting and quarterly and annual progress reporting; (ii) drafting of terms of reference, technical specifications and other documents as necessary; (iii) identification, proposal of project consultants to be approved by the PSCs, coordination and supervision of consultants and suppliers; (iv) Prepare and organize the material and equipment procurement equipment based on the RRF and work plan through tendering; (v) organization of duty travel, seminars, public outreach activities and other project events; and (vi) maintaining working contacts with project partners at the central and local levels; (vii) organize the exchange and cooperation activities.

CICETE will act as Implementing Partner and be responsible for the following project management activities:

1. Prepare the project management manual based on the UNDP Result-Based Management (RBM) and NEX modality;

2. Implementation management approved and authorized by NPD of Rugao Municipality, namely , financial management for all project activities approved and authorized by NPD or Project Manager designated by NPD, based on approved budget; recruitment of international and national consultants; organizing the bidding process of subcontracts, preparing and signing subcontracts with qualified subcontractor; material procurement; progress reporting etc.

3. Responsible for carrying out capacity-building trainings and workshops in collaboration with UNDP for PMO staff of Rugao Municipality and other relevant stakeholders based on UNDP/CICETE NEX manual;

4. Carry out Monitoring and Evaluation (M&E) along with UNDP based on UNDP/CICETE NEX manual;

5. Information sharing and publication of the project results;

Project steering committee is composed by UNDP, Rugao Municipality, CICETE, technical advisor group as well as relevant departments of Jiangsu Province. The technical advisor group shall be composed by experts from Fuel Cell Vehicle policy, renewable energy, Fuel Cell, FCV Standard, Project chief technical advisor etc. Annual project steering committee shall be prepared every year with the experts in order to demonstrate the direction and management of the project. Based on the project steering committee, an annual project review shall be conducted annually at a time specified during the project inception to assess the performance of the project and appraise the Four Year Work Plan with specific focus on the following year. This review is driven by the Project Steering Committee but may involve other stakeholders as required. It shall focus on the extent to which progress is being made towards outputs, and that these remain aligned to appropriate components.

To efficiently implement the Knowledge and Information Development and Technology Demonstration section, Team A (FCV and stationary demonstration), Team B (Hydrogen production and hydrogen refilling station) and Team C (Policy, Standards Finance & Dissemination) will be formed under the guidance and coordination of PMO. Generally speaking, Team A (Team A (FCV and stationary demonstration)) will be responsible for activities under Output 4,mainly related to 5 FCBs, 2 FC cars and FC cogeneration system demonstration and operation collection and analysis. Rugao public transportation companies, FC cars operation companies, FCB and FC car suppliers, FC cogeneration system suppliers and operation companies and Bing Energy Company will involve in these technologies demonstration. Team B (Hydrogen production and hydrogen refilling station) is principally responsible for activities under Output 2 and Output 3, mainly related to hydrogen production from renewable energy and hydrogen refilling station demonstration. Companies from hydrogen production, equipment suppliers, and demonstration& operation companies will involve these technology demonstrations. Team C (Policy, Standards& Dissemination) will be responsible for activities under Output1, Output 5, Output 6, mainly include hydrogen and FCV roadmap, related incentive policy development, related standards and codes and project dissemination. Institutes, society organization, companies and universities in the field of hydrogen and FCV and FC will involve these knowledge and information development.

What is more, the project will develop a communications, publicity and information strategy in the first year, which will be updated annually and have its implementation supported by a communications, education and awareness team. This will include capturing and disseminating lessons from the project steering committee in order to demonstrate the direction and management of the project, and shared with project stakeholders as

appropriate. The results from the project, as well as the awareness raising materials, will also be publicized and used for information exchange through a number of existing information sharing networks and forums. The lessons learned from this project will also benefit related programs and provide some significant experience to related agencies. Support project communications, publicity and information exchange with related programs and agencies.

IX. LEGAL CONTEXT AND RISK MANAGEMENT

Select the relevant one from each drop down below for the relevant standard legal text:

1. Legal Context:
   - √ Country has signed the Standard Basic Assistance Agreement (SBAA)
   - Country has not signed the Standard Basic Assistance Agreement (SBAA)
   - Regional or Global project

2. Implementing Partner:
   - √ Government Entity (NIM)
   - UNDP (DIM)
   - CSO/NGO/IGO
   - UN Agency (other than UNDP)
   - Global and regional projects

Or click here for the MS Word version of the standard legal and risk management clauses.

X. ANNEXES

1. **Project Quality Assurance Report**

2. **Social and Environmental Screening Template** [English][French][Spanish], including additional Social and Environmental Assessments or Management Plans as relevant. *(NOTE: The SES Screening is not required for projects in which UNDP is Administrative Agent only and/or projects comprised solely of reports, coordination of events, trainings, workshops, meetings, conferences, preparation of communication materials, strengthening capacities of partners to participate in international negotiations and conferences, partnership coordination and management of networks, or global/regional projects with no country level activities).*

Project Information

Project Information	
1. Project Title	Hydrogen Economy Pilot in China
2. Project Number	00096939
3. Location (Global/Region/Country)	China

Part A. Integrating Overarching Principles to Strengthen Social and Environmental Sustainability

QUESTION 1: How Does the Project Integrate the Overarching Principles in order to Strengthen Social and Environmental Sustainability?
Briefly describe in the space below how the Project mainstreams the human-rights based approach
The project does not have any activities specifically focused on mainstreaming the human rights based approach. It will, however, in general terms ensure it follows the human rights based approach, despite one identified risk, as explained below.
Briefly describe in the space below how the Project is likely to improve gender equality and women's empowerment
The project does not have any activities specifically focused on mainstreaming gender equality and women's empowerment. As such, it is not likely to improve these areas in a general way. Yet, efforts will be taken to promote gender equality and women's empowerment where possible and as follows: Throughout all its activities, the project will aim to include as many women as possible, both as recipients of various forms of technical assistance and as consultants retained by the project. In particular, six major project activities,workshops, and study tours include in their design efforts to include as many women as possible.
Briefly describe in the space below how the Project mainstreams environmental sustainability
This project's objective is demonstrate the application of hydrogen production and technology in the field of manufacturing and consumer, and build the first "Hydrogen City" to demonstrate the hydrogen economy. Renewable energy based hydrogen production of substantial scale is introduced into China as are hydrogen refueling stations with varied business models. Policy promoting FCVs is enhanced as is awareness of FCVs.

Part B. Identifying and Managing Social and Environmental Risks

QUESTION 2: What are the Potential Social and Environmental Risks? *Note: Describe briefly potential social and environmental risks identified in Attachment 1 – Risk Screening Checklist (based on any "Yes" responses). If no risks have been identified in Attachment 1 then note "No Risks Identified" and skip to Question 4 and Select "Low Risk". Questions 5 and 6 not required for Low Risk Projects.*	**QUESTION 3: What is the level of significance of the potential social and environmental risks?** *Note: Respond to Questions 4 and 5 below before proceeding to Question 6*			**QUESTION 6: What social and environmental assessment and management measures have been conducted and/or are required to address potential risks (for Risks with Moderate and High Significance)?**
Risk Description	***Impact and Probability (1-5)***	***Significance (Low, Moderate, High)***	***Comments***	***Description of assessment and management measures as reflected in the Project design. If ESIA or SESA is required note that the assessment should consider all potential impacts and risks.***
Risk 1 (Principle 1-4): There is a possibility that residents of certain neighborhoods will not be included in decisions to site hydrogen refueling stations in those neighborhoods.	I = 3 P = 3	Moderate		Project plans annual survey of public perception of hydrogen refueling stations in the neighborhood of the HRS demos. For cities that lack standard consultative process, first annual survey will serve to initiate consultation process.
Risk 2 (Principle 2-2): There is a possibility that the project will unintentionally reproduce discrimination against women based on gender, particularly with regard to participation in some project activities. While women are well-represented in the workplace in China, they may face a "glass ceiling" and as such may not be accorded equal opportunities for involvement in special activities, such as workshops and international study tours.	I = 3 P = 3	Moderate	The reason a probability of 3 "moderately likely" is given is that it will generally be the beneficiary work unit rather than the project itself that makes the decision as to who will be involved in project activities. Beneficiary work units may have a bias towards involving men in project activities over women. The impact is also rated 3 ("moderate"). With fewer women involved in project activities than might be, the potential for them to be significantly involved in the	Throughout all its activities, the project will aim to include as many women as possible, both as recipients of various forms of technical assistance and as consultants retained by the project. In particular, six major project activities, one for each of the aforementioned groups) include written into their design that an effort to include as many women as possible will be made.

			FCV sector is further reduced.	
Risk 3 (Principle 3, Standard 3-3.1): It is possible that elements of project operation will lead to potential safety risks to the community, as relates to the production, transport, and refueling of hydrogen, as well as its use in vehicles. For FCVs the main risk relates to hydrogen leaks (due to part failure or rupture due to impact), which could lead to fire or explosion. For hydrogen refueling stations, the main risk relates to hydrogen leaks (due to part failure or misuse), which could lead to fire or explosion. For hydrogen production, the main risk is that hydrogen leak (due to part failure) could lead to fire or explosion. As for hydrogen transport (from producer to station), the main risk is hydrogen leak at tanker truck (due to part failure, accident) that could lead to fire or explosion.	I = 2 P = 2	Low	While safety issues are acknowledged and deserve careful attention, there is in a sense also a certain level of myth in regard to hydrogen safety issues. Hydrogen has some substantial advantages that limit the impact of any incident: It is so light that it immediately evaporates upwards and disappears. It is also non-poisonous, so that there is no contamination or health impact to affected people or environment (except fire/explosion). Finally, because hydrogen is so light, any fire will be gone quickly (much faster than a gasoline/natural gas fire).	Safety issues will receive prominent position in technical assistance for FCV manufacturers and renewable energy based hydrogen production, as well as in technical assistance for hydrogen refueling stations. Their coverage is specifically indicated in the text of the project design. Standards and testing work will further reinforce safety aspects. Specific countermeasures taken for each sub-area of risk and that will be adopted in the aforementioned activities include the following: (1) FCV risk: countermeasures in vehicle and component design (special hoses, valves, position of tank in vehicle), hydrogen sensors, and shutoff-valves; (2) hydrogen refueling station risk: station design, safety/shutoff mechanisms, control of station, and location of pump and equipment; (3) hydrogen production risk: design, shutoff mechanisms, and operator training; (4) hydrogen transport risk: tanker and component design, safety/shutoff mechanisms, and operator training.
Risk 4 (Principle 3, Standard 3-3.2): It is possible that elements of project operation will lead to potential occupational safety risks as relates to the production, transport, and refueling of hydrogen, as well as its use in vehicles. The specific risks for each of these areas is the same as outlined above under Risk 3.	I = 2 P = 2	Low		Same management measures as described in cell directly above in Table 1 .

	QUESTION 4: What is the overall Project risk categorization?		
	Select one (see SESP for guidance)		**Comments**
	Low Risk	☐	
	Moderate Risk	√☐	Of four risks, two are rated “moderate;” Two rated “low.”
	High Risk	☐	
	QUESTION 5: Based on the identified risks and risk categorization, what requirements of the SES are relevant?		
	Check all that apply		**Comments**

	Principle 1: Human Rights	√☐	Risk 1 relates to human rights – the right to be involved in decisions that impact one's community
	Principle 2: Gender Equality and Women's Empowerment	√☐	Risk 2 relates to gender equity and women's empowerment – the principle that women should be treated equally and have equal opportunity (in this case equal opportunity for participation in the project and related career advancement or business opportunity)
	1. Biodiversity Conservation and Natural Resource Management	☐	
	2. Climate Change Mitigation and Adaptation	☐	
	3. Community Health, Safety and Working Conditions	√☐	Risks 3 and 4 relate to safety of the community and employees with regard to hydrogen production, transport, refueling, and use in vehicles.
	4. Cultural Heritage	☐	
	5. Displacement and Resettlement	☐	
	6. Indigenous Peoples	☐	
	7. Pollution Prevention and Resource Efficiency	☐	

Final Sign Off

Signature	***Date***	***Description***
QA Assessor		UNDP staff member responsible for the Project, typically a UNDP Programme Officer. Final signature confirms they have "checked" to ensure that the SESP is adequately conducted.
QA Approver		UNDP senior manager, typically the UNDP Deputy Country Director (DCD), Country Director (CD), Deputy Resident Representative (DRR), or Resident Representative (RR). The QA Approver cannot also be the QA Assessor. Final signature confirms they have "cleared" the SESP prior to submittal to the PAC.
PAC Chair		UNDP chair of the PAC. In some cases PAC Chair may also be the QA Approver. Final signature confirms that the SESP was considered as part of the project appraisal and considered in recommendations of the PAC.

SESP Attachment 1. Social and Environmental Risk Screening Checklist

Checklist Potential Social and Environmental Risks	
Principles 1: Human Rights	**Answer (Yes/No)**
1. Could the Project lead to adverse impacts on enjoyment of the human rights (civil, political, economic, social or cultural) of the affected population and particularly of marginalized groups?	No
2. Is there a likelihood that the Project would have inequitable or discriminatory adverse impacts on affected populations, particularly people living in poverty or marginalized or excluded individuals or groups?[11]	No
3. Could the Project potentially restrict availability, quality of and access to resources or basic services, in particular to marginalized individuals or groups?	No
4. Is there a likelihood that the Project would exclude any potentially affected stakeholders, in particular marginalized groups, from fully participating in decisions that may affect them?	No
5. Is there a risk that duty-bearers do not have the capacity to meet their obligations in the Project?	No
6. Is there a risk that rights-holders do not have the capacity to claim their rights?	No
7. Have local communities or individuals, given the opportunity, raised human rights concerns regarding the Project during the stakeholder engagement process?	No
8. Is there a risk that the Project would exacerbate conflicts among and/or the risk of violence to project-affected communities and individuals?	No
Principle 2: Gender Equality and Women's Empowerment	
1. Is there a likelihood that the proposed Project would have adverse impacts on gender equality and/or the situation of women and girls?	No
2. Would the Project potentially reproduce discriminations against women based on gender, especially regarding participation in design and implementation or access to opportunities and benefits?	No
3. Have women's groups/leaders raised gender equality concerns regarding the Project during the stakeholder engagement process and has this been included in the overall Project proposal and in the risk assessment?	No
4. Would the Project potentially limit women's ability to use, develop and protect natural resources, taking into account different roles and positions of women and men in accessing environmental goods and services? *For example, activities that could lead to natural resources degradation or depletion in communities who depend on these resources for their livelihoods and well being*	No
Principle 3: Environmental Sustainability: Screening questions regarding environmental risks are encompassed by the specific Standard-related questions below	
Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management	
1.1 Would the Project potentially cause adverse impacts to habitats (e.g. modified, natural, and critical habitats) and/or ecosystems and ecosystem services? *For example, through habitat loss, conversion or degradation, fragmentation, hydrological changes*	No
1.2 Are any Project activities proposed within or adjacent to critical habitats and/or environmentally sensitive areas, including legally protected areas (e.g. nature reserve, national park), areas proposed for protection, or recognized as such by authoritative sources and/or indigenous peoples or local communities?	No
1.3 Does the Project involve changes to the use of lands and resources that may have adverse impacts on habitats, ecosystems, and/or livelihoods? (Note: if restrictions and/or limitations of access to lands would apply, refer to Standard 5)	No
1.4 Would Project activities pose risks to endangered species?	No
1.5 Would the Project pose a risk of introducing invasive alien species?	No
1.6 Does the Project involve harvesting of natural forests, plantation development, or reforestation?	No

[11] Prohibited grounds of discrimination include race, ethnicity, gender, age, language, disability, sexual orientation, religion, political or other opinion, national or social or geographical origin, property, birth or other status including as an indigenous person or as a member of a minority. References to ''women and men'' or similar is understood to include women and men, boys and girls, and other groups discriminated against based on their gender identities, such as transgender people and transsexuals.

1.7	Does the Project involve the production and/or harvesting of fish populations or other aquatic species?	No
1.8	Does the Project involve significant extraction, diversion or containment of surface or ground water? *For example, construction of dams, reservoirs, river basin developments, groundwater extraction*	No
1.9	Does the Project involve utilization of genetic resources? (e.g. collection and/or harvesting, commercial development)	No
1.10	Would the Project generate potential adverse trans-boundary or global environmental concerns?	No
1.11	Would the Project result in secondary or consequential development activities which could lead to adverse social and environmental effects, or would it generate cumulative impacts with other known existing or planned activities in the area? *For example, a new road through forested lands will generate direct environmental and social impacts (e.g. felling of trees, earthworks, potential relocation of inhabitants). The new road may also facilitate encroachment on lands by illegal settlers or generate unplanned commercial development along the route, potentially in sensitive areas. These are indirect, secondary, or induced impacts that need to be considered. Also, if similar developments in the same forested area are planned, then cumulative impacts of multiple activities (even if not part of the same Project) need to be considered.*	No
Standard 2: Climate Change Mitigation and Adaptation		
2.1	Will the proposed Project result in significant[12] greenhouse gas emissions or may exacerbate climate change?	No
2.2	Would the potential outcomes of the Project be sensitive or vulnerable to potential impacts of climate change?	No
2.3	Is the proposed Project likely to directly or indirectly increase social and environmental vulnerability to climate change now or in the future (also known as maladaptive practices)? *For example, changes to land use planning may encourage further development of floodplains, potentially increasing the population's vulnerability to climate change, specifically flooding*	No
Standard 3: Community Health, Safety and Working Conditions		
3.1	Would elements of Project construction, operation, or decommissioning pose potential safety risks to local communities?	Yes
3.2	Would the Project pose potential risks to community health and safety due to the transport, storage, and use and/or disposal of hazardous or dangerous materials (e.g. explosives, fuel and other chemicals during construction and operation)?	Yes
3.3	Does the Project involve large-scale infrastructure development (e.g. dams, roads, buildings)?	No
3.4	Would failure of structural elements of the Project pose risks to communities? (e.g. collapse of buildings or infrastructure)	No
3.5	Would the proposed Project be susceptible to or lead to increased vulnerability to earthquakes, subsidence, landslides, and erosion, flooding or extreme climatic conditions?	No
3.6	Would the Project result in potential increased health risks (e.g. from water-borne or other vector-borne diseases or communicable infections such as HIV/AIDS)?	No
3.7	Does the Project pose potential risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during Project construction, operation, or decommissioning?	Yes
3.8	Does the Project involve support for employment or livelihoods that may fail to comply with national and international labor standards (i.e. principles and standards of ILO fundamental conventions)?	No
3.9	Does the Project engage security personnel that may pose a potential risk to health and safety of communities and/or individuals (e.g. due to a lack of adequate training or accountability)?	No
Standard 4: Cultural Heritage		
4.1	Will the proposed Project result in interventions that would potentially adversely impact sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture (e.g. knowledge, innovations, practices)? (Note: Projects intended to protect and conserve Cultural Heritage may also have inadvertent adverse impacts)	No
4.2	Does the Project propose utilizing tangible and/or intangible forms of cultural heritage for commercial or other purposes?	No
Standard 5: Displacement and Resettlement		
5.1	Would the Project potentially involve temporary or permanent and full or partial physical displacement?	No
5.2	Would the Project possibly result in economic displacement (e.g. loss of assets or access to resources due to land acquisition or access restrictions – even in the absence of physical relocation)?	No
5.3	Is there a risk that the Project would lead to forced evictions?[13]	No

[12] In regards to CO_2, 'significant emissions' corresponds generally to more than 25,000 tons per year (from both direct and indirect sources). [The Guidance Note on Climate Change Mitigation and Adaptation provides additional information on GHG emissions.]

5.4	Would the proposed Project possibly affect land tenure arrangements and/or community based property rights/customary rights to land, territories and/or resources?	No
Standard 6: Indigenous Peoples		
6.1	Are indigenous peoples present in the Project area (including Project area of influence)?	No
6.2	Is it likely that the Project or portions of the Project will be located on lands and territories claimed by indigenous peoples?	No
6.3	Would the proposed Project potentially affect the human rights, lands, natural resources, territories, and traditional livelihoods of indigenous peoples (regardless of whether indigenous peoples possess the legal titles to such areas, whether the Project is located within or outside of the lands and territories inhabited by the affected peoples, or whether the indigenous peoples are recognized as indigenous peoples by the country in question)? *If the answer to the screening question 6.3 is "yes" the potential risk impacts are considered potentially severe and/or critical and the Project would be categorized as either Moderate or High Risk.*	No
6.4	Has there been an absence of culturally appropriate consultations carried out with the objective of achieving FPIC on matters that may affect the rights and interests, lands, resources, territories and traditional livelihoods of the indigenous peoples concerned?	No
6.5	Does the proposed Project involve the utilization and/or commercial development of natural resources on lands and territories claimed by indigenous peoples?	No
6.6	Is there a potential for forced eviction or the whole or partial physical or economic displacement of indigenous peoples, including through access restrictions to lands, territories, and resources?	No
6.7	Would the Project adversely affect the development priorities of indigenous peoples as defined by them?	No
6.8	Would the Project potentially affect the physical and cultural survival of indigenous peoples?	No
6.9	Would the Project potentially affect the Cultural Heritage of indigenous peoples, including through the commercialization or use of their traditional knowledge and practices?	No
Standard 7: Pollution Prevention and Resource Efficiency		
7.1	Would the Project potentially result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional, and/or trans-boundary impacts?	No
7.2	Would the proposed Project potentially result in the generation of waste (both hazardous and non-hazardous)?	No
7.3	Will the proposed Project potentially involve the manufacture, trade, release, and/or use of hazardous chemicals and/or materials? Does the Project propose use of chemicals or materials subject to international bans or phase-outs? *For example, DDT, PCBs and other chemicals listed in international conventions such as the Stockholm Conventions on Persistent Organic Pollutants or the Montreal Protocol*	No
7.4	Will the proposed Project involve the application of pesticides that may have a negative effect on the environment or human health?	No
7.5	Does the Project include activities that require significant consumption of raw materials, energy, and/or water?	No

3. **Risk Analysis**. Use the standard Risk Log template. Please refer to the Deliverable Description of the Risk Log for instructions

[13] Forced evictions include acts and/or omissions involving the coerced or involuntary displacement of individuals, groups, or communities from homes and/or lands and common property resources that were occupied or depended upon, thus eliminating the ability of an individual, group, or community to reside or work in a particular dwelling, residence, or location without the provision of, and access to, appropriate forms of legal or other protections.

Table lists both the risks and mitigation strategy in terms of market, economic, environmental, and social and policy perspectives.

Table The risks and mitigation strategies

Types of risks	Risk description	Levels of the risk	Mitigation strategy
Risks in material supply	It is difficult to procure the improved FCV and other hydrogen related equipment.	Low	International and national consultants' expertise in FCV will be recruited to provide technical support in procurement.
Market and economic risks	The level of co-sharing amount may not be transferred into designated account timely and support the project implementation promptly and sufficiently.	Low	Substantial co-sharing commitment has been obtained. During project implementation, the project team will closely monitor and ensure co-sharing is available by project partners and co-financers promptly and at least as per their respective committed amounts.
Policy and institutional risks	Recommended policies may not be approved by the relevant authorities, or may be approved but not effectively enforced.	Low	The project will include the piloting of the application of the support policies for hydrogen economy to gauge the effectiveness of said policies. That will help guide the relevant government authorities in the finalization, approval, and effective enforcement of such policies.

4. **Capacity Assessment:** Results of capacity assessments of Implementing Partner (including HACT Micro Assessment)

5. **Project Board Terms of Reference and TORs of key management positions**

TORs below are "skeleton" style, consisting mainly of required tasks, deliverables, and required qualifications. During implementation, more TORs will be expanded if required.

International Consultants

1. Fuel Cell Vehicle consultant (2 working month/year)

Required Tasks

- Provide leadership in project design, implementation and dissemination
- Build channels between Rugao city and international enterprises, projects and organizations
- Develop hydrogen pilot plans to meet project targets
- Select appropriate manufacturers for assistance in FCV demonstration
- Provide technical assistance to pilot city via site visits and conference calls to achieve aforementioned targets
- Prepare technical reports needed. Reports will be targeted at stakeholders in industry, academia, and government.
- Help disseminate project progress through contacts with relevant stakeholders (governments, international hydrogen/FC organizations, vehicles and energy enterprises, investors etc),or relevant hydrogen/FCV meetings/workshops needed
- Prepare project duplicate reports
- Other tasks required by project

Deliverables

- List of selected FCV manufacturers
- RFPs for demonstration equipment
- FCV Memos plans in transportation, demonstration summary and improvement reports
- All relevant technical reports required

Required Qualifications

- Ten or more years of experience in FCV design and manufacturing, including experience with top OEM
- Recognition as expert in FCV field
- 15 or more years of experience in auto industry
- Strong communication skills
- High level of integrity

2. International Fuel Cell consultant (2 Working month/year)

Required Tasks

- Assessment of current FC and stationary technology and quality
- Build channels between Rugao city and international enterprises, projects and organizations
- Development of FC demonstration plan in the field of transportation and stationary
- Provide technical assistance to improve production and demonstration
- Support in potential procurement of FC and stationary related equipment
- Other tasks required by project

Deliverables

- Reports on assessment of current FC and stationary technology and quality
- RFP of FC and FC stationary
- Reports on improvements adopted and quality improvements and cost reductions achieved thereby

Required Qualifications

- Recognized expert in FC membranes

- Expertise in FC and stationary
- Strong communication skills
- High level of integrity

TORs of main National Consultants

1. Project FCV and hydrogen policy advisor (4 working month/year)

Required Tasks

- Provide leadership in project design, implementation and dissemination
- Build channels between Rugao city and international enterprises, projects and organizations
- Provide technical provision in FCV and hydrogen policy development and planning
- Provide technical provision in Rugao hydrogen economy roadmap
- Select appropriate manufacturers for assistance in FCV demonstration
- Provide technical assistance to pilot city via site visits and conference calls to achieve aforementioned targets
- Prepare technical reports needed. Reports will be targeted at stakeholders in industry, academia, and government.
- Help disseminate project progress through contacts with relevant stakeholders (governments, international hydrogen/FC organizations, vehicles and energy enterprises, investors etc),or relevant hydrogen/FCV meetings/workshops needed
- Other tasks required by project

Deliverables

- All policy related technical reports
- Technical reports and application plan about policy and planning reports

2. Chief Technical Advisor (5 working month/year)

Required Tasks

- Refine project activities on annual basis, contributing to preparation of annual work plan
- Provide technical advice, with focus on project's Outcomes, outputs, activities. Technical advice will focus on how to improve activities, as well as quality control of ongoing activities
- Provide technical support on activities implementation and summary reports
- Support TOR design with technical input
- Assist PMO in recruiting appropriate international consultants, assistance will include leveraging of network to identify promising candidates
- Review project relevant reports and identify needed improvements
- Support preparing RFPs for project vehicles or equipment and subcontractors and provide support on contract negotiation.
- Assist pilot city in liaising with relevant international manufactures and service suppliers.
- Coordinate with stakeholders and present project progress at meetings/workshops needed
- Review monitoring results of project demos and provide recommendations for trouble shooting and improvement of demos
- Other tasks required by project

Deliverables

- Annual work plans (in conjunction with rest of PMO)
- Revision/expansion of technical aspects of project activities
- Memos describing current status of demos and actions for improvement
- RFPs and contracts for demonstration equipment procured
- Step-by-step action plans for project progress
- Technical reports required

Required Qualifications

- At least ten years of experience in hydrogen, FCVs and NEVs generally
- At least 10 years of experience in auto industry
- Strong network within hydrogen, FCV and FCV/FC component industry
- Experience in designing and implementation UNDP demos
- Experience in monitoring and reporting on hydrogen/FCV demo results
- High level of integrity
- Strong communication skills

3. Renewable energy consultant (2 working month/year)

Required Tasks

- Design renewable energy plan
- Provide technical support in designing hydrogen produced from wind, solar PV-based or other waste
- Provide support in hydrogen production demonstration
- Help disseminate project progress through contacts with relevant stakeholders (governments, international hydrogen/FC organizations, vehicles and energy enterprises, investors etc),or relevant hydrogen/FCV meetings/workshops needed
- Prepare project duplicate reports
- Other tasks required by project

Deliverables

- Renewable energy technical status reports
- Technical reports and application plan about renewable energy
- project duplicate reports

Required Qualifications

- Recognized expert in renewable energy based hydrogen production
- Broad knowledge of renewable energy based hydrogen production and worldwide projects in this area, covering wind, solar PV, and biogas/landfill methane based hydrogen production
- Strong communication skills
- Strong network

4. Fuel Cell consultant (2 Working month/year)

Required Tasks

- Assessment of current FC and stationary technology and quality
- Development of FC demonstration plan in the field of transportation and stationary
- Provide technical assistance to improve production and demonstration
- Support in potential procurement of FC and stationary related equipment
- Other tasks required by project

Deliverables

- Reports on assessment of current FC and stationary technology and quality
- RFP of FC and FC stationary
- Reports on improvements adopted and quality improvements and cost reductions achieved thereby

Required Qualifications

- Recognized expert in FC membranes
- Expertise in FC and stationary

- Strong communication skills
- High level of integrity

5. FCV Standard consultant (2 working month/year)

Required Tasks:

- Identify priority gaps in China's existing standards for FCVs, hydrogen stations, and hydrogen production/transport, as well as priority areas in which harmonization with international standards may be increased.
- Review existing Chinese standards, as well as international counterpart standards, to identify gaps. Propose areas for revision to the relevant committees responsible for designing standards in each area.
- Develop and promote approval of testing and certification system for FCV vehicles, Review certification testing and certification needs in relevant areas, as well as international experience in these areas. Based on findings, design testing and certification system.
- Develop and promote adoption and enforcement of standard safety. Based on findings, design recommendations for relevant government regulatory departments.

Deliverables

- Written reporting gaps in China's existing standards for FCVs, HRSs, and hydrogen production transport and proposing areas for revision to the relevant committees responsible for designing standards in each area.
- Draft testing and certification system for FCVs, HRS, and products supporting the FCV industry.
- Draft standard safety and procedures for FCVs and hydrogen infrastructure.

Required Qualifications

- Proven track recording in designing technical standards for China, particularly in auto and hydrogen related sectors
- Strong experience related to NEV standards, testing and certification
- Strong familiarity with international standards for FCVs and HRSs
- Ten or more years of experience advising Chinese Government on standards, testing, and certification
- Very strong writing skills
- High level of integrity

6.Fuel Cell Vehicle demonstration consultant (2 working month/year)

Required Tasks

- Provide leadership in project design, implementation and dissemination
- Develop hydrogen pilot plans to meet project targets
- Select appropriate manufacturers for assistance in FCV demonstration
- Provide technical assistance to pilot city via site visits and conference calls to achieve aforementioned targets
- Prepare technical reports needed. Reports will be targeted at stakeholders in industry, academia, and government.
- Help disseminate project progress through contacts with relevant stakeholders (governments, international hydrogen/FC organizations, vehicles and energy enterprises, investors etc),or relevant hydrogen/FCV meetings/workshops needed
- Prepare project duplicate reports
- Other tasks required by project

Deliverables

- List of selected FCV manufacturers
- RFPs for demonstration equipment
- FCV Memos plans in transportation, demonstration summary and improvement reports
- All relevant technical reports required
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Required Qualifications

- Ten or more years of experience in FCV design and manufacturing, including experience with top OEM
- Recognition as expert in FCV field
- 15 or more years of experience in auto industry
- Strong communication skills
- High level of integrity