TNA-Project-Yemen
Report III
Technology Action Plan (TAP)

November 2024

Foreword

The Technology Needs Assessment (TNA) represents a crucial milestone in Yemen's efforts to enhance climate resilience and transition towards a low-emission, sustainable future. As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, Yemen recognizes the vital role of technology transfer in achieving both mitigation and adaptation objectives. The TNA process provides a strategic approach to identifying, assessing, and prioritizing technologies that align with our national circumstances, development priorities, and climate commitments.

Yemen is among the countries most vulnerable to the adverse impacts of climate change, facing increasing temperatures, water scarcity, and extreme weather events. At the same time, limited access to modern, sustainable technologies has constrained national efforts to reduce greenhouse gas emissions (GHG) and build climate resilience. The TNA reports serve as guiding documents for decision-makers, development partners, and private-sector stakeholders to mobilize resources and implement concrete actions for technology deployment and diffusion.

The TNA reports not only highlight priority technologies in key sectors such as energy, transport, water, and agriculture but also provide a clear Technology Action Plan (TAP) that outlines pathways for their implementation. The TAP focuses on overcoming technical, financial, and institutional barriers to accelerate the adoption of climate-resilient and low-carbon technologies. Importantly, translating this report into tangible projects and investments is essential for achieving real progress on the ground.

The successful implementation of the identified technologies requires a multi-stakeholder approach, involving government institutions, international development partners, private sector actors, and local communities. We call upon all relevant stakeholders to support and contribute to the realization of this plan, ensuring that technology transfer is not just a policy recommendation but a transformative process that enhances climate resilience, economic development, and environmental sustainability in Yemen.

The Ministry of Water and Environment extends its appreciation to all experts, institutions, and international partners who contributed to this assessment. We reaffirm our commitment to advancing technology solutions that drive Yemen's sustainable development and strengthen its ability to adapt to and mitigate the impacts of climate change.

Eng Taofeg AL-Sharjabi
Minister of Water and Environment

Acknowledgement

Addressing climate change requires a collective effort, dedication, and expertise. The successful completion of Yemen's Technology Needs Assessment (TNA) project stands as a testament to the commitment and collaboration of various stakeholders working towards a more sustainable and climate-resilient future. This achievement would not have been possible without the unwavering support and contributions of numerous individuals and organizations.

We extend our deepest appreciation to the **Climate Change Unit team** for their leadership and commitment to steering the project forward. Their expertise and tireless efforts have been instrumental in identifying Yemen's climate technology priorities and developing enabling frameworks to support their implementation.

Our sincere gratitude goes to the **national experts, sectoral specialists, and key stakeholders** who actively contributed to the assessment process. Their valuable insights, technical knowledge, and engagement ensured that the outcomes of the TNA reflect the real needs and priorities of Yemen in addressing climate change.

A special acknowledgment is extended to the **UNEP Copenhagen Climate Centre (UNEP CCC)** for their invaluable technical support and guidance throughout the project. In particular, we express our sincere thanks to **Ms. Sara Trærup, Dr. Gordon Mackenzie, and Dr. Debbie Sparks** for their dedicated assistance, expertise, and unwavering commitment to strengthening Yemen's climate planning efforts. Their contributions have played a pivotal role in ensuring a comprehensive and impactful TNA process.

This collaborative effort marks an important milestone in Yemen's pursuit of sustainable climate action. The knowledge, partnerships, and strategies developed through this initiative will serve as a foundation for future efforts to enhance the country's resilience and low-carbon development.

We extend our heartfelt appreciation to everyone who contributed to the successful implementation of the TNA project and look forward to continued collaboration in advancing Yemen's climate ambitions.

Eng Faisal Al-Thalabi
Environment Protection Authority Chairman

1. List of Steering Committee Members

Name	Title	Authority/Organization
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Eng. Farooq Ben-Taleb	TNA focal Point the Agriculture Sector	Ministry of Agriculture and Irrigation, & Fish Wealth (MAIF)

List of Acronyms

AF	Adaptation Fund
BRT	Bus Rapid Transit
BAEF	Barrier Analysis and Enabling Framework
CA	Custom Authority
CCC	Climate Change Centre
CTCN	Climate Technology Centre and Network
CO2	Carbon Dioxide
CA	Custom Authority
CIF	Climate Investment Fund
CoC-CDS	Chamber of Commerce, and Car Dealers Syndicate
CSOs	Civil Society Organizations
CDM	Clean Development Mechanism
CP	Country Programme
DTU	Technical University of Denmark
ADFD	Abu Dhabi Fund for Development
EPA	Environment Protection Authority
EbA	Ecosystem-based Adaptation
EIAs	Environmental Impact Assessments
FAO	Food and Agriculture Organization
FCDO	Foreign, Commonwealth and Development Office
GEF	Global Environment Facility
GJ	Gigajoules
GWP	Global Warming Potential
GDP	Gross domestic product
GoY	Government of Yemen
GCF	Green Climate Fund
Gg	Gigagram
eq	Equivalents
GHGs	Greenhouse Gases
HEV	Hybrid Electric Vehicles
IGOs	Intergovernmental organizations
INDC	Intended Nationally Determined Contribution
IsDB	Islamic Development Bank
IWRM	Integrated Water Resource Management
KFW	Kreditanstalt Für Wiederaufbau
KDB	Korea Development Bank

LT-LEDs	Long-Term Low Emission Development Strategy
LDC	Least Developed Country
LEAP program	Low Emissions Analysis Platform program
LWSSC	Local Water Supply and Sanitation Corporation
MCA	Multi-Criteria Analysis
MW	Megawatt
MEE	Ministry of Electricity and Energy
MT	Ministry of Transport
MPIC	Ministry of Planning and International Cooperation
MWE	Ministry of Water and Environment
MGW	Ministry of General Works
MIT	Ministry of Industry and Trade
MAIF	Ministry of Agriculture, Irrigation and Fisheries Wealth
MF	Ministry of Finance
M&E	Monitoring and Evaluation
m^3	Cubic metres
NSREE	National Strategy on Renewable Energy and Energy Efficiency
NWRA	National Water Resources Authority
NDCs	Nationally Determined Contributions
NAPs	National Adaptation Plans
NGOs	Non-Governmental Organizations
NDA	National Designated Authority
O&M	Operation and Maintenance
PWP	Public Work Project
PPPs	Public-Private Partnerships
RE	Renewable and Energy
R.O desalination	Seawater Reverse Osmosis Desalination
R&D	Research and Development
RWH	Rainwater Harvesting
SDGs	Sustainable Development Goals
SC	Steering Committee
SFD	Social Fund for Development
TNA	Technology Needs Assessment
TAPs	Technology Action Plans
TA	Tax Authority
TOR	Term of Reference of the Study
TP-MoI	Traffic Police – Ministry of Interior
TEI	Technical Education Institute
UNEP	United Nation Environment Programme
WFP	World Food Programme
WB	World Bank

Executive Summary

This Technology Action Plan (TAP) is the third and final report in the Technology Needs Assessment (TNA) process. The TAP builds on the two previous reports: (1) Technology Identification and Prioritization, and (2) Barrier Analysis and Enabling Framework (BA&EF). The TAP provides a roadmap for promoting prioritized mitigation and adaptation technologies in selected sectors, with proposed project ideas that may be developed into detailed proposals for funding and implementation.

The TAP builds on the economic and non-economic measures identified in Phase II (BA&EF). These measures were refined through consultations with technical groups from relevant institutions across four sectors. They were prioritized following TAP guidelines from the UNFCCC and UNEP DTU Partnership (2017). The TAP included the highest-ranked measures as actions, each of which was further developed into specific activities based on available time, capacity, and the required institutional and legislative frameworks. The interconnected and implementable nature of these activities was carefully considered.

Successful TAP implementation will require a capacity-building programme, assessments, and effective planning at multiple levels. Key capacities include institutional, technical, financial, and operational capabilities, along with monitoring, evaluation, and coordination. Several risks have been identified, including financial, technical, scheduling, and performance challenges, with mitigation measures proposed to address them. The TAP also emphasizes gender inclusion by actively engaging women in technical and administrative roles throughout project teams and key stakeholder groups across all sectors.

Energy sector

Yemen's energy sector is crucial for the country's economic development and is the largest source of greenhouse gas emissions, contributing 65% of national emissions, with approximately 22,038 Gg CO_2 -eq from fossil fuel combustion. Ongoing conflict has caused significant infrastructure damage, creating an energy deficit of over 2,000 MW. This deficit hinders socioeconomic progress and exposes the population to climate risks due to its direct impacts on public health caused by temperature rise. To address the energy shortage and increase Renewable Energy (RE) in Yemen's energy mix, the two technologies selected for this sector are off and on gird Solar PV and Wind Turbine.

Solar PV and Wind Turbine TAP

The ambition for these technologies is to expand solar PV capacity to 400 MW and wind energy to 200 MW by 2035. To achieve this target, the TAP report proposes implementing key actions identified, including 1) Spreading awareness by developing studies and research on the economic, social, and environmental benefits of Solar PV and Wind energy, 2) Updating the legislation system and enhancing the regulatory and policy framework for solar and wind energy in Yemen, 3) Updating the National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009), prioritizing solar PV and wind energy among the RE options, and enhancing the institutional framework of RE, 4) Updating and expanding the national grid to enhance its capacity to be able to accommodate renewable energy in the energy mix, 5) Expanding and facilitating access to all the available finance sources from national and international bilateral and multilateral funds including the development of innovative financial mechanisms.

The timeframe for the planning and implementation of the TAP of these technologies is 6 years (2025 to 2030). The estimated total cost of the TAP of the energy sector is $750,000 regardless of the salary and administrative costs. The Ministry of Water and Environment in coordination with the Ministry of Electricity and Energy will lead the TAP implementation under the United Nations Framework Convention on Climate Change (UNFCCC) with the support of other key stakeholders including the Ministry of Finance, the Ministry of Planning

and International Collaboration, the Ministry of Industry and Trade, development banks, and the private sector and another relevant stakeholder.

Project Ideas for the Energy Sector

Two project ideas are proposed to launch the implementation of the energy TAP. The first project focuses on deploying Off-Grid Renewable Energy Systems, specifically solar photovoltaic (PV) and wind technologies, to address Yemen's energy crisis. With a $40 million budget over three years, this project seeks to install 25 MW of renewable energy capacity, benefiting 1 to 1.5 million people in vulnerable urban and rural coastal communities, reducing greenhouse gas emissions, and strengthening climate resilience through increased energy access. The second project aims to build climate resilience in Yemen's coastal cities by installing off-grid solar PV systems in primary and secondary schools across the Aden, Hadramawt, and Al Hodeidah governorates. This project will provide reliable electricity for cooling, lighting, and income-generating activities, thereby improving educational conditions, and students' health and fostering community resilience in conflict-affected areas.

Transport sector

The transport sector plays a crucial role in Yemen's economic and social development. Due to population growth and increased movement within and between urban and rural areas, the demand for road transportation is projected to rise. In 2010, Yemen had 891,736 vehicles, consuming 189.6 million GJ of energy, with energy demand expected to reach 470.9 million GJ by 2040.To reduce fuel consumption and mitigate CO_2 emissions, Bus Rapid Transit (BRT) and Hybrid Electric Vehicles (HEVs) have been selected as priority technologies.

Bus Rapid Transit (BRT) systems TAP

The goal is to launch pilot projects in two cities by 2035, expanding to other major cities by 2040. Key actions include: 1) Conducting a feasibility study to assess impacts and secure financial support for the BRT project while addressing adverse effects through a just transfer mechanism,2) Developing financial policies to encourage private-sector investment and foster Public-Private Participation (PPP) for the BRT system,3) Establishing professional institutions for technical standards, capacity building, and creating an Information System Management for transport data. The estimated total cost of the TAP is USD 150,000 excluding salary and administrative costs.

Hybrid electric vehicles (HEVs) TAP

The ambition of this technology can begin within a year, to reach 30% of vehicles on the road by 2030, once the required procedures are in place. This can be archived by implementing the key actions:1) Constitute financial policies to reduce the cost of HEV, by providing financial incentive schemes such as market incentives, and Bank facilities,2) Enact legal, regulatory, institutional, and technical procedures to develop and enhance the HEV market by creating professional institutions to support technical standards,3) Training programmes for mechanics and technicians for maintenance of HEV.

The estimated total cost of the TAP is USD 95,000. As same as, the BRT system, the salary and administrative costs are excluded, as they are covered by the recurrent budget.

The timeframe established for planning and implementation of the two technologies of transport TAP's actions is six years (2025 to 2030). The Ministry of Water and Environment in coordination with the Ministry of Transport will lead the TAP implementation under the United Nations Framework Convention on Climate Change (UNFCCC). With the support of the Key, stakeholders in the Ministry of Finance (MF), Local Administrative Councils (LAC), the Technical Education Institute (TEI), and the private sector.

Project Ideas for the Transport Sector

The two project ideas are proposed to promote sustainable development and reduce greenhouse gas emissions. The first project focuses on enabling the adoption of Hybrid Electric Vehicles (HEVs) by 2030 to reduce transport-related emissions in line with Yemen's climate commitments. This will be achieved by offering financial incentives like loan interest subsidies, establishing authorized dealerships, providing accredited technician training, and creating supportive legal and institutional frameworks. The second project aims to conduct a feasibility study for introducing a Bus Rapid Transit (BRT) system in Aden and the adjacent governorates of Lahej and Abyan. Targeting implementation by 2035, the project aligns with Yemen's goal to reduce emissions by 2040. It is expected to deliver social and economic benefits, including job creation, business attraction, and improved connectivity, thus supporting Yemen's sustainable development priorities. Additionally, reduces road congestion, air pollution, and fossil fuel dependency by providing efficient, high-capacity public transport.

Water Sector

Yemen's water sector is critical for livelihoods, agriculture, public health, and environmental sustainability. Severe water scarcity, weak institutions, and ongoing conflict threaten its performance. Climate change exacerbates water stress by intensifying shortages as demand outstrips recharge rates, causing groundwater depletion. To address water scarcity, Seawater Desalination and Rainwater Harvesting (RWH) have been prioritized.

Seawater Desalination TAP

The goal of seawater desalination is to provide sustainable water resources and reduce the dependency on groundwater by producing 165,000 m^3 of desalinated water daily by 2035. This can be achieved by implementing the key main actions including1) Facilitate the financing sources and developing financial models to support the technology transfer,2) Providing training and workshops to local entities and policymakers to enhance technical skills,3) Integrate the technology into the national climate change and water plans and policies,4) Develop technical, social, and environmental feasibility studies about desalination. The estimated total cost of the TAP is USD 475,000, excluding administrative and salary costs, which will be covered by the recurrent budget

Action Plan for Rainwater Harvesting (RWH) TAP

The goal of implementing the RWH is to enhance efficient rainwater use and support sustainable development in highland communities reliant on groundwater and rainwater for agriculture and livelihoods to help them store 100,000 m^3 of rainwater annually by 2035. This gable can be archived by the main three key actions: (1) facilitating access to financing and developing financial mechanisms, (2) strengthening institutional capacity for water harvesting in households and agriculture, and (3) integrating RWH into IWRM and climate change plans. The estimated total cost of the TAP is USD 195,000, excluding administrative and salary costs, which will be covered by the recurrent budget.

The timeframe for implementing the TAP is 6 years (2025–2030), aligned with Yemen's current Climate Finance Country Programme (CFCP), which provides a roadmap derived from the TAP. The Ministry of Water and Environment will lead the TAP implementation under UNFCCC with the support of the Key stakeholders involved in this process including the Ministry of Planning and International Cooperation (MPIC), of Industry and Trade (MoIT), Ministry of Agriculture, Council of Ministers, Prime Minister Office, Presidential Council, Environment Protection Authority, University of Aden, UN-accredited agencies, Multilateral Development Banks and Bilateral donors, and other relevant stakeholders.

Project Ideas for Water Resources

Two project ideas are proposed to launch the implementation of the water TAP. The first project focuses on solar-powered reverse osmosis desalination in coastal areas like Aden and the Tuban Delta, producing 25,000 m³ of fresh water daily by 2030. This $63 million GCF-funded initiative aims to reduce groundwater dependence, mitigate drought impacts, and strengthen water security across multiple sectors. The second project promotes integrated water harvesting technologies, blending traditional and modern methods to address water shortages in rural and urban areas. With $7 million in GCF funding, the project will benefit over 6,000 people by improving irrigation, supporting drought-resistant crops, and reducing groundwater overuse.

Agriculture Sector

The agricultural sector is one of the most important in Yemen, with 75% of the population relying on it for their livelihood. It consumes 90% of the country's water resources, making water shortages a serious threat to its growth. In light of the current global situation, including wars and their impact on agricultural production sources, an increase in agricultural production in Yemen is anticipated. However, the increasing effects of climate change are shifting agricultural seasons, reducing productivity, and lowering crop yields. Therefore, it is essential to safeguard the availability of fertile soil and water resources to ensure sustainable agricultural development. Two technologies were selected for this sector: Drip Irrigation Technology and Soil Conservation (Terraces).

Drip Irrigation TAP

The aim is to expand drip irrigation across all 22 governorates of Yemen, targeting smallholder farmers, especially those with solar-powered water pumps, and key crops such as coffee in four governorates (Mahwit, Taiz, Abyan and Lahj). Four pilot sites in each governorate will cover 12 hectares, or 48 hectares per governorate per year, with a target area of 1,152 hectares over six years (2025-2030) in four governorates. The programme will build on successful drip irrigation projects and gradually expand, including farmer training, and will be implemented with key stakeholders, particularly the Ministry of Agriculture. The programme can be combined with terrace technology as coffee production is concentrated in terraced areas at altitudes of 100-2,500 metres above sea level.

This ambition can be achieved by implementing the key main actions including) Mobilize resources from donors, including climate finance operating entities, and encourage private sector and microfinance participation,2) Strengthen coordination and communication between stakeholders, especially local authorities' government and private sectors, 3) Design and implement knowledge and awareness Programs for the farmers and local communities. The total estimated cost is US$ 62,000. As same as, drip irrigation, the salary, and administrative costs are excluded.

Soil Conservation (Terraces) Technology action plan

A 6-year (2025-2030) terrace maintenance program will focus on conserving 662,000 hectares of terraces across the southern highlands (Taiz, Aldhale, Lahej, and Abyan), targeting small farmers and crops like sorghum, wheat, barley, and coffee. According to a case study conducted by ARERA, the rate of deterioration in terraces ranges between 5-14%, meaning an approximate average of 10%, so there is an opportunity to conserve approximately 66,200 hectares (Muharram & Alsharjabi, 2019). This can be done through a 6-year terrace maintenance program with a focus on small farmers and crops of sorghum, wheat and barley, in addition to cash crops such as coffee. On the other hand, there is still the possibility of adding new stands. Each year, the program will build new terraces for coffee conservation on 1,200 hectares, benefiting 1,200 farmers. The long-term goal is to create terraces on 7,200 hectares over 6 years.

The timeframe established for planning and implementation of the Soil Conservation (Terrae) TAP's actions and activities is 6years (2025 to 2030). The Ministry of Water and Environment in collaboration with the Ministry of

Agriculture, Irrigation and Fishery will lead the TAP implementation UNFCCC. With the support of other Key stakeholders in the government (i.e. Environment Protection Authority, Ministry of Education, and Climate Change Unit) and private sector (i.e. Microfinance institutions) and NGOs, and farmers

Project Ideas for the Agriculture Sector (Mountains Resilience Agricultural)

The project aims to improve water efficiency through drip irrigation and solar energy, targeting farmers with solar pumps. It will also restore 40 hectares of agricultural terraces for coffee cultivation and enhance water harvesting technologies. By integrating modern irrigation and water conservation, the project supports rural agriculture, boosts food security, and strengthens economic stability while adapting to climate change through drought resistance and soil moisture improvement.

Innovative Financial Strategies for TAP Implementation in Yemen

The TAP implementation requires an innovative approach to leverage finance from all potential sources using multiple finance modalities. By utilizing, mobilizing, and blending finance from in-kind or cash government contributions, the TAP engages multiple stakeholders to support sustainable development. In addition to domestic funding, it will draw upon resources from a wide array of multilateral and bilateral climate finance actors—engaging with international institutions, INGOs, philanthropists, and development agencies' programs offering financial assistance for climate initiatives and solutions.

The TAP will also focus on drawing support towards creating the enabling environment for nascent and active actors from the private sector, such as institutions of microfinance and renewable energy companies. Some technologies will require a Public-Private partnership (PPP) framework to facility the implementation of the technologies. This approach could potentially lead to access to direct investments in the Yemeni climate sector.

Mainstreaming the TAP with National documents

All the TAPs in both energy and transport sectors in the field of mitigation with be aligned with Yemen's under-preparation, Nationally Determined Contributions (NDC), and Long-Term Low Emission Development Strategy (LT-LEDS). On the other hand, All the TAPs in both water and agricultural sectors in the field of adaptation will be aligned with Yemen's under-preparation, National Adaptation Plan (NAP).

The pre-post for implementing Yemen's TAP requires immediate coordination, led by the Ministry of Water and Environment (MOWE), the Environment Protection Authority (EPA), and the Climate Change Unit (CCU). This involves organizing meetings with key stakeholders to present TAP outcomes, clarify roles, and establish timelines. The Government of Yemen (GoY) must allocate dedicated budgets to support TAP activities, while Cabinet-level approval is crucial to align the plan with national policies and ensure institutional commitment. Developing project proposals quickly, based on identified initiatives, and engaging early with donors, such as the Green Climate Fund (GCF), will be essential for securing financing and ensuring smooth execution. Key institutions, including the Ministry of Water and Environment (MWE), will take the lead in policy development, capacity building, and implementation efforts. This coordinated approach will strengthen Yemen's climate resilience and promote sustainable development through the adoption and deployment of prioritized technologies.

Furthermore, the TAP employs a tracking system to monitor progress, identify challenges early, and achieve project targets effectively, the system operates on three levels: strategic, operational, and community. Including periodical reviews and reports, technical monitoring, and data collection, communication among partners, and ensuring transparent and adaptive management throughout the TAP implementation period. This can be under MVR which is currently under preparation.

In conclusion, Yemen's Technology Action Plan represents a comprehensive framework for implementing critical climate technologies across energy, transport, water, and agriculture sectors. With a total estimated investment of

approximately $1.65 million for TAP implementation (excluding administrative costs), the plan provides a clear roadmap for achieving specific targets by 2035, including 600 MW of renewable energy capacity, 30% hybrid vehicle adoption by 2020, 165,000 m^3 daily desalinated water production by 2035, and significant agricultural land improvements. Success will depend on strong institutional coordination led by the Ministry of Water and Environment, innovative financing mechanisms blending public and private resources, and effective monitoring through the MVR system. By mainstreaming these technologies with national climate commitments and development strategies, the TAP will strengthen Yemen's climate resilience while promoting sustainable socio-economic development despite ongoing challenges.

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Chapter 1 Technology Action Plan and Project Ideas for The Energy Sector

1.1 TAP for PV and wind energy

This chapter focuses on the Technology Action Plan (TAP) for the energy sector. The TAP considers the following technologies: Solar PV and Wind turbines.

1.1.1 Sector Overview

The energy sector plays a vital role in Yemen's socio-economic development while being the largest contributor to greenhouse gas emissions. This sector faces significant challenges due to ongoing conflicts and infrastructure damage, resulting in a substantial energy deficit exceeding 2,000 MW. This shortfall severely impacts social and economic development across the country.

According to the latest GHG inventory in 2010, the energy sector contributed approximately 22,038 Gg CO_2-eq, representing 65% of national emissions. The sector's emissions are primarily generated through the combustion of fossil fuels including petroleum oil, diesel, mazut, and natural gas for power generation. Most power generation plants are operating well beyond their expected lifespan, with total production sometimes falling below 100 MW due to fuel shortages and maintenance issues.

The current energy infrastructure consists primarily of:

- One gas power plant with 340-380 MW capacity
- Thermal power plants using fossil fuels with a combined capacity of around 1100 MW
- Limited renewable energy installations (approximately 1.5 MW from small PV projects)
- Aging transmission and distribution networks
- Isolated grid systems with limited interconnection

Table 1:1: Key energy sector policies and legal framework

Policy/Law	Year Enacted	Latest Revision	Main Contents
National Strategy for Renewable Energy and Energy Efficiency (NSREEE)	2009	Under revision	• Sets RE targets and implementation framework • Promotes energy efficiency measures
Public Electricity Law	2009	-	• Regulates electricity sector Establishes institutional framework
Investment Law	2010	-	• Incentives for RE investments Private sector participation framework

Through the Technology Needs Assessment process using Multi-Criteria Analysis (MCA), two key renewable energy technologies were identified as priorities for Yemen's energy sector. The first is solar PV technology, which currently has limited installations primarily in urban areas. The national target for solar PV by 2035 is to achieve a total capacity of 400 MW, with 250 MW through off-grid systems and 150 MW through on-grid systems.

The second prioritized technology is wind energy, which currently has minimal uptake with only pilot projects in place. The national target for wind energy is to achieve 200 MW of capacity by 2035 through a combination of on-grid and off-grid systems. These targets are aimed at meeting the energy needs of households and government institutions, including ministries, water institutions, hospitals, schools, and universities. The implementation of these technologies is supported by Yemen's abundant renewable resources, with solar radiation ranging from 5.21-7.23 kWh/m2 per day and average wind speeds exceeding 8 m/s in coastal areas.

1.1.2 Action Plan for PV and Wind Energy

1.1.2.1 Introduction

Solar PV and wind energy technologies have been identified as priority solutions to address Yemen's critical energy challenges while contributing to climate change mitigation and sustainable development. These technologies were selected through a comprehensive MCA process during the Technology Needs Assessment (TNA) phase, emerging as the most promising options for transforming Yemen's energy landscape.
Solar photovoltaic technology, which converts solar radiation directly into electricity through semiconductor materials, offers a highly modular and scalable solution with minimal maintenance requirements. The technology's selection was driven by its low operational costs, declining installation expenses, and zero direct emissions during operation. Solar PV systems provide immediate electricity availability during daylight hours and can be deployed in both grid-connected and off-grid applications, making them particularly suitable for Yemen's diverse geographical context. For detailed specifications and performance data, readers can refer to the Solar PV Technology Fact Sheet in TNA Report I.

Wind energy technology, which harnesses wind's kinetic energy through turbine generators to produce electrical power, complements solar PV in Yemen's renewable energy portfolio. The technology's competitive levelized cost of electricity and substantial emission reduction potential made it a compelling choice for further development. Wind energy systems are available in various sizes and can operate in both distributed and centralized generation modes, offering flexibility in deployment. The technology's ability to generate power during different times of day and seasons makes it particularly valuable when integrated with solar PV systems. Technical specifications and detailed performance characteristics can be found in the wind energy technology fact sheet in TNA Report I.

1.1.2.2 Ambition for the TAP

Aden’s loads in all sectors (except the industrial and commercial sectors) are over 600 MW. Since most power generation plants are old and have exceeded their expected lifespan, their total production sometimes falls to less than 100 MW due to the lack of fuel.

The ambitions of these technologies, up to 2035, are already mentioned in the BAEF reports:
(1) Production of 250 MW of solar power through off-grid PV systems.
(2) Production of 150 MW of solar power through on-grid PV systems.
(3) Producing 200 MW of wind energy through on and off-grid.
This will cover the needs of households and all government institutions, including ministries, water institutions, hospitals, schools, universities, etc.

Gender Considerations

By integrating gender-responsive approaches across all project stages—from design and implementation to M&E—the TAP will not only enhance energy security but also promote social inclusion and women's empowerment. This alignment ensures that the transition to sustainable energy systems contributes to both gender equality and the broader socio-economic development of Aden.

1.1.2.3 Actions and Activities Selected for Inclusion in TAP

This section provides a discussion of the actions and activities that have been selected for inclusion in the TAP for solar PV and wind turbine

Summary of Barriers and Measures to Overcome Barriers

A summary of the barriers and measures identified for solar PV and wind turbine technologies are derived from the TNA Barriers Analysis and Enabling Framework report (Phase II), then during the meeting to conduct Phase III, the consultants summarized all measures in Phase III into more concentrated measures.

Table 1:2 Barriers, measures, and summarized measures for PV and wind turbine technologies

Category	Identified barriers	Summarized Measures
Economic and Financial	• High initial system cost • High interest rate on loans • Inadequate subsidy programs	• Expanding and facilitating access to all the available finance sources from national and international bilateral and multilateral funds including the development of innovative financial mechanisms
Legal, regulatory, and institutional	• Gaps between existing legislation and actual implementation	• Updating the legislation system and enhancing the regulatory framework for solar and wind energy in Yemen
	• Old and inadequate strategies and plans	• Update the RE Strategy and prioritize solar PV and wind energy among the RE options and enhancing the institutional framework of RE.
	• Existence of low-quality systems • Non-existence of an institutional body to coordinate the investment mobilization of Solar PV systems and renewable energy in general. • Weak private sector engagement in solar PV, and wind turbine investment, especially large-scale projects.	• Developing manuals and quality standards for solar PV and wind turbine systems and components. • Ensuring enforcement of quality standards to avoid importing poor-quality systems.
Awareness and information	• Inadequate awareness of the benefits of solar PV and wind turbine technologies • Lack of data and information	• Spreading awareness by developing studies and research on the economic, social, and environmental benefits of solar PV and wind turbine technologies
Technical Capacity	• Absence of Local Manufacturers of solar PV and wind turbine systems	• Provide facilities for the private sector to establish local factories for PV and wind energy systems or parts of them.
	• Weak technical capacity and limited skilled labour to install and maintain the systems	• Integrating solar PV and wind turbine systems into the academia, engineering faculties, and technical institutions programs.
	• Inefficient and Traditional Outdated Grid System	• Updating and expanding the national grid

Actions Selected for Inclusion in the TAP

The measures proposed were ranked in consultation with the technical group in the Renewable Energy Department (RED) at the Ministry of Electricity and Energy (MEE). Criteria used as per TAP guidelines (UNFCCC and UNEP DTU Partnership, 2017):[1]

Ranking results vary from 1 to 8, with 8 being the lowest score. The results of the ranking of measures to be included in the TAP for solar PV and wind turbine systems are based on the feedback from the RE unit-MEE. (See Annex 1)

The first five ranked actions will be considered. The actions constituting the TAP for solar and wind turbine technologies are listed in Table 1:3 together with the activities accompanying each one of them.

[1] https://tech-action.unepccc.org/wp-content/uploads/sites/2/2020/09/tap-guidance-2020-4.pdf

Activities Identified for Implementation of Selected Actions

The selection of activities for each action was carried out through a stakeholder consultation process. This section summarizes the identified actions into more specific activities. These activities need to be done to make each identified action work. A list of activities needed for the implementation of each identified action is presented in Table 1:3.

Table 1:3: Identification of specific activities to support actions in the solar and wind turbine technologies TAP.

Actions and activities to implement the solar and wind turbine technologies TAP	
Action 1:	Spreading awareness by developing studies and research on the economic, social, and environmental benefits of Solar PV and wind energy
Activity 1.1	Conducting an assessment to identify awareness and knowledge gaps among the most relevant stakeholders
Activity 1.2	Validate the assessment results and determine how to address the identified gaps.
Activity 1.3	Establish partnerships with academic universities, research centers, and other stakeholders.
Activity 1.4	Planning and holding a national congress on the economic, environmental, and social potentials of renewable energy (particularly solar PV and wind turbines) in Yemen and publishing the presented technical and scientific papers in the congress.
Action 2:	Updating the legislation system and enhancing the regulatory and policy framework for solar and wind energy in Yemen.
Activity 2.1	Conducting a comprehensive review and assessment of existing policies, legislation, and regulations related to renewable energy, and developing a detailed proposal to enhance the policy and regulatory framework for renewable energy in Yemen
Activity 2.2	Organizing workshops for the enhanced renewable energy policy and regulatory framework
Activity 2.3	Finalizing the proposal for the enhanced renewable energy policy and regulatory framework to be submitted
Action 3:	Updating the National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009), prioritizing solar PV and wind energy among the RE options, and enhancing the institutional framework of RE.
Activity 3.1	Conducting a comprehensive review and assessment of the current National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009).
Activity 3.2	Finalize the plan or proposal and its financing mechanism for updating the strategy.
Activity 3.3	Incorporating the updated plan for the NSREE into the Long-Term Low Emission Development Strategy (LT-LEDs).
Activity 3.4	Creating a detailed deployment plan for solar and wind turbine off-grid systems.
Activity 3.5	Assessing and enhancing the institutional framework.
Action 4:	Updating and expanding the national grid to enhance its capacity to be able to accommodate renewable energy in the energy mix.
Activity 4.1	Performing an initial desk assessment to evaluate the current capacity and identify limitations and deficiencies in the national grid infrastructure.
Activity 4.2	Developing and finalizing a comprehensive plan for assessing the national grid capacity in key Yemeni cities, starting with Aden, Hadhramaut, and Taiz
Activity 4.3	Carrying out detailed on-site assessments of the national grid infrastructure in Aden, Hadhramaut, and Taiz.
Activity 4.4	Develop a proposal for necessary upgrades to the national grid.
Activity 4.5	Establishing a monitoring and evaluation framework to track the implementation of grid upgrades.
Action 5:	Expanding and facilitating access to all the available finance sources from national and international bilateral and multilateral funds including the development of innovative financial mechanisms.
Activity 5.1	Identify financial challenges for solar and wind off-grid and on-grid systems and develop a roadmap to access financing sources and prioritize strategic projects.
Activity 5.2	Creating a detailed financing strategy and mapping for the prioritized off-grid and on-grid renewable energy systems, specifically solar PV and wind turbine systems.
Activity 5.3	Draft a request to the CTCN or relevant agency for a feasibility study.

Activity 5.4	Developing financial mechanisms to design and implement the developed mechanism to diversify funding sources and enhance access to capital for renewable energy projects
Activity 5.5	Preparing a high-quality concept note and funding proposal to be submitted to (GCF) and other potential funding sources.

Actions to be Implemented as Project Ideas

Based on the comprehensive analysis of the identified actions in the TAP, two key actions have been selected for development into detailed project ideas:

1. Off-Grid Renewable Energy Systems Deployment Selected from Actions 3, 4, and 5, this project idea combines the deployment of solar PV and wind energy systems with grid infrastructure development and financing mechanisms. This action was selected for the following reasons:
    - Addresses immediate energy access needs while building long-term infrastructure.
    - Combines technical implementation with necessary financial mechanisms.
    - Offers scalable solutions for both urban and rural areas.
    - Provides clear, measurable outcomes for monitoring and evaluation.
    - Creates significant opportunities for local capacity building and employment.
2. Builds Climate Resilience Through School Empowerment Derived from Actions 1 and 5, this project focuses on installing renewable energy systems in educational institutions. This action was selected because it:
    - Demonstrates practical application of renewable energy technologies.
    - Creates immediate social impact through improved educational facilities.
    - Serves as a model for community-based renewable energy projects.
    - Provides a clear pathway for awareness building and capacity development.
    - Offers potential for scaling and replication across different regions.

Gender Considerations

The TAP activities will benefit women in Yemen through targeted energy access improvements:

- Reliable electricity in homes will reduce domestic burdens by enabling basic electrical appliance use and improving indoor lighting conditions.
- Solar-powered water pumps in communities will significantly reduce the time women spend on water collection tasks.
- Electrified health centres will enhance access to essential maternal healthcare services.
- Improved lighting in schools will create better educational environments, particularly benefiting girls and female teachers.

These benefits will be implemented with full consideration of local customs and cultural norms, ensuring appropriate access for women within Yemen's social context.

The TAP will address gender considerations through three key approaches:

1. Participation and Capacity Building
    - Include women representatives in community consultations.
    - Provide gender-separated technical training opportunities.
    - Design flexible training schedules that respect family responsibilities.
2. Economic Opportunities
    - Create appropriate roles for women in project implementation.
    - Support women-led households in energy access programs.
    - Enable home-based business opportunities through energy access.
3. Monitoring and Evaluation
    - Track women's participation in project activities.
    - Measure the impact on women's daily activities and household conditions.
    - Assess energy access improvements in women-led households.
    - Implementation will respect local customs while ensuring meaningful benefits for women in the community.

1.1.2.4 Stakeholders and Timelines for Implementation of the TAP

Overview of Stakeholders for the Implementation of the TAP

There are several key stakeholders whose full cooperation and participation are required for the Solar PV and wind turbine TAP’s implementation. The TNA project falls under the purview of the United Nations Framework

Convention on Climate Change (UNFCCC), and the focal point is located in the Environmental Protection Agency (EPA)of Yemen. Hence, the EPA is the implementing agency for all the actions and projects proposed in the TAP. However, there will be other stakeholders involved in the implementation of each action and activity. The list and roles of the key stakeholders who have been identified for the implementation of each action of the TAP for solar PV and wind turbine is provided in Table 1:4

Table 1:4: Roles of main stakeholders involved in the implementation of the introduction of the solar PV and wind turbine systems TAP

Key Stakeholders	Role
Ministry of Electricity and Energy	Develop the energy strategy and prepare electricity legislation and regulations. It also evaluates the electricity grid.
Ministry of Water and Environment	Develop the national strategy for the energy sector, legislation, and laws to ensure the reduction of greenhouse gas emissions.
Ministry of Finance	Secure financial support to develop terms of reference, coordinate with financial institutions, and ensure proper preparation and evaluation of tender dossiers. preparing the budget, developing financial instruments
Ministry of Industry and Trade	Import and trading operations related to electrical equipment and supervising the quality of imported materials.
Commercial Chamber	Develop and represent commercial activities across sectors, liaise with government bodies, and protect and enhance activities within the designated jurisdiction.
Private Sector	Invest in clean energy solutions that are environmentally friendly while supporting the thousands of households, public utilities, and businesses that lack regular access to electricity in Yemen.

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementation of the solar PV and wind turbine TAP's actions and activities leading to the creation of a robust policy framework for the deployment of the prioritized energy sector technologies is 6 years (2025 to 2030). This period is aligned with the finalization of Yemen's Nationally Determined Contributions (NDC), Fourth National Communication, Long-Term Low Emission Development Strategy (LT-LEDS), and Measuring, Reporting, and Verifying (MRV) system. These are key national policies related to development priorities and climate change mitigation for the attainment of Yemen's energy sector goal of raising the share of renewable energy. A detailed timetable for the activities is given in the planning table, Table 1:5.The TAP for solar PV and wind turbine systems is planned for implementation over the period 2025-2030.

Gender Considerations

The TNA project team itself demonstrates gender inclusion, with women actively participating as key team members in both technical and administrative roles. This existing gender representation in the project team provides a foundation for understanding and addressing women's perspectives in technology implementation.
Stakeholder Involvement:

- Government Institutions: Female staff contribute to planning, technical assessments, and policy development.
- Private Sector: Female business representatives participate in commercial and implementation aspects.
- Civil Society: Female community members facilitate local engagement and provide community perspectives.
- Academic Institutions: Female experts support research and capacity-building activities.

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Implementation Timeline Considerations:

- Initial Assessment Phase (2025): Female team members will participate in data collection and needs assessment.
- Planning Phase (2025-2026): Female stakeholders will contribute to workshop organization and policy review.
- Implementation Phase (2026-2030): Women from local communities will be involved in monitoring and feedback.

These arrangements ensure appropriate representation while maintaining cultural sensitivity throughout the project timeline.

1.1.2.5 Estimation of resources needed for actions and activities

This section discusses the capacity-building elements of the TAP, as well as an estimation of its implementation costs

Estimation of Capacity Building Needs

The successful implementation of solar PV and wind energy technologies requires comprehensive capacity building across multiple domains. At the technical level, there is a critical need to develop engineering capabilities for system design, installation, and maintenance. This includes developing expertise in grid integration, system optimization, and quality control procedures. Professional training programs will need to focus on practical skills development to ensure proper operation and maintenance of renewable energy systems.

Institutional capacity building is equally important, focusing on developing project management and coordination capabilities within key organizations. Staff at implementing agencies need training in policy development, procurement procedures, and contract management. Additionally, monitoring and evaluation skills must be strengthened to ensure proper project oversight and implementation.

Knowledge management capabilities require significant enhancement to support effective project implementation. This includes developing expertise in data collection, analysis, and reporting mechanisms. Staff need training in documentation procedures and information-sharing protocols to ensure effective communication among all stakeholders.

Estimations of Costs of Actions and Activities

The total cost of the technical action plan is estimated at US$ 750,000, funded by the private sector, international organizations, and the government. Salary and administrative costs are excluded and covered by the recurrent budget. The estimate includes only immediate costs as outlined in Table 1:5

Table 1:5: Planning and implementation table of activities with the estimated cost

Action 1:	Spreading awareness by developing studies and research on the economic, social, and environmental benefits of Solar PV and wind energy							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 1.1 Conducting an assessment to identify awareness and knowledge gaps among the most relevant stakeholders	1st Q 2025	1st Q 2025	MEE & MWE	2nd Q 2025	2nd Q 2025	MEE, MWE, and RE experts	3,000	MEE and MWE.
Activity 1.2 validate the assessment results and determine the way forward to address the identified gaps."	3rd Q 2025	3rd Q 2025	MEE & MWE	4th Q 2025	4th Q 2025	MEE, MWE, and private sector.	5,000	MEE, MWE, and private sector.
Activity 1.3 Establishing partnerships with academic universities, research centres, and other stakeholders.	4th Q 2025	4th Q 2025	MEE	1st Q 2026	1st Q 2026	MEE and MWE	6,000	MEE, MWE
Activity 1.4 Planning and holding a national congress on the economic, environmental, and social potentials of renewable energy (particularly solar PV and wind turbines) in Yemen and publishing the presented technical and scientific papers in the congress	1st Q 2026	1st Q 2026	MEE	2nd Q 2026	2nd Q 2026	MEE, MWE	300,000	MEE, MWE, and GCF
Action 2:	Updating the legislation system and enhancing the regulatory and policy framework for solar and wind energy in Yemen							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 2.1 Conducting a comprehensive review and assessment of existing policies, legislation, and regulations related to renewable energy, and developing a detailed proposal to enhance the policy and regulatory framework for renewable energy in Yemen	2nd Q 2026	2nd Q 2026	MEE	3rd Q 2026	3rd Q 2026	MEE, MWE, and MPIC	30,000	MEE, MWE, and MPIC

Activity 2.2 Organizing workshops for the enhanced renewable energy policy and regulatory framework	**3rd Q 2026**	**3rd Q 2026**	**MEE**	**4th Q 2026**	**4th Q 2026**	**MEE, MWE and MPIC and private sectors**	**15,000**	**MEE, MWE, and MPIC**
Activity 2.3 Finalizing the proposal for the enhanced renewable energy policy and regulatory framework to be submitted.	4th Q 2026	4th Q 2026	ME	1st Q 2027	1st Q 2027	MEE, MWE, and MPIC	2,000	MEE, MWE, and MPIC
Action 3:	Updating the National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009) prioritizing solar PV and wind energy among the RE options and enhancing the institutional framework of RE.							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 3.1 Conducting a comprehensive review and assessment of the current National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009)	1st Q 2027	1st Q 2027	MEE	2nd Q 2027	2nd Q 2027	MEE, MPIC, and MWE	100,000	MEE, MWE, MPIC, and MF, and GCF
Activity 3.2 Finalize the plan or proposal and its financing mechanism for updating the strategy	2nd Q 2027	2nd Q 2027	MEE	3rd Q 2027	3rd Q 2027	MEE, MWE, MPIC and MF	10,000	MEE, MWE, MF GCF, MPIC and
Activity 3.3 Incorporating the updated plan for the NSREE into the Long-Term Low Emission Development Strategy (LT-LEDs)	3rd Q 2027	3rd Q 2027	MEE	4th Q 2027	4th Q 2027	MEE, MWE, MPIC and MF	3,000	MEE, MWE, GCF, MPIC and MF
Activity 3.4 Creating a detailed deployment plan for solar off-grid systems and wind turbine systems.	4th Q 2027	4th Q 2027	MEE	1st Q 2028	1st Q 2028	MEE, MWE, MPIC, and MF	60,000	MEE, MWE, GCF, MPIC and MF
Activity 3.5 Assessing and enhancing the institutional framework.	1st Q 2028	1st Q 2028	MEE	2nd Q 2028	2nd Q 2028	MEE, MWE, MPIC, MF and Private sector	6000	MEE, MWE, GCF, MPIC, MF AND Private sector
Action 4:	Updating and expanding the national grid to enhance its capacity to be able to accommodate Renewable Energy in the Energy Mix, particularly Solar PV and Wind Turbines Systems							
Activities	Planning			Implementation			Costs and funding needs	

	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 4.1 Performing an initial desk assessment to evaluate the current capacity and identify limitations and deficiencies in the national grid infrastructure.	2nd Q 2028	2nd Q 2028	MEE	3rd Q 2028	3rd Q 2028	MEE, MWE, MPIC, and MF	4000	MEE, MWE, GCF, MPIC, and MF
Activity 4.2 Developing and finalizing a comprehensive plan for assessing the national grid capacity in key Yemeni cities, starting with Aden, Hadhramaut, and Taiz.	3rd Q 2028	3rd Q 2028	MEE	4th Q 2028	4th Q 2028	MEE, MWE, MPIC, and MF	10,000	MEE, MWE, GCF, MPIC, and MF
Activity 4.3 Carrying out detailed on-site assessments of the national grid infrastructure in Aden, Hadhramaut, and Taiz.	4th Q 2028	4th Q 2028	MEE	1st Q 2029	1st Q 2029	MEE, MWE, MPIC, and MF	30,000	MEE, MWE, GCF, MPIC, and MF
Activity 4.4 Developing a proposal, based on the findings from the assessments, for necessary upgrades to the national grid.	1st Q 2029	1st Q 2029	MEE	2nd Q 2029	2nd Q 2029	MEE, MWE, MPIC, and MF	6000	MEE, MWE, GCF, MPIC, and MF
Activity 4.5 Establishing a monitoring and evaluation framework to track the implementation of grid upgrades.	2nd Q 2029	2nd Q 2029	MEE	3rd Q 2029	3rd Q 2029	MEE, MWE, MPIC, and MF	8000	MEE, MWE, GCF, MPIC, and MF
Action 5:	Expanding and facilitating access to all the available finance sources from national and international bilateral and multilateral funds including the development of innovative financial mechanisms							
Activities	Planning			Implementation			Costs and funding needs	
			Responsible entity			Responsible entity	Costs (USD)	Who will fund?
Activity 5.1 Identify financial challenges for solar and wind off-grid and on-grid systems, develop a roadmap to access financing sources, and prioritize strategic projects.	3rd Q 2029	3rd Q 2029	MEE	4th Q 2029	4th Q 2029	MEE policymakers, MWE, MPIC, MF, and Private sectors.	10,000	MEE policymakers, MWE, GCF, MPIC, MF and Private sectors
Activity 5.2	4th Q 2029	4th Q 2029	MEE	1st Q 2030	1st Q 2030	MEE, MWE, MPIC, and MF	30,000	MEE, MWE, GCF, MPIC, and MF

Creating a detailed financing strategy and mapping for the prioritized off-grid and on-grid renewable energy systems, specifically solar PV and wind turbine systems.								
Activity 5.3 Draft a request to the CTCN or relevant agency for a feasibility study	1st Q 2030	1st Q 2030	MEE	2nd Q 2030	2nd Q 2030	MEE, MWE, and MPIC	2000	MEE and MW
Activity 5.4 Developing and proposing financial mechanisms to design and implement the developed mechanism to diversify funding sources and enhance access to capital for renewable energy projects	2nd Q 2030	2nd Q 2030	MEE. and MWE	3rd Q 2030	3rd Q 2030	MEE, MWE and MPIC	100,000	MEE, MWE and GCF
Activity 5.5 Preparing a high-quality concept note and funding proposal on off-grid solar and wind turbine systems to be submitted to GCF) and other potential funding sources.	3rd Q 2030	3rd Q 2030	MEE	4th Q 2030	4th Q 2030	MEE, MWE, and MPIC	10,000	MEE, MWE and GCF

Gender Considerations

Capacity development programs are designed with consideration for women's needs, including appropriate facilities and timing arrangements. Professional development opportunities are structured to encourage women's participation while respecting cultural norms.

The budget incorporates necessary provisions for ensuring effective women's participation, including arrangements for separate training facilities when required and support for women-focused awareness activities. Implementation support includes practical considerations such as appropriate transport arrangements and timing flexibility to accommodate family responsibilities.

These resource allocations are integrated into the overall budget while maintaining cultural sensitivity and project efficiency. Regular assessment of resource utilization will ensure effective support for women's participation throughout the project implementation phase.

1.1.2.6 Management Planning

Risks and Contingency Planning

Some risks may be faced in the implementation of the TAP for solar and wind energy. These risks have been categorized as those associated with costs, schedules, and performance. Contingency measures were identified for each of the identified risks and are highlighted in
Table 1:6.

Table 1:6: Risks associated with the solar PV and wind turbines technologies tap and their contingency actions

Type of risk	Related to Action	Description of Risk	Contingency actions

	or Activity			
Financial risk	All Activities	Difficulty in securing funding or delays in securing the specified budget may hinder the implementation of the planned actions and activities.	M&E Time interval:	Quarterly
			M&E responsibility:	MWE and the Ministry of Finance
			Contingency measures needed:	-Engage early and proactively with donors, investors, and funding agencies to ensure clear communication and minimize delays. -Review and update the funding plan regularly to ensure that potential delays or shortfalls are identified early. -Seek alternative or additional funding sources
			Responsibility for contingency measure	Project administration and Ministry of Finance
			Timing for contingency measure:	Within 30 days of the planned timelines if funding is not secured
Cost Ris	All Activities	Here is a risk that the costs of activities may exceed the original budgeted amounts.	M&E Time interval:	Quarterly
			M&E responsibility:	MEE, MWE, and Ministry of Finance
			Contingency measures needed:	-Negotiate with suppliers and contractors for better pricing or payment terms. -Explore additional funding sources, including emergency funds, grants, or loans. -Allocate a 15% emergency budget on top of the initial budget as a financial cushion to cover unexpected cost increases.
			Responsibility for contingency measure	Project administration and Ministry of Finance
			Timing for contingency measure:	within 30 days of identifying a potential cost overrun
Scheduling Risks	All Activities	Activities take longer to complete than originally planned. Delays in decision-making by the government	M&E Time interval:	Every 6 months and whenever there is a delay
			M&E responsibility:	MWE, MEE, and stakeholders
			Contingency measures needed:	-The time frame for implementing activities is scheduled taking into account some delays in planning and implementing activities. -The activity planning and implementation schedule will be monitored regularly with the involvement of all stakeholders, and corrective actions taken decisively. -Commitment to implementing the planned action with continuous monitoring and quickness of path correction when any deviation occurs
			Responsibility for contingency measure	Project administration
			Timing for contingency measure:	Throughout the project implementation period
			The time interval for M&E:	Every 6 months

Performance Risks	All Activities	Information not being provided in time or not available. Limited capacity of the responsible party to implement the procedures	M&E responsibility:	MEE and stakeholders
			Contingency measures needed:	-Ensure there is policy-level acceptance and support. -Establish a project steering committee to bring key institutions into the process. -Building and strengthening capacity -Continuous engagement with stakeholders to increase the level of awareness of the regulations and requirements.
			Responsibility for contingency measure	Project administration
			Timing for contingency measure:	Throughout the project implementation period
	Activity 1.3	Failure to establish partnerships or lack of engagement.	Time interval for M&E	Quarterly
			M&E responsibility:	MWE
			Contingency measures needed:	Develop multiple partnership options; create engagement incentives. Implement outreach strategies and follow-ups.
			Responsibility for contingency measure	Partnership Development Team
			Timing for contingency measure:	Ongoing
	Activity 1.1, Activity 2.1, Activity 3.1, Activity 4.1, Activity 4.3,	Inaccurate or incomplete data could lead to a flawed assessment. Difficulty in identifying all relevant gaps due to outdated data.	M&E Time interval:	Monthly
			M&E responsibility:	MWE
			Contingency measures needed:	Enhance data collection methods; include diverse stakeholders. Adjust assessment methodologies based on initial feedback.
			Responsibility for contingency measure	Research and Data Collection Team
			Timing for contingency measure:	Immediate upon identifying inaccuracies
	Activity 1.2, Activity 2.2, Activity 5.1.	Lack of active participation from key stakeholders, especially from the private sector and communities.	M&E Time interval:	Every six months
			M&E responsibility:	MWE
			Contingency measures needed:	-Early engagement and regular reminders; provide incentives for participation. -Develop strategies to increase stakeholder involvement.
			Responsibility for contingency measure	Workshop Coordinator
			Timing for contingency measure:	Before workshops

Next Steps

Table 1:7 provides a summary of the immediate requirements and critical steps for the successful implementation of the TAP

Table 1:7: Summary of immediate requirements and critical steps for implementation of TAP

Immediate requirements:	a) The EPA should schedule a meeting with other key stakeholders to disseminate the outcomes of the TAP. b) EPA together with the key stakeholders needs to integrate this TAP into the country's Energy Strategy, Nationally Determined Contributions (NDC), Long-Term Low Emission Development Strategy (LT-LEDS), and fourth national communication.
Critical steps:	a) The EPA should ensure that the TAP's outcomes are approved at the Cabinet level. b) Project proposals based on the project ideas should be developed as soon as possible. c) GoY must engage with donors early to secure financing for TAP projects to ensure that activity timelines are met.

Gender Considerations

The implementation of the Technology Action Plan (TAP) identifies Gender considerations related to the lack of active participation from women and marginalized groups, as well as data gaps that could hinder effective assessments. To address these, the project ensures enhanced data collection methods, engaging diverse stakeholders, including women's organizations, to provide accurate, gender-disaggregated insights. Socio-cultural barriers limiting women's involvement are mitigated through outreach strategies, accessible workshop schedules, and incentives for participation.

To foster equitable outcomes, the TAP integrates continuous monitoring and evaluation (M&E) with a focus on gender aspects, ensuring timely adjustments based on stakeholder feedback. Capacity-building initiatives empower women to participate in technical roles and decision-making processes. These measures promote inclusive participation, ensuring both men and women benefit equitably from renewable energy initiatives and improved public services.

1.1.2.7 Reporting

TAP Overview Table - Energy Sector - PV and wind energy

An overview of the TAP for solar PV and wind turbine technology diffusion is presented in Table 1:8.

Table 1:8: TAP overview table for solar PV and wind turbine technologies

Sector	**Energy**						
Sub-sector	Renewable Energy						
Technology	Solar PV and Wind Turbines						
Ambition	(1) Production of 250 MW of solar power through off-grid PV systems. (2) Production of 150 MW of solar power through on-grid PV systems. (3) Producing 200 megawatts of wind energy on and off-grid						
Benefits	Solar PV and wind turbine technologies can contribute to the global transition towards renewable energy while reaping the benefits of clean, affordable, and sustainable power generation. The expected benefits could be: • Increased renewable energy deployment to the overall energy mix in Yemen. • Enhanced energy accessibility. • Job creation and economic development. • Reduce dependence on fossil fuels, leading to a decrease in greenhouse gas emissions and environmental degradation. • Increase awareness and knowledge about the benefits of renewable energy and fostering a culture of sustainability.						
Actions	**Activities to be implemented**	**Sources of funding**	**Responsible body**	**Time frame**	**Risks**	**Success criteria and indicators for monitoring of implementation**	Budget per activity (US)

Action 1: Spreading awareness by developing studies and research on the economic, social, and environmental benefits of Solar PV and wind energy	**Activity 1.1 Conducting an assessment to identify awareness and knowledge gaps among the most relevant stakeholders**	**MEE and MWE.**	**MEE, MWE, and RE experts and**	**6 months**	**-Delay in time and lack of funding**	**-Participation of all stakeholders. -The awareness and knowledge gaps are identified.**	3000
	Activity 1.2 Validate the assessment results and determine the way forward to address the identified gaps.	MEE, MWE, and private sector.	MEE, MWE, and private sector.	6 months	-Lack of funding and probably the absence of some related parties	-Participation of all stakeholders and policymakers in the workshop. -The assessment results are validated	5000
	Activity 1.3 Establishing partnerships with academic universities, research centres, and other stakeholders.	MEE, MWE	MEE and MWE	6 months	-Irresponsive of some parties to the partnership	-Signing the partnership agreement	6000
	Activity 1.4 Planning and holding a national congress on the economic, environmental, and social potentials of renewable energy (particularly solar PV and wind turbines) in Yemen and publish the presented technical and scientific papers in the congress	MEE, MWE and GCF	MEE, MWE	6 months	-Lack of funding and probably the absence of some related parties	-Convening of the congress on time, presentation of scientific research papers. -Publishing the proceedings of the conference.	300,000
Action 2: Updating the legislation system and enhancing the regulatory and policy framework for solar and wind energy in Yemen	Activity 2.1 Conducting a comprehensive review and assessment of existing policies, legislation, and regulations related to renewable energy, and developing a detailed proposal to enhance the policy and regulatory framework for renewable energy in Yemen	MEE, MWE, and MPIC	MEE, MWE, and MPIC	6 months	-Lack of funding and delay in time	-Ability to assess all the existing legislation and regulations of RE and identify the gaps.	30,000
	Activity 2.2 Organizing workshops for the enhanced renewable energy policy and regulatory framework	MEE, MWE, and MPIC	MEE, MWE and MPIC and private sectors	6 months	-Lack of funding	-Convening the workshops with all the participants. -A refined proposal has arisen.	15,000

	Activity 2.3 Finalizing the proposal for the enhanced renewable energy policy and regulatory framework to be submitted.	MEE, MWE, and MPIC	MEE, MWE, and MPIC	6 months	-Delay in time and lack of funding	-Approval of the proposed enhanced policy and regulatory framework for renewable energy and its submission to the Council of ministers for adoption and implementation.	2000
Action 3: Updating the National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009) prioritizing solar PV and wind energy among the RE options and enhancing the institutional framework of RE.	Activity 3.1 Conducting a comprehensive review and assessment of the current National Strategy on Renewable Energy and Energy Efficiency (NSREE 2009)	MEE, MWE, MPIC and MF and GCF	MEE, MPIC and MWE	6 months	-Delay in time and lack of funding	-Ability to assess all the existing strategies of RE and identify the gaps. -Preparing an updated plan or proposal for the strategy	100,000
	Activity 3.2 finalize the plan or proposal and its financing mechanism for updating the strategy	MEE, MWE, GCF, MPIC and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time and lack of funding	-Engagement of all the participants in the workshop. -The plan/proposal is Finalized and agreed.	10,000
	Activity 3.3 Incorporating the updated plan for the NSREE into the Long-Term Low Emission Development Strategy (LT-LEDs)	MEE, MWE, GCF, MPIC and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time and lack of funding	-The updated plan for the NSREE is incorporated in the (LT-LEDs)	3000
	Activity 3.4 Creating a detailed deployment plan for solar off-grid systems and wind turbine systems.	MEE, MWE, GCF, MPIC and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time and lack of funding	-A deployment Plan for solar off-grid systems and wind turbine systems has been created	60,000
	Activity 3.5 Assessing and enhancing the institutional framework for renewable energy, focusing on strengthening the roles, responsibilities, and coordination mechanisms	MEE, MWE, GCF, MPIC, MF, and Private sector	MEE, MWE, MPIC, MF, and Private sector	6 months	-Delay in time and lack of funding	-The institutional framework for renewable energy is assessed and enhanced	6000

Action 4: Updating and expanding the national grid to enhance its capacity to be able to accommodate Renewable Energy in the Energy Mix, particularly Solar PV and Wind Turbines Systems	Activity 4.1 Performing an initial desk assessment to evaluate the current capacity and identify limitations and deficiencies in the national grid infrastructure.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding. -Lack of experienced engineers.	-Desk assessment of the current capacity of the national grid is evaluated. limitations and deficiencies in the grid infrastructure are identified.	4000
	Activity 4.2 Developing and finalizing a comprehensive plan for assessing the national grid capacity in key Yemeni cities, starting with Aden, Hadhramaut, and Taiz.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding. -Lack of experienced engineers.	-A comprehensive assessment plan is developed and finalized	10,000
	Activity 4.3 Carrying out detailed on-site assessments of the national grid infrastructure in Aden, Hadhramaut, and Taiz.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding. -Lack of experienced engineers.	-On-site assessments of the national grid infrastructure in Aden, Hadhramaut, and Taiz are carried out.	30,000
	Activity 4.4 Developing a proposal, based on the findings from the assessments, for necessary upgrades to the national grid.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding. -Lack of experienced engineers	-A proposal for necessary upgrades to the national grid is developed.	6000
	Activity 4.5 Establishing a monitoring and evaluation framework to track the implementation of grid upgrades.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding. -Lack of experienced engineers	-A monitoring and evaluation framework for the implementation of the upgrade grid is established.	8000
Action 5: Expanding and facilitating access to all the available finance sources from	Activity 5.1 identify financial challenges for solar and wind off-grid and on-grid systems and develop a roadmap to access financing sources and prioritize strategic projects.	MEE policymakers, MWE, GCF, MPIC, MF, and Private sectors.	MEE policymakers, MWE, MPIC, MF, and Private sectors.	6 months	-Delay in time. -Lack of funding.	-Convening the workshops with all the participants. -A roadmap to facilitate access to all available financing sources is developed.	10,000

national and international bilateral and multilateral funds including the development of innovative financial mechanisms	Activity 5.2 Creating a detailed financing strategy and mapping for the prioritized off-grid and on-grid renewable energy systems, specifically solar PV and wind turbine systems.	MEE, MWE, GCF, MPIC, and MF	MEE, MWE, MPIC, and MF	6 months	-Delay in time. -Lack of funding	A detailed financing strategy and mapping is created. -Identify clear paths to securing the necessary funds in the financial strategy.	30,000
	Activity 5.3 Draft a request to the CTCN or relevant agency for a feasibility study	MEE and MWE	MEE, MWE, and MPIC	6 months	-Delay in time. -Lack of funding	-CTCN and other relevant agencies are corresponding. -A feasibility study on various financial mechanisms is received.	2000
	Activity 5.4 Developing and proposing financial mechanisms to design and implement the developed mechanism to diversify funding sources and enhance access to capital for renewable energy projects	MEE, MWE, and GCF	MEE, MWE, and MPIC	6 months	-Delay in time. -Lack of funding	-Developing and proposing financial mechanisms for off-grid and on-grid renewable energy systems. -Engagement of all partners in developing the proposal.	100,000
	Activity 5.5 Preparing a high-quality concept note and funding proposal on off-grid solar and wind turbine systems to be submitted to GCF) and other potential funding sources.	MEE, MWE, and GCF	MEE, MWE, and MPIC	6 months	-Delay in time. -Lack of funding	-Sending a concept note on off-grid solar and wind turbine systems to the GCF and other potential funding sources.	10,000

1.1.2.8 Tracking the Implementation Status of the TAP

Rationale, Responsibility, and Content of TAP Tracking

The tracking system for the TAP implementation is designed to ensure effective monitoring of progress, timely identification of challenges, and achievement of targets for solar PV and wind energy deployment in Yemen. This system will operate under the primary coordination of the Environmental Protection Agency (EPA) of Yemen, working in close collaboration with the Ministry of Electricity and Energy (MEE) and other key stakeholders.

The tracking process will be implemented through a three-tier system:

- Strategic Level Tracking The EPA, as the UNFCCC Focal Point, will oversee the overall implementation tracking, conducting quarterly reviews of progress against established targets. They will maintain a central database of all implementation indicators and prepare annual progress reports for national and international stakeholders.
- Operational Level Tracking: The MEE will manage day-to-day monitoring of technical implementation, collecting monthly data on installation progress, technical performance, and capacity-building activities. They will coordinate with local authorities and implementation partners to ensure accurate data collection and reporting.
- Community Level Tracking Local authorities and implementing organizations will conduct regular field monitoring, gathering data on local implementation progress and community feedback. This information will be reported monthly to the MEE for consolidation and analysis.

Table 1:9 :Key performance indicators and tracking schedule

Category	Indicators	Tracking Frequency	Responsible Entity
Technical Implementation	- MW of installed capacity Number of systems installed Grid connection status	Monthly	MEE
Financial Performance	-Disbursement rates Cost per MW installed Private sector investment	Quarterly	Ministry of Finance
Capacity Building	-Number of training sessions technical staff trained Maintenance capabilities	Quarterly	MEE & EPA
Social Impact	-Number of beneficiaries Energy access improvements Community satisfaction	Semi-annually	Local Authorities

A centralized digital platform will be established to facilitate data collection, analysis, and reporting. This platform will:

- Maintain real-time tracking of implementation progress.
- Generate automated reports for different stakeholder groups.
- Store all relevant documentation and verification data.
- Enable communication between implementing partners.

Table 1:10: Monitoring and reporting schedule

Activity	Frequency	Deliverable
Data Collection	Monthly	Progress Data Sheets
Technical Review	Quarterly	Technical Assessment Report
Stakeholder Meetings	Quarterly	Meeting Minutes and Action Points
Progress Reports	Semi-annually	Comprehensive Progress Report
Impact Assessment	Annually	Impact Evaluation Report

The tracking system includes mechanisms for identifying implementation challenges and initiating corrective actions:

- Monthly review of progress against targets.
- Quarterly assessment of implementation barriers.
- Development of specific action plans to address identified challenges.

- Regular stakeholder consultations to validate and adjust approaches.

This comprehensive tracking system will ensure transparent monitoring of TAP implementation while enabling timely adjustments to achieve the intended outcomes. Regular reviews and updates of the tracking system itself will be conducted to maintain its effectiveness throughout the implementation period.

Gender Considerations

Specific criteria will be tracked to ensure the appropriate participation of women throughout implementation:

Table 1:11 :Women's participation tracking metrics

Area	Tracking Metrics
Technical Roles	Women in technical positions
Training	Women participating in capacity building
Beneficiaries	Female-headed households served
Community Engagement	Women in community consultations

1.2 Project Ideas for the Energy Sector

1.2.1 A Brief Summary of the Project Ideas for the Energy Sector

The project ideas represent concrete actions designed to support the realization of the overall targets outlined in Yemen's Technology Action Plan (TAP). The first project focuses on building climate resilience in Yemen's coastal cities by installing off-grid solar PV systems in primary and secondary schools. This initiative was identified based on the need for reliable energy in conflict-affected areas, aiming to enhance educational opportunities, reduce climate vulnerability, and foster community resilience. The second project addresses Yemen's broader energy crisis through the deployment of off-grid renewable energy systems, including solar PV and wind energy. Developed from the Technology Needs Assessment (TNA) and related frameworks, this project seeks to increase energy access, reduce greenhouse gas emissions, and strengthen climate resilience, particularly in urban and rural communities. Both projects contribute to the transfer, diffusion, and deployment of relevant renewable energy technologies, aligning with Yemen's mitigation and adaptation goals.

1.2.2 Project Idea 1: Off-Grid Renewable Energy Systems Deployment in Yemen

This project aims to deploy off-grid renewable energy systems, focusing on solar photovoltaic (PV) and wind energy technologies, to enhance energy access, reduce greenhouse gas emissions, and increase climate resilience in Yemen. Developed in response to the country’s Technology Needs Assessment (TNA) and aligned with its sustainable development priorities, the project targets vulnerable urban and rural communities, particularly in coastal zones. Over three years, the project will install 25 MW of renewable energy capacity, benefiting 1-1.5 million people, while also building local capacity and raising public awareness. With an estimated budget of $40 million, funded by international partners, the project will contribute significantly to Yemen’s transition to sustainable energy.

Section	Details
Introduction/ Background	The project addresses Yemen's energy crisis caused by ongoing conflict, focusing on deploying off-grid renewable energy systems (solar PV and wind energy) to enhance energy access, reduce GHG emissions, and increase climate resilience. Developed based on TNA, BA&EF, and TAP.

Objectives	1. Enhance energy access for urban and rural communities. 2. Mitigate GHG emissions by reducing fossil fuel use. 3. Increase resilience to climate change, especially in coastal zones. 4. Improve livelihoods through renewable energy.
Outputs and Measurability	- National off-grid renewable energy plan developed by Year 1. - 25 MW of solar PV and wind energy systems installed, reducing GHG emissions by 175,200 tonnes annually. - Increased public awareness. - Strengthened technical and institutional capacities.
Relationship to Yemen's Sustainable Development Priorities	Aligns with Yemen's INDC, TNA, and GCF Country Programme. Contributes to sustainable energy transition, climate change mitigation, and adaptation goals. A new initiative building on previous assessments and plans.
Project Deliverables	- Reliable energy access, improved living conditions, and economic development. - GHG emission reduction, increased energy security, enhanced climate resilience. - Feasibility and benefits of clean energy in conflict-affected regions.
Project Scope and Possible Implementation	Covers urban and rural areas across Yemen, focusing on coastal zones. Linked to TNA and BA&EF initiatives. High feasibility based on Yemen's renewable energy potential. Implementation involves collaboration between ministries and international partners.
Project Activities	1. Develop a national off-grid renewable energy plan. 2. Install solar PV and wind turbine systems. 3. Design innovative financial mechanisms. 4. Conduct capacity-building workshops and public awareness campaigns.
Timelines	3 Years: - Year 1: Develop plan and policies. - Year 2: Install systems and establish financial mechanisms. - Year 3: Capacity building, public awareness, and project evaluation.
Budget/ Resource Requirements	Estimated Cost: $40 million.
	Funding Sources: Green Climate Fund(GCF), Global Environment Facility(GEF), Government of Yemen(GOY) in-kind contributions.
	Resources: Ministry staff, consultants, international partnerships.
Measurement/Evaluation	Success Metrics:
	-25 MW of renewable energy capacity installed.
	-175,200 tonnes annual reduction in GHG emissions.
	-Improved energy access for 1-1.5 million beneficiaries.
	Tools: Regular monitoring and evaluation reports.
Possible Complications/Challenges	Political instability, security risks, limited technical capacity, financial constraints. Mitigation: Close coordination with local authorities, capacity building, and flexible management.
Responsibilities and Coordination	-Ministry of Water and Environment (MWE):Project management and coordination. -Ministry of Energy and Electricity (MEE): Technical supervision and policy development. -International Partners and Donors: Funding and technical expertise. -Local NGOs: Implementation and awareness.

1.2.3 Project Idea 2: Building Climate Resilience in Yemen's Coastal Cities Through School Empowerment

The project aims to build climate resilience in Yemen's coastal cities by enhancing educational opportunities through the installation of off-grid solar PV systems in primary and secondary schools in the Aden, Hadramawt, and Al Hodeidah governorates. By providing reliable electricity for space cooling, lighting, the project will improve learning conditions and foster community resilience to climate change impacts, and foster a culture of sustainability. The initiative also includes training and capacity-building programs for students, teachers, and community members, creating educational opportunities that support long-term adaptation to climate change. It aligns with Yemen's national strategies for sustainable development and will be implemented over five years with a focus on creating a supportive environment for renewable energy, capacity building, and knowledge management. The project is crucial for reducing climate vulnerability and supporting long-term educational and economic stability in conflict-affected regions.

Section	Details
Project Title	Building Climate Resilience in Yemen's Coastal Cities Through School Empowerment
Introduction/ Background	Yemen's coastal cities have been severely impacted by climate change and the ongoing conflict, leading to frequent power outages and a lack of reliable energy access in schools. This project was developed in response to these challenges, aiming to enhance the climate resilience of primary and secondary schools in the Aden, Hadramawt, and Al Hodeidah governorates. By installing off-grid solar PV systems, the project will not only provide reliable electricity but also support income-generating activities, thereby fostering overall community resilience.
Objectives	- Promote climate-resilient educational opportunities. - Improve learning conditions with reliable electricity. - Foster income-generating activities. - Enhance community resilience to climate change impacts.
Outputs and Measurability	Measurable Outputs: 1. Installation of off-grid solar PV systems. 2. Renewable energy policy framework. 3. Technical standards and guidelines. 4. Training programs on O&M. 5. Pipeline of renewable energy pilot projects.
	- Measurability: Success measured by the number of electrified schools, GHG emissions reduction, and resilience enhancement.
Relationship to Yemen's Sustainable Development Priorities	- Aligns with national strategies for climate resilience and education improvement.
	- Introduces new development by integrating energy access with education and income generation.
Project Deliverables	- Value/Benefits:
	1. Reliable electricity for better education.
	2. Reduced climate vulnerability.
	3. Economic benefits from income generation.
	- Importance: Crucial for building climate resilience and supporting Yemen's educational infrastructure.
Project Scope and Implementation	- Scope: Focuses on schools in three governorates with potential expansion.
	- Feasibility: Leverages Yemen's renewable energy potential.
	- Linkages: Builds on past UNDP initiatives in renewable energy and peacebuilding.

Project Activities	- Conduct feasibility studies and develop business plans. - Install solar PV systems. - Develop and implement O&M procedures and training. - Create a knowledge management system.
Timelines	Duration: 60 months (5 years). - Phases: 1. Initial feasibility and planning (Year 1). 2. Installation and training (Years 2-3). 3. Monitoring and evaluation (Years 4-5).
Budget/Resource Requirements	- Total Budget: $7,105,936 (GEF Project Grant).
	- Funding: GEF Trust Fund.
	- Resources: Consultants, partnerships with local entities, UNDP involvement.
Measurement/ Evaluation	- Evaluation: Regular monitoring of progress, GHG emissions reduction, school resilience, and community engagement. - Success Metrics: Number of electrified schools, system efficiency, community satisfaction, educational outcomes.
Possible Complications/ Challenges	- Challenges: Security in conflict zones, logistical challenges in remote areas, potential local resistance.
	- Mitigation: Early community engagement, flexible project design.
Responsibilities and Coordination	- Ministry of Water and Environment: Project management and coordination.
	- Ministry of Energy and Electricity: Technical supervision and policy development.
	- International Partners and Donors: Funding and technical expertise.
	- Local NGOs: Implementation and awareness.

Transport Sector

Chapter 2 Technology Action Plan and Project Ideas for the Transport Sector

2.1 TAP for Bus Rapid Transit and Hybrid Electric Vehicles

2.1.1 Sector Overview:

The Transport Sector plays a major role in the economic and social development of any country or nation. As a result of the population growth and population movement within the cities or from rural areas to urban areas and vice versa, the demand for road transportation is likely to increase in Yemen over the coming years. The number of all types of vehicles was estimated to be around 891736 in 2010, and reached 1091899 vehicles in 2013, a growth of around 22%, and the number of motorbikes was 99410 in 2010 and reached 131412 in 2013 which is a growth of 32%. However, passenger road transportation accounts for 65.31% of the number of vehicles while Road Freight Transportation accounts for the remaining 34.69%. [1,2]

The amount of energy consumed in road transportation in 2010 was 189.6117 million GJ, using a LEAP program, the energy demand for transport was estimated to reach 470.9 million GJ in 2040.

In 2018 the Transport Authority and other relevant authorities implemented mitigation procedures to limit fuel consumption and mitigate CO_2 emissions by road vehicles, these included improving vehicle fuel combustion efficiency, regular maintenance, and annual inspection. Using the mitigation scenario (LEAP program), the estimated energy demand was expected to reach 308.2 million GJ in 2040 instead of the predicted 470.9 million GJ without the mitigation scenario. Consequently, the Global Warming Potential (GWP) from the GHG emissions should be expected to decrease to reach 21.8 million metric tonnes of CO_2 in 2040, instead of the 33.3 million metric tonnes of CO_2 without the mitigation scenario. That is a 34.5 % reduction in the GHG emissions. [1]

Table 2:1 shows the percentage trend of CO_2 emissions in G_g CO_2-eq for the transport sector, and its contribution from the Total National Contribution for the years 1995 – 2010.

Table 2:1 :Transport sector emissions in Gg CO_2 -eq (1995 -2010)

Year	1995	2000	2005	2010
Gg CO_2 -eq (of Total National Contribution)	4014 (30%)	4956 (28%)	5541 (26%)	7181 (21%)

There are many laws and legislations related to road transport that discuss the transport of people or goods between Yemeni cities. Some of them have not been reachable since the 2015 conflict because they are blocked. Here, some legislations and laws have been reviewed in a summary to review some points related to the technology.

1-Minister of Transport Decision No. (137) of 2009 regarding the regulations, procedures, and requirements for licensing the practice of technical inspection activities for road transport vehicles.

The law discusses some issues related to the requirements for light and medium-duty transportation inspection and operation. It mandates the use of technical inspection devices to measure and monitor vehicle emissions, including gases from petrol, diesel, and gas-powered vehicles to adhere to environmental protection laws to minimize pollution from transportation is required. Vehicles joining the system must not exceed a lifespan of three years, with an optional one-year extension, and can operate within a facility for up to five years, extendable by one year. Strict adherence to environmental protection laws to minimize pollution from transportation is required.

2-Ministerial Resolution No. (68) of 2009 regarding the regulation of land transport activities for passengers by buses

The law discusses some issues related to requirements for practicing land transport activities. It emphasizes obtaining the necessary permits, providing suitable parking for buses, and maintaining comprehensive operating schedules detailing routes, stops, and times while complying with traffic laws.

It mandates ongoing inspections and periodic maintenance of buses to ensure technical readiness and adherence to safety and security protocols before each trip.

3-Republican Decree No. (291) of 2008 establishing the General Authority for Regulating Land Transport Affairs (GARLTA)

The law discusses some issues related to the need to define the main road transport networks according to set standards. It also mandates the examination of imported transport means to ensure compliance with specifications, preventing entry of non-compliant vehicles to reduce environmental pollution in line with protection laws.

4-Law No. (33) of 2003 regarding land transport

The law discusses some issues related to developing and organizing land transportation services to support economic development. It includes preparing plans based on population needs, conducting studies for city and intercity transport conditions, and creating solutions. It emphasizes determining transportation departure and parking locations, complying with traffic laws regarding vehicle weights and dimensions, and organizing waiting and parking areas. It promotes investment expansion in transportation and stresses the necessity of providing buses specifically designed for urban transit.

5-Republican Decree No. (265) of 1997 regarding the organizational regulations of the Ministry of Transport

The law discusses some issues related to the preparation of studies for project establishment, development, and follow-up, alongside promoting investment in land transportation activities. It emphasizes organizing and enhancing transportation services to identify suitable transport means and proposes strategic growth plans. The development of data-driven programs and technical studies on transportation use and its impact on roads and the environment is also essential.

2.1.2 Action Plan for Bus Rapid Transit (BRT) System

2.1.2.1 Introduction

The BRT system is a high-capacity transport system with dedicated lanes for bus transit. It consists of a systematic combination of infrastructure (bus ways, stations, terminals) with organized operations and intelligent technologies to provide a higher quality experience than possible with traditional bus operations. Main services enhancements are increasing the average speed and ensuring matching of the scheduled timetables.

2.1.2.2 Ambitions of Bus Rapid Transit (BRT) TAP

Bus Rapid Transit (BRT) is planned for major Yemeni cities, with pilot projects in two cities by 2035. By 2040, BRT systems aim to be operational in most major cities across the country.

Gender Considerations

The Technology Action Plan (TAP) for Bus Rapid Transit (BRT) systems in Yemen integrates gender considerations through gender-sensitive infrastructure design, equal employment opportunities, and inclusive service delivery. BRT stations and vehicles will feature well-lit waiting areas, priority seating, and routes that align with women's mobility needs, improving access to essential services.

The TAP promotes gender balance by offering women employment and leadership roles in BRT operations, supported by targeted training programs. Gender-disaggregated data will be collected to monitor participation and impact, while social safeguards will ensure that women, including those from marginalized communities, benefit from enhanced mobility. These efforts aim to foster gender equality and social inclusion alongside improved public transportation.

2.1.2.3 Actions and Activities selected for inclusion in the TAP

This section provides a discussion of the actions and activities that have been selected for inclusion in the TAP for Bus Rapid Transit (BRT) systems

Summary of Barriers and Measures to Overcome Barriers

Table 2:2 is presented a summary of the main barriers and measures associated with the transfer and diffusion of Bus Rapid Transit (BRT) systems which were identified in the Barrier Analysis and Enabling Framework (BA&EF) report. Also, these measures are summarized in this phase to be more concentrated and facilitate the assessment of all the measures according to the criteria considered for concentrated measures during this phase of the report.

Table 2:2: Summary of the main barriers and measures associated with the transfer and diffusion of Bus Rapid Transit (BRT) systems

Barriers by category	Sub-barriers	Summary of measures for each barrier
Economic and Financial	• Lack of financial donors for such a project	• Assess the capital cost for the BRT system by carrying out a feasibility study, including the required infrastructure, to facilitate and encourage private sector investment and attract donors from various climate change funds to finance the BRT project. The feasibility study will also cover the adverse effects that might result from BRT system implementation, and the study will put a proposal for a just mechanism for the affected people.
	• High investment cost of BRT project • High inflation rate and inadequate financial policies • No BRT system market in the country	• Set financial and economic policies to facilitate investment in new transport technologies such as BRT, these could be through financial incentives to develop the BRT market and other new transport technologies.
	• The increased unemployment rate, where the low-income of local population (small bus owners), will lose their jobs has adverse effects not only on small bus owners' daily income but also on the tax loss that the government transport sector gets from the drivers.	• Just transition mechanism will be in the feasibility study measure.
Legal and Regulatory	• Insufficient legal and regulatory framework for the transport sector especially public transport.	• Setting up a legal and regulatory framework to enhance public mass transport such as BRT, and create an active market for new transport technologies.
Communication and Coordination between the actors and stakeholders	• No coordination between the actors and stakeholders, in the same sector or with other sectors.	• Set a plan for coordination mechanism between relevant government institutions and various stakeholders.
Institutional, Organizational Human Skills, Technical, and Information System.	• Limited institutional and organizational capacity, and inadequate human skills • The regular decision-making process for implementing BRT can be expected to be more bureaucratic and might cause delays and cost overrun • There is no national strategy plan for the technology or the sector itself	• Create professional institutions for the transportation sector, to support technical standards, to carry out training workshops for capacity building for personnel in relevant authorities, in all new transport technologies, with the recommendation of creating a centre for certifications, standards, codes, testing, and demonstration of all new technologies such as the BRT, also, for providing scientific data regarding the transportation sector, by establishing Information Management System(IMS). Integrate the technology into the national climate change policies and plans.

Social, Cultural, Behavioural, and low awareness	• Most people may be hesitant to use new technology such as BRT due to the waiting time where most people prefer using small buses that wait a few minutes to move.	• Carry out information and public awareness campaigns on the social, economic, and environmental benefits of the BRT system, and its advantage of being comfortable, fast, and cheap transport, and providing much-improved transport service.
Information and Data System	• lack of information on the BRT in the scope of the country stakeholders, labourers, drivers, and local people in this sector.	• Establishment of Data and Information Management (DIM) systems for public transport. This measure is incorporated with institutional, organizational, human skills, and technical. Category 4
Technical	• No standards, codes, or certifications for new technology vehicles. • There are no specialized personnel for the service and maintenance of BRT.	• As for category (4) institutional and organizational human skills
Infrastructure	• Poor infrastructure for the BRT system as the current infrastructure needs to be repaired or a new one established, considering the random urban expansion that happening recently.	• The feasibility study will cover both the BRT system and the infrastructure required.

Actions Selected for Inclusion in the TAP

The measures above were ranked by urgency (low to high) during the consultation process. The ranking was based on criteria like effectiveness, efficiency, conflicts, suitability, and cost-benefit. All measures, grouped by barrier categories, were retained as actions for the BRT system TAP (See Annex). The actions which are included in TAP are shown in Table 2:3

Activities Identified for Implementation of Selected Actions

The three measures selected as actions for the Introduction of the BRT system were detailed into specific activities, as outlined in Table 2:3.

Table 2:3: Actions and activities for inclusion in TAP The selected actions and the activities for each action are explained

Actions and activities to implement the BRT technology TAP	
Action 1: Conduct a feasibility study to assess impacts and secure financial support for the BRT project while addressing adverse effects through a just transfer mechanism.	
Activity 1.1	Discuss the feasibility study proposal and initial Term of Reference of the study (TOR)
Activity 1.2	Develop and send a request to CTCN for technical support
Activity 1.3	Establish a steering and technical committee for feasibility study implementation
Activity 1.4	Develop initial project ideas and concept notes for funding
Action 2: Develop financial policies to encourage private-sector investment and foster PPP for the BRT system.	
Activity 2.1	Discuss the roadmap for developing a framework
Activity 2.2	Review the policies to identify the gaps
Activity 2.3	Develop a proposal for a financial, legal, and regulatory framework
Activity 2.4	Promote government/private partnerships for the BRT
Action 3: Establish professional institutions for technical standards, capacity building, and creating an Information System Management for transport data.	
Activity 3.1	Assess the current institutional and organizational capacity of the transportation authority.
Activity 3.2	Design and implement a capacity-building program
Activity 3.3	Develop an institutional and technical framework for operating the BRT system

Actions to be Implemented as Project Ideas

The selected actions to be implemented as project ideas are actions 1,2,3 for many reasons. Where Action 1 (Feasibility Study) ensures that the project starts on a solid foundation with a clear understanding of the technical and financial requirements. Action 2 (Financial Policies and PPP Development) guarantees financial sustainability and encourages collaboration between the public and private sectors. Action 3 (Institutional Strengthening and Capacity Building) builds the human and institutional capacity needed to manage the BRT effectively and ensures data-driven decision-making.

In other words, these actions are selected because they represent the core pillars needed to establish, operate, and sustain the BRT system: feasibility, financing, and capacity. Together, they address the project's key risks and opportunities.

Gender Considerations

The TAP for the BRT system in Yemen integrates gender outcomes through key activities across planning, financial policy, and capacity building. During the feasibility study phase, stakeholder

consultations will ensure that both men's and women's perspectives are included, with women actively participating in the steering and technical committees to align project design with their needs.
The development of financial policies and Public Private Participation (PPP) will foster gender-sensitive frameworks that promote women's participation in transportation businesses. Policy reviews will identify barriers to women's economic involvement, encouraging inclusive entrepreneurship and employment opportunities within the BRT system.
Through capacity-building programs, the TAP will equip women with the necessary skills for operational and leadership roles in transportation. Institutional frameworks will incorporate gender-disaggregated data, ensuring data-driven decisions that support equitable access and outcomes, making the BRT system more inclusive and sustainable.

2.1.2.4 Stakeholders and timeline for Implementation of TAP

Overview of Stakeholders for the Implementation of TAP

Overview of Stakeholders The roles of the main stakeholders for the implementation of the TAP for BRT are given in Table 2:4

Table 2:4: Roles of main stakeholders involved in the implementation of the introduction of the BRT system" TAP

Key Stakeholders	Role
Ministry of Transport (MT)	Regulate the transport policies, regulations, legislation, and institutional arrangements for the transport sector.
Ministry of Planning and International Cooperation (MPIC)	Arranges the cooperation between Yemen and bilateral and multilateral international financial bodies,
Ministry of Water and Environment (MWE)	Facilitate the accessing to climate funds
Ministry of Finance (MF), Custom Authority (CA), and Tax Authority (TA)-MFCATA	Draft a financial scheme for the incentives proposed
Ministry of General Works (MGW)	Carries out the construction of the infrastructure, monitors, assesses, and follows the procedures according to the agreed plan.
Technical Education Institute (TEI)	Provide technical training and develop capacity-building programs for implementing BRT and advancing knowledge in new transport technologies.
Private Travel Companies (PTCs)	Participate in implementing the technology as a co-finance
Local Administrative Council (LAC)	Administer the BRT system

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementation of the BRT system TAP's actions and activities leading to the creation of a robust policy framework for the deployment of the prioritized transport sector technologies is 6 years (2025 to 2030). The phased approach will allow for iterative improvements based on ongoing assessments, ensuring that the BRT system aligns with both local transportation needs and Yemen's long-term environmental and climate resilience goals. Also, this period is aligned with the finalization of NDC, FNC, and Long-Term Low Emission Development Strategy (LT-LEDS). These are key national policies related to development priorities and climate change mitigation for the transport sector. A detailed timetable for the activities can be found in Table 2:5.

Gender Considerations

The TAP for the BRT system integrates gender considerations through the active involvement of stakeholders and gender-responsive actions. Key stakeholders, including the Ministry of Transport(MT), Local Administrative Councils(LAC), and the Technical Education Institute(TEI), will ensure equal representation of men and women in decision-making bodies and committees. The TAP will implement

capacity-building programs targeting women, equipping them with skills for technical and leadership roles within the BRT system.

Gender analysis of the TAP's actions ensures that women's needs are reflected throughout the project. Feasibility studies will involve consultations with women's groups to design safe and accessible transport services. Financial policies will address barriers faced by women entrepreneurs, promoting their participation in public-private partnerships (PPPs). Institutional strengthening efforts will integrate gender-disaggregated data to monitor women's participation and ensure equitable outcomes. These measures foster gender equality and inclusivity, ensuring the BRT system meets the needs of all users.

2.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of Capacity Building Needs

The required capacity building for implementing the technology is updating and developing the policy and legal framework, technical training on implanting and maintaining BRT and conducting feasibility studies to get funds to implement the technology in the country.

Estimation of Costs of Actions and Activities

The total cost of the Technical Action Plan (TAP) is estimated at USD 150,000, funded by the private sector, international organizations, and the government. Salary and administrative costs are excluded, as they will be covered by the recurrent budget. The TAP cost only includes immediate expenses detailed in Table 2:5

Table 2:5: Planning table - characterization of activities for implementation of actions

Action 1:	**Conduct a feasibility study to assess impacts and secure financial support for the BRT project while addressing adverse effects through a just transfer mechanism.**							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 1.1 Discuss the feasibility study proposal and initial Term of Reference of the study (TOR)	1st Q 2025	1st Q 2025	MT, EPA, Local Council Authority,	2nd Q 2025	2nd Q 2025	MT, TF, Local Council Authority.	30,000	GEF and other climate change funds
Activity 1.2 Develop and send a request to CTCN for technical support	3rd Q 2025	3rd Q 2025	TM, EPA, local council, MPW, and private Travel companies	4th Q 2025	4th Q 2025	MT, local council, MPW, and private Travel companies	-	
Activity 1.3 Establish a steering and technical committee for feasibility study implementation	1st Q 2026	1st Q 2026	MF, MPW, MT, and private Travel companies	2nd 2026	2nd Q 2026	Financial Consultant	10,000	
Activity 1.4 Develop initial project ideas and concept notes for funding	3rd Q 2026	3rd Q 2026	Transport Authority	4th Q 2026	4th Q 2026	Transport Authority, and Technical Expert	15,000	
Action 2:	Develop financial policies to encourage private sector investment and foster government-private partnerships for the BRT system							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Cost in USD	Responsible entity
Activity 2.1	1st Q 2027	1st Q 2027	Transport Ministry, and EPA	2nd Q 2027	2nd Q 2027	MT, EPA, and MF	15,000	GEF and other

Discuss the roadmap for developing the needed framework								climate change funds
Activity 2.2 Review the policies to identify the gaps	3rd Q 2027	3rd Q 2027	MT, EPA, MF, Travel companies, and local private banks.	4th Q 2027	4th Q 2027	MF, EPA, and Transport Authority	15,000	
Activity 2.3 Develop a proposal for a financial, legal, and regulatory framework	1st Q 2028	1st Q 2028	MT, EPA, MF	2nd Q 2028	2nd Q 2028	MF, Transport Authority, Local Private Banks.	20,000	
Activity 2.4 Promote government/private partnerships for the BRT	3rd Q 2028	3rd Q 2028	MT, EPA, and MIT.	4th Q 2028	4th Q 2028	MT and private investors	5,000	TBC
Action 3:	Establish professional institutions for technical standards, capacity building, and creating an Information System Management for transport data							
Activity 3.1 Assess the current institutional and organizational capacity of the transportation authority.	1st Q 2029	1st Q 2029	MT, EPA, Local Council Authority,	2nd 2029	2nd Q 2029	MT, Technical Expert, Trade and Industry.	10,000	GEF and other climate change funds
Activity 3.2 Design and implement a capacity-building program.	3rd Q 2029	3rd Q 2029	MT, Technical Expert, Trade and Industry.	4th Q 2029	4th Q 2029	MT, Technical Expert, Trade and Industry.	20,000	
Activity 3.3 Develop an institutional and technical framework for operating the BRT system	1st Q 2030	1st Q 2030	MT, and technical experts from relative institutional	2nd 2030	2nd Q 2030	Technical experts from relative institutional	10,000	

Gender Considerations

The capacity-building programs for implementing the BRT system will be designed to ensure equal participation and skill development opportunities for both men and women. Technical training on BRT maintenance, operation, and policy development will actively target women by offering incentives, flexible schedules, and outreach programs to encourage their involvement. Specific efforts will focus on empowering women with leadership and managerial skills, promoting their participation in decision-making roles. Gender-responsive training modules will address any potential socio-cultural barriers and promote an inclusive learning environment.

2.1.2.6 Management Planning

Risks and Contingency Planning

Risk and contingency plans must be identified to effectively implement the actions identified. Table 2:6 provides a detailed overview of identified risks and contingency plans.

Table 2:6: Provides an overview of the main risks to the successful implementation of the TAP for Bus Rapid Transit (BRT), and contingency actions.

Type of risk	Related to Actionor Activity	Description of risk	Contingency actions	
Financial risk (Non-availability of funding)	Action 2	Non-availability of funding and the unstable financial and economic situation may result in changes in exchange rate, and interest rate and may impact negatively on programs and projects.	The time interval for M&E:	-Annual
			M&E responsibility:	-MoF, Customs and Tax Authorities, MTI, and MT
			Contingency measures needed:	-Carry out awareness campaigns, and capacity building of the stakeholders. The continuous review of the financial incentives proposed for action 2, to limit the economic and financial losses that may occur to the government revenues.
			Responsibility contingencymeasure:	-Ministry of Finance, and all project stakeholders
			Timing contingency measure:	-In the first year of the commencement of the TAP.
Scheduling risk	All types of activities	The action and its activities take longer tocomplete than originally planned, because of the political instability.	The time interval for M&E:	- At the time of the scheduled delay
			M&E responsibility:	-Ministry of Transport, Ministry of General Works or Contractor, and Financing Institutions

			Contingency measures needed:	-The planned budget for each action and its activities should increase by 10 %, to meet the possible costs of the delays.
			Responsibility contingencymeasure:	-MT and MGWC
			Timing contingency measure:	-Lifetime of TAP
Performance Risk	Actions during thetechnology implementation phase	The BRT system does not meet the agreed standards, that originally stated	The time interval for M&E:	-Annually
Political instability and change in government policies risk.	All actions and all activities	Due to the current situation in the country government may change, hence, the priorities of the new government also change.	M&E responsibility:	-Ministry of Transport, Ministry of Trade and Industry, Private Investor/Operator, Technical Expert.
			Contingency measures needed:	-Enhance BRT system performance according to agreed standards, with continuous monitoring by Transport authorities. If the operator fails to meet efficiency standards, they will face penalties or be replaced by a competent substitute.
			Responsibility contingencymeasure:	-Transport ministry, Technical Standards Expert, and Investor/Operator.
			Timing contingency measure:	-Annual
			The time interval for M&E:	-Annually
			M&E responsibility:	-Transport ministry, and all stakeholders.
			Contingency measures needed:	-Regularly review and adjust planned programs based on new government policies or political changes. Conduct awareness campaigns for decision-makers and provide capacity building for personnel from various stakeholders, including the Transport Ministry.
			Responsibility contingencymeasure:	-Regularly review and adjust planned programs based on new government policies or political changes. Conduct awareness campaigns for decision-makers and provide capacity building for personnel from various stakeholders, including the Transport Ministry.

Next Steps

Table 2:7: Summary of immediate requirements and critical steps for implementation of BRT TAP

Immediate Requirements	a) Potential donors may be identified and a feasibility study may be developed to get donor fund for the BRT project.
Critical steps	a) Active engagement of the private sector must be promoted, and encourage government-private sector partnership.

Gender Considerations

The TAP for the BRT system identifies and mitigates gender-related risks through proactive measures. Political instability and policy changes could deprioritize gender considerations, so the plan includes awareness campaigns and capacity-building initiatives to maintain gender priorities regardless of shifts. Performance risks are managed through continuous monitoring to ensure the BRT system meets safety and accessibility standards for women and vulnerable groups. Additionally, capacity-building efforts will target women, equipping them with the necessary skills to participate in technical and leadership roles, ensuring an inclusive and equitable transport system throughout the implementation.

2.1.2.7 Reporting

Table 2:8 The overview of the TAP for Bus Rapid Transit (BRT) technology diffusion.

Sector: Transport								
Sub-Sector: Mass Public Transport								
Technology: Bus Rapid Transit (BRT)								
Ambition	Bus Rapid Transit (BRT) systems will be piloted in two cities by 2035, with plans to expand to most major Yemeni cities by 2040.							
Benefits	Implementing BTR technology: • Reduces congestion and improves air quality by cutting fossil fuel consumption and CO2 emissions, benefiting urban poor and women. • Creates employment opportunities in construction and operation, boosting local economic development. • Promotes social equity by offering affordable, accessible transport, benefiting low-income communities. • Enhances connectivity and reduces travel times, decreasing reliance on private transportation.							
Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame (yr)	Risks	Success criteria	Indicators for Monitoring of Implementation	Budget per activity (USD)
Action 1. Conduct a feasibility study to assess impacts and secure financial support for the BRT project while	Activity 1.1 Discuss the feasibility study proposal and initial Term of Reference of the study (TOR)	GEF and other climate change funds	Transport Ministry, Finance Ministry, Local Council Authority	6months	-Non-availability of funding	-Meetings were executed	-CC funds and private investors gave commitments to fund the BRT project	30,000
	Activity 1.2 Develop and send a request for CTCN for technical support		Transport Ministry, Local	6months	-Delay in the preparation of the outlook	-Outlook for the BRT system finished	-Outlook for BRT system printed and distributed	-

addressing adverse effects through a just transfer mechanism	Activity 1.3 Establish a steering and technical committee for feasibility study implementation		Financial Consultant	6months	-Delay in carrying out the feasibility study	-A feasibility study carried out	-Feasibility study approved	10,000
	Activity 1.4 Develop initial project ideas and concept notes for funding		MT, financial expert, and technical expert	6months	-Capacity building not carried out on time (delay)	-Capacity-building talks and presentations were gathered	-Capacity building was carried out on time	15,000
Action 2: Develop financial policies to encourage private sector investment and foster government-private partnerships for the BRT system.	Activity 2.1 Discuss the roadmap for developing the needed framework	GEF and other climate change funds	MT, MF	6months	-Delay in the meeting and not all the stakeholders attended	-All the stakeholders attended the meeting	-The meeting was carried out and all the stakeholders showed interest in the contribution	15,000
	Activity 2.2 Review the policies to identify the gaps		MT, and MF,	6months	-Proposals were not developed and prepared	-Potential proposals were suggested	-Financial proposals were prepared	15,000
	Activity 2.3 Develop a proposal for a financial, legal, and regulatory framework.		MT, EPA, MF	6months	-Delay in government approval of the financial proposals	-The government committed to the approval of proposals	-The Council of Ministers approved the financial proposals	20,000
	Activity 2.4 Promote government/private partnerships for the BRT		MT, EPA, MF	6months				5,000
Action 3. Establish professional institutions	Activity 3.1 Assess the current institutional and organizational capacity of the transportation authority.	GEF and other climate change funds	MT, Technical Expert,	6months	-Delays in timing	-High rate of participation.	-Discussions and meetings were carried out, with	10,000

for technical standards, capacity building, and creating an Information System Management for transport data.			Trade and Industry				valuable outcomes.	
	Activity 3.2: Design and implement a capacity-building program		MT, technical expert,	6months	-No Technical Standards for the BRT system was developed	-Technical Standards were developed	-Technical Standards for the BRT system were developed and applied	20,000
	Activity 3.3 Develop an institutional and technical framework for operating the BRT system		Technical Expert, MT	6months	-Delay in setting up of the accredited centre	-The transport ministry decided to establish a Centre for Technical Standards	-The Centre for Technical Standards was established	10,000

Gender Considerations

To ensure gender is integrated into TAP reporting for the BRT system, gender-disaggregated indicators will monitor women's participation in capacity-building programs, employment, and decision-making roles. Reports will highlight gender-specific outcomes, such as improved access to transport for women and their inclusion in steering committees. Success criteria will reflect how the BRT system enhances social equity, benefiting women and vulnerable groups through affordable, accessible services. Capacity-building reports will track women's involvement in technical training, ensuring progress toward equitable skill development and gender-responsive institutional frameworks. These measures promote transparency, accountability, and inclusive development throughout TAP implementation.

2.1.2.8 Tracking the implementation status of the TAP

Rationale, Responsibility, and Content of TAP Tracking

Table 2:9: Institutional responsibilities for implementing and managing the BRT TAP

Entity	Responsibilities	Related Activities
Transport Ministry (MT)	Lead the feasibility study, policy development, and government-private partnerships. Manage capacity-building programs and regulatory frameworks.	1.1–1.4, 2.1–2.4, 3.1–3.3
Finance Ministry (MF)	Coordinate financial policies and secure funding for BRT implementation. Engage with private sector stakeholders to foster partnerships.	1.1, 2.1–2.3
Local Council Authorities	Support local engagement and coordination during feasibility studies and project implementation. Ensure community participation in discussions.	1.1, 1.2
Technical Experts and Consultants	Provide expertise for feasibility studies, capacity-building programs, and the establishment of technical standards.	3.1–3.3

Table 2:10: Key activities and outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Feasibility Study & Funding	Conduct feasibility studies and secure financial support	TOR developed; feasibility study approved	MT, MF, Local Authorities	Ensure women's representation in consultations and decision-making (GEN 1). Related Activities: 1.1–1.4
Develop Financial Policies & PPPs	Create financial frameworks, encourage private sector investment, and promote PPPs	Frameworks developed; PPPs initiated	MT, MF	Ensure financial inclusion and entrepreneurship opportunities for women (GEN 2). Related Activities: 2.1–2.4
Establish Institutional Frameworks & Capacity Building	Assess current capacity, develop technical standards, and create an information system for transport data	Standards developed; capacity-building programs completed	MT, Technical Experts	Promote women's participation in technical roles and leadership positions (GEN 2–GEN 3). Related Activities: 3.1–3.3

Table 2:11: Monitoring, reporting, and risk management mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor key outputs and progress, ensuring alignment with transport policies and PPPs	Quarterly	MT, MF
Progress Reporting	Submit reports detailing activities, stakeholder engagement, and expenditures	Monthly & Quarterly	Project Management Unit
Stakeholder Engagement	Collect feedback from local communities and government authorities, ensuring inclusive decision-making	Ongoing	MT, Local Authorities
Risk Management	Identify and mitigate risks such as delays in approvals or lack of funding	Continuous	MT, MF, Stakeholders

Table 2:12: Budget and financial tracking

Budget Component	Amount ($)	Description
Total Budget	150,000	-Covers all activities for BRT implementation
Feasibility Studies & Funding	70,000	-Conduct studies, develop project ideas, and secure funding
Financial Frameworks & PPPs	25,000	-Develop financial policies and promote partnerships
Institutional Framework & Capacity Building	55,000	-Create technical standards and conduct capacity-building programs
Administrative Costs	5% of each activity	-Covers reporting, monitoring, and financial oversight

Gender Considerations

Table 2:13: Gender inclusion strategy with role transformation ambition

Activity	Gender Marker and Transformation Ambition
Feasibility Study & Funding	-Ensure women's participation in consultations and project planning (GEN 1–GEN 2).
Financial Policies & PPPs	-Provide entrepreneurship opportunities through PPPs, and engage women in financial decision-making (GEN 2).
Institutional Framework & Capacity Building	-Promote technical training for women and ensure their inclusion in leadership roles within transport governance (GEN 2–GEN 3).
Information Systems & Technical Standards	-Ensure gender-inclusive data collection and promote women's involvement in technical roles (GEN 3).

2.1.3 Action Plan for the Hybrid Electric Vehicle (HEV):

2.1.3.1 Introduction

Hybrid electric vehicles (HEVs) combine an internal combustion engine with an electric motor, reducing CO2 emissions by 23-43% in urban areas due to regenerative braking and electric motor use. They are most effective in city traffic but offer limited benefits on highways. Unlike other emission-reducing options, HEVs require no additional infrastructure. In Yemen, HEVs are imported individually, with no government plan, suppliers, or regulations in place. While HEVs have lower fuel, maintenance, and operating costs, their high battery costs and maintenance are drawbacks. HEVs also serve as a transition to fully electric vehicles.

2.1.3.2 Ambitions of Hybrid Electric Vehicle (HEV) TAP

HEV promotion can begin within a year, to reach 30% of vehicles on the road by 2030, once the required procedures are in place.

Gender Considerations

The TAP for HEV promotion integrates gender by ensuring women's participation in policy design and decision-making through their inclusion in stakeholder consultations and advisory bodies. Capacity-building programs will target women for technical and managerial roles in HEV services, while financial incentives will promote women's entrepreneurship in the EV ecosystem. Gender-disaggregated data will be used to monitor participation and assess how HEV adoption improves women's mobility and access to services, ensuring equitable opportunities and inclusive benefits throughout the project**.**

2.1.3.3 Actions and Activities selected for inclusion in the TAP

Summary of Barriers and Measures to Overcome Barriers

Table 2:14 is a summary of the main barriers and measures associated with the transfer and diffusion of Hybrid Electric Vehicle (HEV) which were identified in the Barrier Analysis and Enabling Framework (BAEF) report, which also summarized during conducting this phase to be concentrated.

Table 2:14: Summarizes the barriers and measures identified for HEV

Category	Barriers	Summary of the measures
Financial and Economic	• The relatively high cost of the HEV. • High interest rates for loans, adding to the high inflation make HEV not viable to most of the public. • No market incentives to deploy HEV, together with no consumer incentives to buy HEV. • There is no HEV market in the country yet, and there are no known suppliers of HEV in the country. • There is no demand for HEV, market information on HEV is poor.	• New financial policies such as market and consumer incentives to reduce HEV cost, including Bank facilities such as reducing loan interest and extending loan period, to increase ownership of HEV.
Legal, Institutional, and Technical Policies	• Lack of clear policies, legislation, and by-laws regulating the import and use of HEV in the country	• Set up a legal and regulatory framework to create HEV market and other new transport technologies markets, through the establishment of professional institutions to support technical standards.

Communication and Coordination	• Insufficient coordination between relevant ministries and possible HEV suppliers. • Lack of involvement of stakeholders in decision-making regarding transport policies	• Set a plan for coordination and communication mechanisms between relevant government institutions and various stakeholders, particularly from the private sector.
Institutional and Organizational Capacity	• Insufficient professional institutions, with limited institutional capacity • Lack of/inefficient regulatory body in the transport sector. • Lack of institutions to support technical standards for transportation	• Merged with category no 2 measure
Human Skills	• Lack of service and maintenance specialists for HEV	• Set up education and training workshops for capacity building in all new technology transportation especially, HEV and EV
Social, and Cultural Behaviour	• Lack of confidence in HEV • Resistance to change due to unfamiliar technology, and wrong perception of new technologies.	• Dissemination of information to consumers on the HEV performance, environmental and economic benefits
Information and Awareness	• Inadequate information, No dissemination of information to consumers on HEV performance, public awareness about environmental and economic benefits, etc.	• Merged with the measure of category 6
Technical	• Inadequate guidelines and safety standards, codes, and certification • Lack of initiatives to set standards on emissions and fuel efficiency for new technology vehicles. • The technical capacity limitation of the electrical and mechanical engineering programs taught at the technical and academic institutions affects the quality of resource technicians available.	• Merged with category no 2 measure

Actions Selected for Inclusion in the TAP for HEV

The TAP actions for the "Promotion of HEV," derived from the BAEF Report, focus on the simultaneous implementation of prioritized measures, ranked by urgency (low, moderate, high) based on effectiveness, efficiency, and relevance to Yemen's context. High-urgency measures were selected as key TAP actions, while low-ranking measures serve as supporting actions that can be implemented in parallel to high-priority ones to ensure the successful promotion of HEV (see Table 2:15). The actions included in TAP are shown in Table 2:15.

Activities Identified for Implementation of Selected Actions

This section summarizes the identified actions into more specific activities the selection of activities for each action was carried out through a stakeholder consultation process.

These activities need to be done to make each identified action work. A list of activities needed for the implementation of each identified action is presented in Table 2:15.

Table 2:15 Identification of specific activities to support actions for the promotion of HEV TAP

Actions and activities to implement the HEV technology TAP	
Action 1: Constitute financial policies to reduce the cost of HEV, by providing financial incentive schemes such as market incentives, and Bank facilities.	
Activity 1.1	Form a Steering Committee (SC) led by the Transport Ministry.
Activity 1.2	Develop and submit proposals for financial incentives and bank facilities to lower HEV costs.
Activity 1.3	Initiate steps for approval and implementation by the government and the relevant authorities.
Action 2: Enact legal, regulatory, institutional, and technical procedures to develop and enhance the HEV market by creating professional institutions to support technical standards.	
Activity 2.1	assess regulatory gaps hindering HEV adoption, identify new regulations, and explore the need for a technical standards centre.
Activity 2.2	Prepare and develop procedures for legal, regulatory, institutional, and technical enactments for government approval
Activity 2.3	implement technical standards, certifications, testing, and demonstrations for HEV and new transport technologies. Establish a Professional Institution for this purpose,
Action 3: Training programs for mechanics and technicians for maintenance of HEV.	
Activity 3.1	Develop a technical training program origin of HEV
Activity 3.2	Have an accredited technical training program as part of their education programs in the Technical Institutions

Actions to be Implemented as Project Ideas

The selected actions to be implemented as project ideas are actions 1,2,3. Where Action 1 (Financial Incentive Schemes) addresses the economic barriers to HEV adoption by reducing upfront costs. Action 2 (Legal and Institutional Frameworks) ensures that market growth is supported by appropriate regulations and professional institutions for quality and safety. Action 3 (Technical Training) builds the technical capacity necessary for vehicle maintenance and service, ensuring operational efficiency and long-term support.

In other words, these actions were selected because they address the key drivers of HEV promotion: affordability, regulatory support, and technical capacity. Together, they create an enabling environment for the HEV market to thrive, with a focus on financial feasibility, institutional development, and workforce readiness.

Gender Considerations

The TAP for HEV promotion achieves gender outcomes by ensuring gender-balanced representation in decision-making through the Steering Committee and by addressing women's access to financial incentives to encourage entrepreneurship. Regulatory assessments will identify and mitigate barriers to women's participation, while technical institutions will offer equal access to certifications and training. Additionally, gender-responsive training programs for HEV maintenance will provide outreach, support, and flexible opportunities for women, fostering their involvement in the technical and entrepreneurial aspects of the HEV sector.

Stakeholders and Timeline for Implementation of HEV TAP

Overview of Stakeholders for the Implementation of the HEV TAP

Overview of Stakeholders The roles of the main stakeholders in the implementation of the TAP for HEV are shown in Table 2:16

Table 2:16: Roles of stakeholders involved in the implementation of the HEV TAP.

Key Stakeholders	Role
Ministry of Transport (MT)	Leads transport policies, regulations, and institutional arrangements, involved in all HEV promotion actions and activities.
Traffic Police – Ministry of Interior (TP-MI)	Responsible for vehicle census, road safety, and vehicle fitness checks to limit air pollution. Assists in implementing policies.
Ministry of Finance MF, Custom Authority CA, and Tax Authority TA.	Drafting financial schemes and coordinating incentives for HEV promotion.
Chamber of Commerce, and Car Dealers Syndicate (CC-CDS)	Legal dealers for HEVs in Yemen, involved in all actions related to HEV promotion.
Technical Education Institute (TEI)	Provides accredited training for HEV maintenance and repair in collaboration with MT and TP-MI.
Commercial Private Banks (CPB) (Action 1)	Participates in subsidy schemes to promote HEVs (Action 1).
Ministry of Trade and Industry (MTC)	Ensures standards for new transport technologies like HEVs, oversees car and spare-part dealers, and issues licenses.

Scheduling and Sequencing of Specific Activities

Scheduling and sequencing of specific activities. The timeframe established for planning and implementation of the HEV TAP's actions and activities leading to the creation of a robust policy framework for the deployment of the prioritized transport sector technologies is 6 years (2025 to 2030). This period is aligned with the finalization of NDC, FNC, Long-Term Low Emission Development Strategy (LT-LEDS)

A detailed timetable for the activities can be found in the planning Table 2:17.

Table 2:17 Planning table - characterization of activities for implementation of actions for the promotion of HEV.

Action 1:	**Constitute financial policies to reduce HEV cost, through setting a financial incentives scheme that includes market and consumer incentives, and Bank facilities.**							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Who	Costs (US$)	Source of fund
1.1 Form a Steering Committee (SC) led by the Transport Ministry.	1st Q 2025	1st Q 2025	Steering Committee (SC)	2nd Q2025	3rd Q2025	Steering Committee (SC)	15,000	Donor، GCF, UNEP, Development Partner.
1.2 Develop and submission project proposals for financial incentives scheme, and Bank facilities to reduce HEV costs	4th Q2025	4th Q2025		2nd Q2026	2nd Q2026		20,000	
1.3 Initiate steps for approval and implementation by the government and the relevant authorities.	3rd Q2026	3rd Q2026		1st Q2027	1stQ2027	Council of Ministers, submitted by the Steering Committee (SC)	10,000	
Action 2:	Enact legal, regulatory, institutional, and technical procedures to develop and enhance HEV market, by creating professional institutions to support technical standards.							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Who	Costs (US$)	Who will fund
2.1 Assess regulatory gaps hindering HEV adoption, identify new regulations, and explore the need for a technical standards centre	2nd Q2027	2nd Q2027	Steering Committee (SC)	4th Q2027	4th Q2027	Steering Committee (SC)	20,000	Donor: GCF, UNEP, and Development Partner
2.2 Prepare and develop procedures for legal, regulatory, institutional, and technical enactments for government approval	1st Q2028	1stQ2028		3rd Q2028	3rd Q2028		10,000	

2.3 Implement technical standards, certifications, testing, and demonstrations for HEV and new transport technologies. Establish a Professional Institution for this purpose.	4th Q2028	4th Q2028		2nd Q2028	2nd Q2028		10,000	
Action 3:	Carry out education and training workshops as part of capacity building for technicians and mechanics in the maintenance and services of HEV.							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Who	Costs (US$)	Funding source
3.1 Develop suitable training programs, led by the Steering Committee (SC)	1st Q2029	1stQ2029	Steering Committee (SC)	3rd Q2029	3rd Q2029	Ministry of Transport, and Technical Education Ministry	5,000	Donor/ GCF, UNEP, and Services Provider
3.2 Have an accredited technical training program as part of their education programs in the technical institutions	4th Q2029	4th Q2029		2nd Q2030	2nd Q2030		5,000	

Gender Considerations

The TAP ensures gender-responsive implementation by promoting equal participation through key stakeholders like MT, Technical Education Institute (TEI), and commercial banks. Financial incentives (Action 1) will address gender-specific barriers to credit access, encouraging women's entrepreneurship in HEV businesses. Regulatory frameworks (Action 2) will ensure equitable participation in policy and licensing processes. Technical training programs (Action 3) will provide targeted outreach and support to recruit women, fostering their involvement in HEV maintenance and technical roles. These efforts promote gender equity across all actions and activities of the TAP.

2.1.3.4 Estimation of Resources Needed for Action and Activities

Estimation of Capacity Building Needs

Required capacity building for implementing the technology is related to capacity building updating and developing the policy and legal framework and technical training on and Maintenance of HEV to ensure accelerated diffusion of the technology in the country.

Estimations of Costs of Actions and Activities

The cost of each activity that makes up the technical action plan is shown in

Table 2:17. The total cost is estimated at US$ 95,000 which several sources including the private sector, international organizations, and the government will fund.

Gender Considerations

The TAP's capacity-building efforts will ensure gender-responsive participation by actively recruiting women for HEV maintenance training and policy development initiatives, with flexible schedules and incentives to encourage involvement. Budgets will allocate funds for workshops, scholarships, and support services to ensure women's access to technical skills and decision-making processes. Monitoring will collect gender-disaggregated data to track progress and ensure equitable outcomes. These efforts promote gender equity by providing equal opportunities for women in both technical and leadership roles within the HEV sector.

2.1.3.5 Management Planning

Risks and Contingency Planning

This section identifies the risks to the successful implementation of the TAP for the "Promotion of HEV". Measures to mitigate the risks are also identified. It also identifies the immediate critical steps that would be required to initiate TAP implementation (table 2.18).

Table 2:18 Overview of risk categories and possible contingencies for the HEV TAP.

Type of risk	Related to Action or Activity	Description of risk	Contingency actions	
1. Financial Risk	Action 1	It is possible that the current political turmoil in the country could drive away any interest in financing the TAP project, either from Climate Change Funds, or other Aid Agencies. For the present time, the government can't finance the TAP project, because it has no revenues, and there are other priorities.	The time interval for M&E:	-Annual
			M&E responsibility:	-Ministry of Finance, Customs and Tax Authorities, Ministry of Trade and Industry, and Ministry of Transport
			Contingency measures needed:	-The contingency plan is to set up a steering committee from the Finance, Transport, Trade and Industry, Customs, and Tax Authorities to prepare the financial incentives scheme, which will also review the scheme on an annual basis. Consequently, the economic losses will need to be minimized through the annual reviewof the financial incentives scheme.
			Responsibility contingency measure:	-Ministry of Finance, and all project stakeholders
			Timing contingency measure:	-In the first year of the commencement of the TAP.
2. Cost Escalation Risk	Actions during the implementation phase	The proposed financial incentives scheme to both market and consumer should reduce the cost of HEV. Moreover, the price of HEV is expected to decrease over time, as more cheap manufacturing brands from China, and India enter the market. This will have little or no effect on the cost of TAP.	The time interval for M&E:	-Annually
			M&E responsibility:	-The steering committee
			Contingency measures needed:	-To undertake the required measures to limit any cost escalation that might arise.
			Responsibility contingency measure:	-The steering committee
			Timing contingency measure:	-During the implementation phase
3. Scheduling Risk	All types of	The action and its activities take longer to complete than originally	The time interval for M&E:	- At the time of the scheduled delay
			M&E responsibility:	- Ministry of Transport

	activities	planned.	Contingency measures needed:	-The planned budget for each action and its activities should be increased by 10 %, to meet the costs of possible delays.
			Responsibility contingency measure:	-Ministry of Transport
			Timing contingency measure:	-Lifetime of TAP
4. Performance Risk	Actions during the technology implementation phase	Hybrid vehicles do not perform as expected.	The time interval for M&E:	-Annually
			M&E responsibility:	-Ministry of Transport, Ministry of Trade and Industry, HEV dealers syndicate, and technical expert.
			Contingency measures needed:	-The performance of HEV Technology can be enhanced by ascertaining that only authorized car dealers that meet the required standards can import HEVs. This will ensure high-quality after-sales services, including providing a skilled technical workforce for maintenance and repairs and ensuring the availability of spare parts. Accredited technical training will be delivered by Technical Institutes.
			Responsibility contingency measure:	-Transport ministry, technical experts, Traffic Police, and stakeholders (also, Technical Institutes)
			Timing contingency measure:	-Annual
5. Socio-economic Deterioration Risks	All types of activities	The unstable socio-economic situations may result in changes in the exchange rate, and interest rate and may impact negatively programs and projects	The time interval for M&E:	-Until the target ambitions – 30 % of vehicles on the road are HEVs by 2030.
			M&E responsibility:	-Steering Committee (SC).
			Contingency measures needed:	-Carry out awareness campaigns as well as capacity building of the stakeholders to enable them to sustain the market shocks and remain resilient.
			Responsibility contingency measure:	-The steering committee. (SC)

6. Change in Government Policies Risk	All types of activities	Due to the current situation in the country, the ruling government may change, hence, the priorities of the new government may also change.	The time interval for M&E:	Annually
			M&E responsibility:	The steering committee (SC)
			Contingency measures needed:	Review and readjust the programs in light of policy changes.
			Responsibility contingency measure:	Steering committee (SC)
7. Political Instability Risk	All types of activities	Political stability plays an important role in private sector investment in the dissemination and diffusion of any technology. Therefore, any political turmoil in the country will prevent private-sector investment	The time interval for M&E:	Annually
			M&E responsibility:	The steering committee (SC)
			Contingency measures needed:	Launch awareness-raising andsensitization programs for decision-makers, politicians, and other stakeholders
			Responsibility contingency measure:	The steering committee (SC)

Next Steps

Table 2:19: provides a summary of the immediate requirements and critical steps for the successful implementation of the HEV TAP.

Immediate requirements:	a) The EPA should schedule a meeting with other key stakeholders such as RREA, MME, and MFDP to disseminate the outcomes of the TAP and to clearly define each stakeholder's roles, responsibilities, and overall timelines. b) Government of Yemen should develop a budget line for funding TAP activities
Critical steps:	a) The EPA should ensure that the TAP's outcomes are approved at the Cabinet level. b) Project proposals based on the project ideas should be developed as soon as possible.

Gender Considerations

The TAP for HEV promotion addresses gender risks by integrating awareness campaigns, capacity building, and inclusive financial schemes to ensure women's participation despite challenges from political instability and socio-economic deterioration. Performance risks are mitigated by enforcing high standards among authorized dealers and offering accredited training for both men and women. Monitoring with gender-disaggregated data ensures women benefit from training, employment, and business opportunities. These strategies promote gender equity and ensure sustained participation throughout the project.

2.1.3.6 Reporting

Table 2:20: TAP overview table for the promotion of HEV" TAP.

Sector	**Transport**							
Sub-sector	Road Transport – Private Passenger Vehicle							
Technology	Hybrid Electric Vehicle HEV							
Ambition	The period for the promotion of HEV can be within a year, once the necessary and required procedures are implemented. Thus, the target and ambition for the HEV deployment is to reach 30% of the number of vehicles on the road by 2030.							
Benefits	Hybrid vehicles have lower fossil fuel dependency, operating costs, and maintenance than conventional vehicles, though battery costs are a disadvantage. Hybrid and electric cars reduce GHG emissions and fossil fuel consumption, offering significant economic savings.							
Action	Activities to beimplemented	Sources of funding	Responsible body andfocal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget per activity
Action 1: Constitute financial policies to reduce the cost of HEV, by providing financial incentive schemes such as market	1.1 Form a Steering Committee (SC) led by the Transport Ministry.	Climate Chane Fund	Steering Committee (SC)[2]	9months	The financial subsidy scheme idea has not attracted relevant government institutions, because of loss of revenues.	All stakeholders attended the discussion/meeting and agreed to contribute to the preparation of the financial scheme for the HEV.	A financial consultant was appointed by the Steering Committee (SC) to prepare the financial scheme	15,000
	1.2 Develop and submit proposals for financial incentives and bank	GEF and other climate	Financial consultant appointed	9months	Delay in preparing the financial scheme	The financial scheme proposal was developed	The financial scheme was submitted to the	20,000

[2] The SC will include financial consultants, technical experts, and representatives from key ministries, authorities, banks, car dealers, and NGOs. The workshop will propose financial incentives and bank facilities for HEV TAP implementation.

incentives, and Bank facilities.	facilities to lower HEV costs.	change funds	jointly by Ministry of Finance and Climate Change fund – GEF.				government for review and approval.	
	1.3 Initiate steps for approval and implementation by the government and the relevant authorities.	None	MF, and Financial Consultant.	9months	The financial scheme was rejected by the government, raising concerns about revenue loss.	The financial scheme was approved by the government,	The number of HEV customers benefiting from the scheme is gradually increasing	10,000
Action 2: Enact legal, regulatory, institutional, and technical procedures to develop and enhance the HEV market, by creating professional institutions to support technical standards.	**2**.1 Assess regulatory gaps hindering HEV adoption, identify new regulations, and explore the need for a technical standards centre	None	Steering Committee (SC).	9months	Lack of political support for setting up legal, institutional, and technical policies to promote HEV market.	Strong political support for setting up legal, institutional, and technical policies.	Initial agreement on the suggested policies, to promote the HEV market	20,000
	2.2 Prepare and develop procedures for legal, regulatory, institutional, and technical enactments for government approval	GEF and other climate change funds.	Steering Committee (SC)	9months	Delay in preparing and developing legal, institutional, and technical standards policies.	Strategies and policies developed and submitted for government approval.	The council of ministers approved the strategy and policies and set a timetable for implementation.	10, 000
	2.3 Implement technical standards, certifications, testing, and demonstrations for HEV and new transport			9months	Lack of interest from stakeholders to establish a technical standards centre for	The Steering Committee (SC) approved a plan to establish the	The technical standards support for new transport technologies such	10,000

	technologies. Establish a Professional Institution for this purpose.				new transport technologies such as HEV.	technical standards support.	as HEV, was established and in operation.	
Action 3. Carry out education and training workshops as part of capacity building for technicians and mechanics in the maintenance and services of HEV.	3.1 Develop a technical training program origin of HEV.	GEF and other climate change funds.	Steering Committee (SC), and technical expert.	9months	The technical training programs are not developed and not enough knowledge on the know/how of HEV services.	The technical training programs are developed	The high number of mechanics and technicians attended the training programs	5,000
	3.2 Have an accredited technical training program as part of their education programs in the Technical Institutions.	GEF and other climate change funds.	Steering Committee (SC)	9months	Technical institutes declined due to commitments to already busy curricula, and a large number of students	Technical institutes agreed in principle to carry out accredited training programs	A high number of trained mechanics and technicians with accredited certificates.	5,000

Gender Considerations

The TAP for HEV promotion will ensure gender inclusion by tracking gender-disaggregated data in reports, highlighting women's participation in financial schemes, training programs, and leadership roles. Success criteria will reflect women's engagement in capacity building and regulatory processes, ensuring equitable access to entrepreneurship and employment. Reports will also document budget allocations for gender-responsive programs and support services, promoting equal opportunities for women in technical and business roles. These measures ensure accountability and gender equity throughout the project.

2.1.3.7 Tracking the Implementation Status of the TAP

Rationale, Responsibility, and Content of TAP Tracking

Table 2:21: Institutional Responsibilities for Implementing and Managing the HEV Action Plan

Entity	Responsibilities	Related Activities
Transport Ministry (MT)	Lead the Steering Committee (SC), coordinate financial policies, oversee government approvals, and support capacity-building programs.	1.1–1.3, 2.1–2.3, 3.1–3.2
Finance Ministry (MF)	Develop financial schemes, manage incentives, and collaborate with SC on funding proposals and regulatory frameworks.	1.2, 1.3
Steering Committee (SC)	Oversee regulatory gap analysis, establish technical standards, and support stakeholder engagement.	2.1–2.3
Technical Experts and Institutions	Provide expertise for training, technical standards, and certifications for HEV maintenance and service programs.	3.1, 3.2

Table 2:22: Key activities and outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Establish Financial Policies & Incentives	Formulate financial schemes, develop proposals, and secure government approval for HEV incentives	The financial scheme developed and approved; increasing the number of HEV users	MT, MF, SC	Ensure women entrepreneurs have access to financial incentives (GEN 1). Related Activities: 1.1–1.3
Develop Legal & Regulatory Frameworks	Assess gaps, develop policies, and establish technical standards for HEV adoption	Policies developed; technical standards operational	SC, MF	Engage women-led institutions in policy discussions and technical standard development (GEN 2). Related Activities: 2.1–2.3
Capacity Building & Technical Training	Develop training programs, accredit technical education programs, and promote certification for HEV services	Accredited programs launched; high participation from technicians	SC, Technical Experts	Ensure women's participation in technical roles and accredited programs (GEN 2–GEN 3). Related Activities: 3.1, 3.2

Table 2:23: Monitoring, reporting, and risk management mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor key outputs, policy implementation, and financial progress, ensuring compliance	Quarterly	MT, MF, SC
Progress Reporting	Submit reports detailing activities, stakeholder engagement, and training outcomes	Monthly & Quarterly	Project Management Unit
Stakeholder Engagement	Engage local communities, industry representatives, and government institutions in planning and implementation	Ongoing	SC, Technical Experts
Risk Management	Identify and address risks, including delays in approvals or lack of political support	Continuous	MT, MF, SC

Table 2:24: Budget and financial tracking

Budget Component	Amount ($)	Description
Total Budget	95,000	Covers all activities for HEV deployment
Financial Schemes & Incentives	20,000	Develop schemes, secure approval, and initiate implementation
Regulatory Frameworks & Technical Standards	55,000	Develop policies, technical standards, and regulatory frameworks
Training Programs & Certification	20,000	Develop and accredit training programs
Administrative Costs	5% of each activity	Covers reporting, monitoring, and financial oversight

Gender Considerations

Table 2:25: Gender inclusion strategy with role transformation ambition

Activity	Gender Marker and Transformation Ambition
Financial Policies & Incentives	Ensure equal access to financial schemes for women entrepreneurs (GEN 1).
Regulatory Frameworks & Technical Standards	Promote women's involvement in technical standard development and policy discussions (GEN 2).
Capacity Building & Training	Provide leadership opportunities in technical education and certifications for women (GEN 2–GEN 3).
Stakeholder Engagement	Engage women in all stages of HEV planning, ensuring inclusive and participatory processes (GEN 2).

2.2 Project Ideas for the Transport Sector

2.2.1 A Brief Summary of the Project Ideas for the Transport Sector

The two transport projects aim to promote sustainable development in Yemen. The first focuses on creating an enabling environment for the adoption of Hybrid Electric Vehicles (HEVs) by offering financial incentives, establishing legal frameworks, and enhancing technical capacity, in alignment with Yemen's goal of reducing greenhouse gas emissions and achieving 30% HEV usage on the road by 2030. The second project proposes a feasibility study for a Bus Rapid Transit (BRT) system in Aden, Lahej, and Abyan, addressing congestion, air pollution, and fossil fuel dependency, this project aligns with Yemen's sustainable development priorities.

2.2.2 Project Idea 01: Enabling Environments (Financial Incentives Scheme, Legal, Institutional, and Technical Capacity Building) for Promoting Hybrid Electric Vehicles (HEV).

The project promotes hybrid electric vehicle (HEV) adoption in Yemen by offering financial incentives, such as loan interest subsidies, to reduce barriers and build consumer confidence. It includes establishing authorized dealerships, accredited technician training, and creating a supportive environment for low-carbon transport technologies. The project aims to reduce transport-related emissions by aligning with Yemen's climate commitments under the INDC. Key activities include forming a steering committee, securing government approval, and launching HEV maintenance training. Despite potential political challenges, the project aims to achieve 30% HEV usage on the road by 2030.

Section	Details
Introduction/ Background	To stimulate HEV market demand, a financial incentive scheme is needed to lower costs compared to conventional vehicles. Boosting consumer confidence requires HEVs to be sold by authorized dealers offering warranties and after-sales services, and ensuring accredited technicians are available for maintenance and repairs.
Objectives	1-To create market demand for HEV. 2-To enhance consumer confidence in HEV.
Outputs and Measurability	The main outputs are: 1-Provide technology-specific loan interest subsidies. 2-Develop strategy and guidelines for HEV dealerships. 3-Establish agreements with Technical Institutes for accredited training in HEV repair and maintenance.
Relationship to Yemen's Sustainable Development Priorities	The Yemeni government's INDC to the UNFCCC outlines plans to reduce GHG emissions, including from the transport sector. The proposed project aims to create enabling conditions for promoting HEVs, increasing Yemen's mitigation targets, and contributing to the review of its first INDC.
Project Deliverables	1- Reduce financial barriers to boost market demand for HEVs. 2- Enhance consumer confidence by regulating the HEV market through authorized dealers and reliable after-sales services.
Project Scope and Possible Implementation	The project is new to both the financial and car markets but aims to pave the way for other low-carbon transport technologies, increasing its chances of successful market penetration and widespread consumer adoption.
Project Activities	The activities are taken directly from the TAPs to show the coherence between TAPs and PIs: 1. Set up a steering committee (SC) to appoint a financial consultant to develop a financial incentives scheme with stakeholders. 2. Seek formal approval of the incentives scheme from the council of ministers. 3. Draft and approve strategy and guidelines for authorized HEV dealers. 4. Establish accredited training programs for mechanics and technicians with a Technical Institute.
Timelines	The activities are expected to be carried out between 2025 and 2030, about 6year

Budget/ means of implementation	**Activity**	**Budget**	**Implemented by**
	Developing the financial incentives scheme	20,000	Steering Committee (SC), and Financial Consultant.
	Approval of the financial incentives scheme	10,0000	Cabinet of Ministers, Steering Committee (SC), and Financial Consultant.
	Legal, Institutional, and Technical Framework for authorized HEV dealers	45,000	Steering Committee (SC), Financial Consultant, Legal Consultant, and Technical Expert
	Developing training programs, and delivering accredited and certified training workshops for Technicians and Mechanics	20,000	Steering Committee (SC), Technical Expert, and Technical Institute.
Measurement/ Evaluation	Activity	M&E Indicators	Sources of verification
	Developing the financial incentives scheme	Financial incentives scheme developed	Project M&E reports
	Approval of the financial incentives scheme	N.O of customers benefiting	Government decisions in newspapers.
	Legal, Institutional, and Technical Framework for authorized HEV dealers	N.O of approved strategies and guidelines	Project M&E reports
	Developing training program, and training workshops for Technicians and Mechanics	N.O of Technicians /Mechanics obtained training certificates	Project M&E reports
Possible Complications/ Challenges	Activities		Challenges
	Developing the financial incentives scheme		-Lack of financial consultant
	Approval of the financial incentives scheme		-Disagreement over the proposed financial incentives scheme leads to the scheme not being approved by the Cabinet of Ministers.
	Legal, Institutional, and Technical Framework for authorized HEV dealers		-Lack of political support for setting up of authorized HEV dealership, and strategy not approved by key stakeholders
	Develop accredited training programs and certified workshops for technicians and mechanics.		-Low rate of the stakeholder's interests.
Responsibilities and Coordination	The Steering Committee (SC) will play a key role in developing and securing Cabinet approval for the HEV financial incentives scheme. The Ministry of Transport will lead efforts to gain political support for the scheme, given its mandate over land transport policy.		

2.2.3 Project Idea 02: A Feasibility Study for the Introduction of Bus Rapid Transit (BRT) System in Aden Governorate and adjacent Lahej and Abyan Governorates

The project aims to introduce a Bus Rapid Transit (BRT) system in Yemen, starting in Aden, to reduce road congestion, air pollution, and fossil fuel consumption. The BRT system will provide efficient, high-capacity public transport, boosting mobility and economic growth. A feasibility study will evaluate routes between Aden and neighbouring cities, assess impacts, and identify potential donors. The project aligns with Yemen's goal to reduce transport-related greenhouse gas emissions and deliver social and economic benefits, including job creation, business attraction, and improved connectivity.

Section	Details
Introduction/ Background	A modern transportation system is essential for economic growth, facilitating the movement of people, goods, and services. However, increasing vehicle numbers cause road congestion, air pollution, and rising fuel costs. Where BRT uses dedicated lanes and advanced technologies to reduce congestion and improve transportation efficiency.
Objectives	The project's objective is to identify potential donors and develop a proposal, by conducting a feasibility study for a BRT network in Aden Governorate, connecting with Zingubar (Abyan) and Al-Hawtah (Lahej). The study will cover energy costs, bus procurement, a BRT feeder network, and dispute resolution mechanisms. It will also assess the economic, social, and environmental impacts, guiding local decision-making.
Outputs and Measurability	The project outcomes include identifying potential donors and developing a project proposal based on the feasibility study, covering the business model, infrastructure design, bus requirements, traffic management, station design, operational plan, and ridership forecast. It will address fare systems, cost estimates, financial planning, safety measures, energy conservation, CO2 emissions, and compliance with the Climate Change Mitigation Framework. Additionally, it will include bottleneck solutions, dispute resolution mechanisms, and a scenario evaluation framework.
Relationship to Yemen's Sustainable Development Priorities	The project aligns with Yemen's sustainable development goals, aiming for a reduction in transport-related GHG emissions by 2035. It promotes safe, affordable, and sustainable public transportation, reducing private vehicle use. The BRT system will improve mobility, cut travel time and costs, reduce accidents and pollution, and create jobs, boosting Aden's economy. Increased BRT connectivity will attract businesses, raise land values, and support thousands of commuters from Aden to Zingubar in Abyan and Al-Hawtah in Lahj. Women, the elderly, and disadvantaged groups will particularly benefit from this system.
Project Deliverables	Identification of Potential Donor. The study will cover: - Compilation of all background information, analysis methods and models, data and other materials relevant to the feasibility study. - Analysis of elements of the multi-modal system will be described/analyzed in both segments of the demonstration corridor in terms of supply (e.g., quantity of infrastructure, condition), demand (e.g., daily, peak period, peak hour public transport private vehicle travel) and performance (e.g., speeds, travel times, reliability, safety, related air quality, user satisfaction). - Overall corridor service and operating plans, including the BRT system. - Capital, operating, and maintenance costing, revenue estimation, and preparation of a detailed financial plan. - -Final Feasibility Report - Development of project proposal in consultation with key stakeholders and the donor.
Project Scope and Possible Implementation	The project aims to develop a feasibility study for a Bus Rapid Transit (BRT) system connecting Aden City with Zingubar in Abyan and Al-Hawtah in Lahj. This efficient BRT network will positively impact economic, social, and environmental development, enhancing quality of life, productivity, and public health. It will create jobs, improve equitable mobility, reduce travel times and costs, lower air pollution, and decrease traffic accidents. The BRT system will improve connectivity between rural and urban areas, particularly benefiting the urban poor and women by providing safe, affordable public transportation. Commuters in Aden, particularly those traveling from Zingubar in Abyan and Al-Hawtah in Lahj, face a shortage of reliable public transport, relying solely on minivans. A BRT network covering

	these busy routes will significantly enhance transportation, reduce traffic congestion from private vehicles, and improve mobility efficiency.		
Project Activities	The proposed activities of the project include: Conducting feasibility study involving: - Development of a study management structure - Development of a Public Involvement Plan (PIP) and conduct public workshops - Collection of data and coordinate with local transportation organizations - Identification of Potential Corridors for Rapid Transit Consideration - Development of a Criteria Screening Process for Corridor Evaluation - Conduction of a Technology Assessment - Conduction of a Corridor Selection and Refinement - Prioritization of Alternative Services/Configurations - Selection of Final Priority Corridors and Prepare Implementation Plans - Development of BRT Project Schedule and Milestones - Preparation of Draft – Final Report - Development and submission of Project proposal and Project Development Document (PDD) for Clean Development Mechanism (CDM), GEF, UNEP, World Bank, etc.		
Timelines	The activities are expected to be carried out in 2035		
Budget/ means of implementation	**Activity**	**Budget**	**Implemented by**
	1-Carrying out the feasibility study project for the BRT system.	10,000 (US$)	Consultants and the working team selected by the Transport Authority, and project donor
	2-Developing the BRT system project document	10,000 (US$)	
Measurement/ Evaluation	**Activity**	**M&E Indicators**	**Sources of verification**
	1-Feasibility study	1-Feasibility study project is developed	The Transport Authority, and project donor
	2-Development and preparation of the BRT system project document.	2- The BRT system project document is prepared	
	Notes: The work team and consultants will be selected by the Transport Authority and project donor.		
Possible Complications/ Challenges	**Activities**		**Challenges**
	-High Capital cost		-The high price of the machinery and equipment.
	-Long gestation period for recovery of the cost.		-The time required to recover the initial capitalcost is long.
	- Specialized infrastructure		-The system requires special lanes, so it takes time to get necessary approvals and arrangements.
Responsibilities and Coordination	The project will be implemented by the Yemeni General Corporation for Transportation in collaboration with provincial/central authorities.		

Water Sector

Chapter 3 Technology Action Plan and Project Ideas for the Water Sector

3.1 TAP for the Water Sector

3.1.1 Sector Overview

The water sector in Yemen plays a pivotal role in supporting livelihoods, agriculture, public health, and the environment. However, severe water scarcity, institutional challenges, and the ongoing conflict significantly affect the sector's ability to function effectively.

The water sector in Yemen faces significant stress due to climate change and variability, demographic pressures, weak governance and institutions, and a worsening economic situation.[3]While these challenges are not solely caused by climate change, it remains a critical threat to water resource management in the country.[4] Water shortages are intensifying each year, exacerbated by the ongoing imbalance between annual recharge and increasing water demand. This has resulted in the alarming groundwater depletion in several basins.

The Strategies and Laws

1) The National Water Sector Strategy and Investment Program (NWSSIP 2005–2009).

This strategy proposed a set of institutional, financial, and other measures, which aim at addressing discrepancies in the five sub-sectors to protect the interests of all stakeholders in the resources.

The program aimed to address the following main problems in the five sub-sectors, water resources, water and sanitation in urban areas respectively rural areas, irrigation, environment, and human:

- ✓ The low water resources availability and groundwater overdraft;
- ✓ Vulnerability of irrigated agriculture;
- ✓ Inefficient service and inadequate coverage;
- ✓ High fiscal subsidy or water supply and sanitation in urban areas;
- ✓ Poor sustainability of water supply and sanitation in rural areas.

Table 3:1: The subsectors, objectives, and measures of NWSSIP 2005–2009

Sub-Sectors	Objectives	The measures
Water Resources Management	1. Ensure the maximum possible degree of sustainability. 2. Give priority to the domestic needs of rural and urban populations. 3. Thereafter, maximize economic benefits through improved allocation, while mindful of equity and social norms. 4. Create a realistic and holistic vision among the general population regarding water resources availability/scarcity. 5. Contribute to poverty alleviation by promoting efficient use and equity in water allocation, to enhance socio-economic development	1. Creating an enabling institutional framework. 2. Providing information on water resources, raising awareness, and creating a shared water management vision among the beneficiaries regarding the optimal management of the resources. 3. Supplying water-related public goods (infrastructure). 4. Protecting water rights, implementing the water law, and creating conducive macroeconomic environment
Urban Water Supply and Sanitation	1. Increase coverage by NWSS services. 2. Financial sustainability of NWSS utilities. 3. Separation of sector regulatory and service-provision functions. 4. Decentralization. 5. Knowledge and skills development. 6. Community and private sector involvement	1. Expand coverage. 2. Continue and expand the reform program after its evaluation. 3. Develop regulation, monitoring, support, and policy-formulation functions. 4. Financial sustainability and poverty orientation. 5. Promoting private investment and public-private partnerships.

[3] https://openknowledge.worldbank.org/entities/publication/535dd55f-829b-5f77-be8e-7b3a40774fb3

[4] unfccc.int/sites/default/files/resource/3490581_Yemen-NC3-2-Yemen_TNC_2018_Final.pdf

		6. Building capacity and improving performance. 7. Enhancing community participation. 8. Sourcing the required quantities of water. 9. Desalination.
Rural Water Supply and Sanitation	1. Reduce the poverty alleviation tool, and consider the positive impact of access to drinking water on health, girls' education, and unemployment.	1. Increasing coverage and implementation capacity improve technology choice 2. Improving the targeting of the communities and sustainability of the schemes.
Irrigation and Watershed Management	1. Improving rural livelihoods and sectoral value added sustainably, the specific objectives for irrigation and watershed management are: a) Enhancing sustainability through water resources protection. b) Improving farmer incomes through increasing water use efficiency. c) Enhancing supply; and d) Improving institutional performance in support of farmers.	1. Sustainability through water resources protection. 2. Increasing farmer incomes through increasing the efficiency of water use in irrigation. 3. Enhancing sustainability and quality through improved watershed management. 4. Institutions for efficient agricultural water use.
Human and Environmental Aspects	1. Ensure equitable access to water and efficient use. At the environmental level, the objectives are to ensure resource sustainability both in quantity and quality.	1. Reduce poverty through improved environmental management 2. Act on water quality through a broad coalition 3. Protect water sources 4. Get environmental monitoring and regulation fully operational.

2) National Water Sector Strategy and Investment Program NWSSIP II Update (2008) for the period (2008–2015)
During the process of monitoring and evaluation of NWSSIP implementation, it was realized that some performance indicators were unattainable during the main constraints for the limited progress were the restricted implementation capacities through the utilities and lack of finance. Therefore, NWSSIP I has been updated for the period (2008–2015) to the program NWSSIP II.
Its revised goal is "to improve the Yemeni population's sustainable and economically efficient use of the nation's scarce water resources" through the following key objectives:

- ✓ Strengthen institutions for sustainable water resources management.
- ✓ Improve community-based water resources management.
- ✓ Increase access to water supply and sanitation services.
- ✓ Increase returns to agricultural water use.
- ✓ Recover control over groundwater abstraction in critical water basins.
- ✓ Establish the NWSS program as a wide sector approach mechanism for implementing the investment programme of NWSSIP Update.

Establish an M&E unit at MWE to ensure effective control of the NWSSIP II implementation. The M&E function has been confined to the urban sub-sector scope using the Performance Information and Indicators System (PIIS) which is still successfully in use at some LCs.
The implementation of the NWSSIP II investment program failed due to misaligned donor funding mechanisms and the limited capacity of implementing agencies. Political instability and security issues further disrupted or halted most investment efforts in recent years.
3) The Water Law No. (33) was established in 2002 as orderly legislation to prevent water resource depletion and organize the various water uses. Unfortunately, implementing this law and by-law has been interrupted due to Yemen Water Sector – Damage Assessment Stage III Part 1 – Resilience Strategy Report. The long period between issuing the law in 2002 and the by-law in 2009, besides other political and social aspects needed to be considered.
4) Water Law No. (41) of December 2006 provides regulations and guidelines for efficient economic water use and its protection. It further determines the rights for the use of water resources.

The two technologies identified for adaptation in the water sector were prioritized using a Multi-Criteria Analysis (MCA), prepared by consultants and utilized by stakeholders and policymakers during workshops. The selected technologies are (I) *Seawater Desalination* and (II) *Rainwater Harvesting.* Through the Barriers Analysis and Enabling Framework (BAEF) process, the barriers and challenges hindering the transfer and diffusion of these technologies were identified. Measures were then proposed to address these barriers, including the creation of an enabling environment for implementation. These measures are incorporated into the development of Technology Action Plans (TAPs) for both technologies.

3.1.2 Action Plan for Seawater Desalination

In this section, the technology action plan for Seawater Desalination is presented.

3.1.2.1 Introduction

Desalination technology has made considerable advances during the last few decades, which have added to its importance as a source for meeting drinking water needs in rural and urban (arid or semi-arid) regions. Such advantages have also led to a substantial reduction in desalination costs, largely due to savings achieved in energy consumed in the desalination process and to the reduction of environmental impacts of desalinization, which previously required high mitigation costs.
Desalination is often looked at as some magical solution to water scarcity, while others consider it an expensive technology, especially when water needs to be transported over long distances or pumped to high altitudes. In such cases, the energy cost for transport, rather than the desalination cost becomes the determining or constraining factor.
The MWE shed some light on the desalination policy in this respect:

- Desalination should be limited at present to coastal towns or highland towns with sustainable quantities of brackish groundwater that can economically be desalinated as a supplementary source for fresh groundwater. The reason for this is the prohibitive cost of transporting and pumping desalinated water over long distances or to high altitudes.
- It will be a mistake to delay the introduction of desalination until all groundwater resources are depleted. Then, it would be difficult for the population to afford the sudden large increase in the water tariff, which would be brought about by the high cost of desalinated water compared with the relatively cheap groundwater.
- Desalinated water should be gradually introduced as a supplementary source to supply coastal towns', to allow a gradual increase of tariffs.
- Engage the private sector to enter into investment partnerships with the public sector, particularly that the water produced can be sold in bulk to service utilities which in turn will pump it into its networks and bill it to its consumers.
- The losses in the water distribution networks should be very small (not exceeding 15%). This entails considerable investment to rehabilitate large segments of the water distribution networks in several Yemeni cities.

3.1.2.2 Ambition for Seawater Desalination TAP

The goal is to enable Yemen to produce 165,000 m³ of water daily through desalination plants by 2035.

Gender Considerations

The TAP for desalination in Yemen integrates gender equity by ensuring women's participation in decision-making through stakeholder consultations and leadership roles. It promotes economic empowerment by offering training programs for women in technical and managerial positions and supporting their entrepreneurship in water-related businesses. The increased water supply will ease the burden on women responsible for water collection, with efforts to ensure equitable access to desalinated water for all communities. Gender-disaggregated data will monitor participation and outcomes, ensuring continuous improvement in addressing water needs fairly.

3.1.2.3 Actions and Activities Selected for Inclusion in the TAP

Summary of Barriers and Measures to Overcome Barriers

This section outlines all the economic and non-economic barriers and measures that were identified during Phase II of the BA&EF to the enabling environment for the development and diffusion of the technology. Also, these measures were summarized to be more concentrated by the consultation process during this phase.

Table 3:2: summarizes the barriers and measures identified for seawater desalination. They are derived from the TNA and BA&EF report

Category	Identified barriers	Summarized Measures
Economic and Financial Barriers	• High capital and installation cost	Facilitate the financing sources and develop financial models to support the technology transfer. Exempting the import duties and eliminating or alleviating Taxes
	• High Loan Interest	
	• Inadequate Subsidy Programs and absence of funds for international tenders	
	• Lack of Capital for large-scale projects	
	• Absence of Guarantees and Incentives	
Non-Financial Barriers	• Lack of training programs locally or abroad for future operators and maintenance personnel	• Provide training courses, workshops, and seminaries to familiarize the technology for the local entities and policymakers and enhance the local experts' knowledge and skills on technology installation, operation, and maintenance
	• Inadequate awareness of the existing desalination technologies	
	• Shortage in a clear article in Water Law of 2002 and • No statement concerning desalination	• Update the water law to include desalination technologies
	• Inactive quality control regulations	• Enhance quality control and management by developing manuals and guidelines for the technologies and provide technical support for the responsible entities to activate their quality control.
	• Absence of local manufacturers of the membranes, carbon filters, and other parts	• Encourage local businessmen to invest in the manufacturing of the parts of the system for small-scale projects and to develop businesses of this kind.
	• Outdated strategies and plans	• Update the national water strategies to include desalination technologies among the key priorities of the country. • Integrate the technology into the national climate change plans and policies, such as NAPs and NDCs.
	• Feeble investment of the private sector in large-scale desalination for domestic supply	• Development of feasibility studies and research about desalination to assess its economic, social, and environmental impacts
	• Lack of institutional and policy support.	• Enhance and strengthen the institutional, regulatory, and policy framework of the water sector in the country.
	• Lack of energy needed to generate for the desalination plants	• Integrate desalination purposes into the agenda of the renewable energy plans of the government.

Actions Selected for Inclusion in the TAP for Seawater Desalination

This section outlines the Actions and Activities selected for inclusion in the Seawater desalination TAP. The Actions are linked to the measures identified following detailed analyses of barriers facing the technology and the enabling environment required to promote the technology.

The summarized measures were ranked in consultation with the technical group according to specific Criteria (UNFCCC and UNEP DTU Partnership, 2017)[5] .The results of the ranking of measures are shown in the Annex 4). The actions selected to be in the TAP of Seawater Desalination are shown in Table 3:3

Activities Identified for Implementation of Selected Actions

The Actions constituting the TAP for Seawater Desalination are listed in the Table below together with the Activities accompanying each one of them.

Table 3:3 Summary of actions for seawater desalination TAP and their corresponding activities

Actions and activities for implementing Seawater Desalination TAP	
Action 1: Facilitate the financing sources and develop financial models to support the technology transfer.	
Activity 1.1	Access to the funding source and the financial mechanism.
Activity 1.2	Identify TOR for a feasibility study [6]
Activity 1.3	Request CTCN support to draft a feasibility study[7] .
Activity 1.4	Develop a detailed concept note and prepare a funding proposal.[8]
Activity 1.5	Conduct a finance mapping and Public-Private Partnerships (PPP)
Action 2: Provide training and workshops to local entities and policymakers to enhance technical skills.	
Activity 2.1	Conduct a comprehensive needs assessment.
Activity 2.2	Organize training courses on the technology.
Activity 2.3	Promote knowledge sharing and collaboration among relevant stakeholders
Activity 2.4	Create comprehensive manuals and guidelines
Action 3: Integrate the technology into the national climate change and water plans and policies.	
Activity 3.1	Conducting a comprehensive review of existing national water plans and policies
Activity 3.2	integrate the technology into national and regional plans and with local needs and priorities.
Action 4: Develop technical, social, and environmental feasibility studies about desalination. [9]	
Activity 4.1	Conduct a comprehensive literature review of existing studies and reports on desalination in Yemen
Activity 4.2	Scope and TOR of study
Activity 4.3	Conduct preliminary surveys.
Activity 4.4	Determine the suitable locations for RO technologies in Coastal areas.
Activity 4.5	Conduct environmental and social impact assessments.
Action 5: Strengthen the institutional, regulatory, and policy framework of the desalination	
Activity 5.1	Review and assess the gap
Activity 5.2	Develop a new institutional, regulatory, and policy framework for desalination.

Actions to be Implemented as Project Ideas

The selected actions to be implemented as project ideas are actions 1,2 and3 for many reasons. Action 1 (Financing and PPP Models) ensures the project secures the necessary financial support for implementation. Action 2 (Capacity Building) equips local stakeholders with essential technical skills to operate and maintain desalination plants. Action 3 (Policy Integration) embeds the technology within national and regional strategies, ensuring long-term water management and climate adaptation efforts are aligned.

[5] https://tech-action.unepccc.org/wp-content/uploads/sites/2/2020/09/tap-guidance-2020-4.pdf

[6] Comprehensive economic and financial assessment of the technology.

[7] economic and financial

[8] Including project rationale, objectives, expected outcomes, detailed activities, budget, financial mechanism \ model, and implementation plan

[9] The feasibility studies and research are social, technical, and environmental. while the feasibility study in action 1 is economic and financial.

In other words, these actions were selected because they focus on the financial sustainability, technical capacity, and policy alignment required to implement and maintain a successful desalination project. Together, they address key barriers, ensuring that the project is technically viable, well-funded, and integrated into broader national strategies.

Gender Considerations

The TAP for desalination promotes gender equity by integrating inclusive financing models and encouraging women's participation in entrepreneurship through PPPs. Training programs will target both men and women, ensuring equitable skill development, with outreach efforts to engage women in technical roles. Social impact assessments and water policies will address gender-specific needs, prioritizing access and reducing the water collection burden on women. Institutional frameworks will promote women's involvement in leadership and decision-making, ensuring equal project governance participation. These activities ensure that the desalination project benefits all members of society equitably.

3.1.2.4 Stakeholders and Timeline for Implementation of Seawater Desalination TAP

Overview of Stakeholders for the Implementation of the Seawater Desalination TAP

The following key stakeholders and their proposed roles in this TAP are briefly described. The table below identifies their interaction with the various actions and activities previously identified.

Table 3:4 Roles of main stakeholders involved in the implementation of the seawater desalination TAP

Key Stakeholders	Role
Ministry of Water and Environment	Secure funding, Incorporate desalinated water into existing supply systems, ensure proper distribution, conduct Environmental Impact Assessments (EIAs), Ensure compliance with environmental standards, and establish monitoring frameworks
Ministry of Planning and International Cooperation	Secure international funding, and technical assistance, and build partnerships with global organizations.
Ministry of Industry and Trade	Create a supportive environment for private sector investment, integrate desalination into supply chains, encourage R&D, and Provide workforce training on the technology.
Chamber Of Commerce and Industry	Engagement of the private sector in desalination investments
Cabinet of Ministers	Admitting and passing the law and the attached executive regulations to the Parliament.
Yemeni Parliament	Discussion and approval of the law and regulations.
Presidential Council	Ratification and signature of the law and regulations.
University of Aden	Research and development of the technology.
Water Supply and Sanitation Corporation	Management and operation of the desalination plants
Local authorities	Field supervision and project management
GCF, FAO, IsDB, KDB, ADFD	Potential Donors and investors

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementation of the seawater desalination TAP's actions and activities is 6 years (2025 to 2030). This period is aligned with the finalization of Nationally Determined Contributions (NDC), National Adaptation Plan (NAP), and Fourth National Communication (FNC). These are key national policies related to development priorities and climate change adaptation for the attainment of Yemen's water sector.
Table 3:5 shows the timeframe for implementing activities, the institution(s) responsible for preparation and implementation, and the cost and potential sources of funding available for each Activity related to the deployment of seawater desalination.

Gender Considerations

The desalination TAP ensures gender equity by involving stakeholders in promoting equal access to water, workforce training, and private-sector participation for both men and women. Financial models and PPPs will enable women-led businesses to access funding. Training programs will actively recruit women with incentives and flexible schedules. Key policies will integrate women's voices, ensuring water governance reflects their needs. Social and environmental assessments will address gender-specific impacts, reducing burdens on women. Institutional frameworks will promote women's leadership in decision-making, ensuring inclusive governance and project management.

3.1.2.5 Estimation of Resources Needed for Action and Activities

This section discusses the capacity-building elements of the TAP, as well as an estimation of its implementation costs.

Estimation of Capacity Building Needs

The required capacity building for implementing the technology includes enhancing access to funding and data, as well as updating and developing relevant policy and legal frameworks. Additionally, technical training is essential for conducting feasibility studies, alongside specialized training on the installation, operation, and maintenance of seawater desalination systems. These efforts are crucial to ensuring the accelerated adoption and effective diffusion of the technology across the country

Estimations of Costs of Actions and Activities

The total cost of the Technical Action Plan (TAP) is estimated at $475,000, excluding salary and administrative costs, which are covered by the recurrent budget. The estimate includes only the immediate costs listed in Table 3:5.

Table 3:5: Planning table - characterization of Activities for implementation of actions

Action 1:	**Facilitate the financing sources and develop financial mechanisms to support the technology**							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 1.1: Access to the funding source and the financial mechanism.	1st Q2025	1st Q2025	MEW, and EPA in collaboration with MPIC	2nd Q2025	2nd Q2025	MEW, and EPA in collaboration with MPIC	60,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 1.2: Identify TOR for a feasibility study.	2nd Q2025	2nd Q2025	MWE, EPA	3rd Q2025	3rd Q2025	MWE, EPA	10,000	
Activity 1.3: Request CTCN support to draft a feasibility study	3rd Q2025	3rd Q2025		4th Q2025	4th Q2025		-	
Activity 1.4: Develop a detailed concept note and funding proposal.	4th Q2025	4th Q2025		1st Q2026	1st Q2026		60,000	
Activity 1.5: Conduct a finance mapping, and Public-Private Partnerships (PPP)	1st Q2026	1st Q2026		2nd Q2026	2nd Q2026		20,000	
Action2:	Provide training and workshops to familiarize local entities and policymakers to enhance experts' skills.							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 2.1: Conduct a comprehensive needs assessment	2nd Q2026	2nd Q2026	MWE, EPA	3rd Q2026	3rd Q2026	MEW, EPA	20,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 2.2: Organize training courses on the technology.	3rd Q2026	3rd Q2026		4th Q2026	4th Q2026		30,000	
Activity 2.3: Promote knowledge sharing and	4th Q2026	4th Q2026		1st Q2027	1st Q2027		15,000	

collaboration among relevant stakeholders								
Activity 2.4: Create comprehensive manuals and guidelines	1st Q2027	1st Q2027		2nd Q2027	2nd Q2027		40,000	
Action3:	Integrate the technology into the national climate change and water plans and policies.							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 3.1: Conducting a comprehensive review of existing national water plans and policies	2nd Q2027	2nd Q2027	MWE, EPA	3rd Q2027	3rd Q2027	MWE, EPA	30,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 3.2: Integrate the technology into national and regional plans and with local needs and priorities.	3rd Q2027	3rd Q2027		4th Q2027	4th Q2027		15,000	
Action 4:	Development of technical and environmental feasibility studies about the desalination.							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 4.1: Conduct a comprehensive literature review of existing studies and reports on desalination in Yemen	4th Q2027	4th Q2027	MEW, EPA	1st Q2028	1st Q2028	MWE	25,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 4.2: Scope and TOR of study	1st Q2028	1st Q2028		2nd Q2028	2nd Q2028		30,000	
Activity 4.3: Conduct preliminary surveys	2nd Q2028	2nd Q2028		3rd Q2028	3rd Q2028		20,000	

Activity 4.4: Determine the suitable locations for RO technologies in coastal areas.	3rd Q2028	3rd Q2028		4th Q2028	4th Q2028		25,000	
Activity 4.5: Conduct environmental and social impact assessments	4th Q2028	4th Q2028		1st Q2029	1st Q2029		25,000	
Action5:	Strengthen the institutional, regulatory, and policy framework of the water sector.							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 5.1: Review and assess the gap	1st Q2029	1st Q2029	MWE, EPA	2nd Q2029	2nd Q2029	MWE, EPA	30,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 5.2: Develop a new institutional, regulatory, and policy framework for desalination.	3rd Q2029	3rd Q2029		1st Q2030	1st Q2030		20,000	

Gender Considerations

The TAP's capacity-building efforts will ensure gender equity by offering outreach, incentives, and flexible schedules to encourage women's participation in technical and managerial roles. Training programs on funding access, policy development, and desalination operations will actively include women, promoting leadership and workforce inclusion. Budgets will support scholarships and gender-sensitive data collection, ensuring inclusive consultations and policies reflecting women's needs. Monitoring will track gender-disaggregated outcomes, ensuring capacity-building efforts provide equal opportunities for both men and women.

3.1.2.6 Management Planning

Risks and Contingency Planning

Risk and contingency plans must be identified to effectively implement the actions identified. Table 3:5 provides a detailed overview of identified risks and contingency plans

Table 3:6: Risks associated with the seawater desalination TAP and their adaptive measures.

Type of risk	Related to Action or Activity	Description Of Risk	Contingency actions	
Financial Risks	All Activities	Delays in resource mobilization may impair the implementation. Challenges associated with the national macroeconomic issues in the country.	The time interval for M&E:	-Quarterly and annually, or as per the financial regulations of donors.
			M&E responsibility:	-MWE and Ministry of Finance, Implementation Partners
			Contingency measures needed:	-Proactively engage with donors, partners, and financial intermediaries to manage risks. -Review and update the funding plan regularly to identify potential delays or shortfalls early. -Diversify funding sources, modalities, implementation partners, and donors per good management practices.
			Responsibility contingency measure	-MWE (NDA), MoF, MPIC, Implementation Partners
			Timing contingency measure:	-According to the type of event, but generally within 30 days.
Cost risk	All Activities	Costing is not accurate, and the required finance exceeds the allocated budget.	The time interval for M&E:	-Quarterly
			M&E responsibility:	-MWE, MPIC, and Implementation Partners
			Contingency measures needed:	-Evaluate procurement processes, explore additional funding sources, allocate time for plan adjustments, and amend targets, reprogramming, and budgets as needed.
			Responsibility contingency measure	-Implementation Partner, MWE (NDA)
			Timing contingency measure:	-Within 30 days of identifying a potential cost overrun
Scheduling risk	All Activities	Activities take longer to be completed than originally planned. Delays in decision-making by MWE (NDA) or Implementation Partners	The time interval for M&E:	-Every 6 months and whenever there is a delay
			M&E responsibility:	-MWE (NDA) and Implementation Partners
			Contingency measures needed:	-The implementation schedule accounts for potential delays, market readiness, seasonality, and required clearances. Regular monitoring with stakeholder involvement ensures proactive corrective actions, maintaining commitment to timely execution and quick adjustments for deviations.
			Responsibility contingency measure	-Implementation Partners, MWE (NDA)
			Timing contingency measure:	-Throughout the project implementation period.
			The time interval for M&E:	-Continuous

Technical Performance Risks	Implementation of R.O seawater desalination	Lower quality of implementation in terms of quality.	M&E responsibility:	-Implementation Partners, MWE, Local Authorities
			Contingency measures needed:	-Engineering supervision and support
			Responsibility contingency measure	-Implementation Partners
			Timing contingency measure:	-Engineering Quality control before, during, and after implementation
Environmental and Social Risks	Implementation of R.O seawater desalination	-Increased salinity levels, which negatively affect marine ecosystems. -Energy Consumption, which contributes to greenhouse gas emissions and exacerbates climate change. -Habitat loss, erosion, and changes in coastal hydrodynamics, impact ecosystems and biodiversity. -Unequal access, particularly if the costs are high, potentially marginalizing low-income -communities. Public health concerns if properly managed high levels of certain chemicals or insufficient minerals, potentially leading to public health concerns.	The time interval for M&E:	-Quarterly
			M&E responsibility:	-Implementing Partners, MWE, and Local Authorities.
			Contingency measures needed:	-Environmental and Social Management Plans with identified risks and stakeholder engagement plans tailored to the specific context of each intervention.
			Responsibility contingency measure	-Implementing Partners, MWE, Local Authorities, and community committees.
			Timing contingency measure:	-During project design and implementation.

Next Steps

Table 3:7: Provides a summary of the immediate requirements and critical steps for the successful implementation of the seawater desalination TAP.

Immediate requirements:	a) The EPA should schedule a meeting with other key stakeholders to disseminate the TAP's outcomes and clearly define each stakeholder's roles, responsibilities, and overall timelines. b) EPA should develop concept notes and budget Plans for funding TAP activities
Critical steps:	a) Project proposals based on the concept note should be developed as soon as possible. b) EPA must engage with donors early to secure financing for TAP projects to ensure that activity timelines are

Gender Considerations

The TAP for desalination addresses gender considerations by recognizing risks like unequal water access and high costs, which could disproportionately impact women. To mitigate these risks, the project incorporates Environmental and Social Management Plans (ESMPs) with stakeholder engagement, ensuring women's participation in decision-making. Monitoring efforts will involve men and women stakeholders to prevent service disruptions from technical or scheduling risks. Local authorities and partners will ensure equitable water distribution, promoting gender equity throughout the project's implementation.

3.1.2.7 Reporting

Table 3:8: The overview of the TAP for seawater desalination technology diffusion.

Sector: Water							
Sub-Sector: water diversity							
Technology: Seawater Desalination							
Ambition	Produce water of 165,000 m3 per day through seawater desalination plants by 2035						
Benefits	Implementing seawater desalination offers multiple benefits, including providing a sustainable freshwater source, boosting the economy by creating jobs and developing industries, and enhancing climate resilience with a stable water supply independent of variable climatic conditions. Additionally, it supports key sectors such as livestock rearing and aquaculture, which are crucial to Yemen's economy.						
Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame (yr)	Risks	Success criteria and indicators for monitoring of implementation	Budget per activity (USD)
Action1: Facilitate the financing sources and develop financial mechanisms to support the technology	Activity 1.1: access to the funding source and the financial mechanism.	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs,	MEW, and EPA in collaboration with MPIC	6months	Technical, scheduling, financial, and performance	-Identified several financial mechanisms and funding sources.	60,000
	Activity 1.2: identify TOR for a feasibility study[10] .		MEW, EPA	6months		-TOR is identified	10000

[10] comprehensive economic and financial assessment of the viability of the technology

	Activity 1.3: Request CTCN support to draft an economic and financial feasibility study	Private Sector	MEW, EPA	6months	Scheduling	-Approved support from CTCN	-
	Activity 1.4: Develop a detailed concept note and funding proposal.			6months	Technical, scheduling, financial, and performance	-Submission of the concept note and then the Funding proposal	60,000
	Activity 1.6: Conduct a finance mapping and Public-Private Partnerships (PPP)		MEW, EPA, MPIC	6months		-The finance mapping is completed. 2-Memorandum of agreement for PPP	20,000
Action 2: Provide training and workshops to familiarize local entities and policymakers to enhance experts' skills.	Activity 2.1: Conduct a comprehensive needs assessment		MEW, EPA	6months	Technical, scheduling, financial, and performance	-A comprehensive needs assessment is conducted addressing knowledge gaps and training needs, and specific areas	20,000
	Activity 2.2: Organize training courses	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MEW, EPA	6months		-The training courses attract a high rate of participants, and training courses are conducted.	30,000
	Activity 2.3: Promote knowledge-sharing and collaboration among relevant stakeholders			6months		-A high level of participation and engagement, and the number of knowledge-sharing conducted during the workshops	15,000
	Activity 2.4: Create comprehensive manuals and guidelines			6months		-A number of manuals and guidelines are developed.	40,000

Action3: Integrate the technology into the national climate change and water plans and policies	Activity 3.1: Conducting a comprehensive review of existing national water plans and policies	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MEW, EPA	6 months	Technical, scheduling, financial, and performance	-A number of agreements of stakeholders to integrate RWH with local needs and priorities.	30,000
	Activity 3.2: Integrate the technology into national and regional plans and with local needs and priorities.			6months		-Number of gaps identified in existing plans and policies,	15000
Action 4: Development of technical and environmental feasibility studies of desalination.	Activity 4.1: Conduct a comprehensive literature review of existing studies and reports on desalination in Yemen			6months	Technical, scheduling, financial, and performance	-Studies, reports, and publications reviewed.	25,000
	Activity 4.2: Scope and TOR of study			6months		-Completion and approval of the final Scope and TOR document.	30,000
	Activity 4.3: Conduct preliminary surveys.	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MEW, EPA	6months		-Data collection, Stakeholders, and community members engaged.	20,000
	Activity 4.4: Determine the suitable locations for RO technologies in Coastal areas.			6months		-Environmental and social impact assessments, Number of potential sites evaluated.	25,000
	Activity 4.5: Conduct environmental and social impact assessments			6months		-Number of environmental and social components evaluated and the potential impacts of	25,000

						desalination projects on marine and terrestrial ecosystems are analysis	
Action 5: Strengthen the water sector's institutional, regulatory, and policy framework.	Activity 5.1: Review and assess the gap	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MEW, EPA	6 months	Technical, scheduling, financial, and performance	-Several actionable recommendations are provided to fill identified gaps.	30,000
	Activity 5.2: Develop a new institutional, regulatory, and policy framework for desalination.			9 months		- New institutional, regulatory, and policy framework is developed	20,000

Gender Considerations

The TAP for desalination will integrate gender-disaggregated data in reporting, and tracking women's participation in training, consultations, and technical roles. Reports will highlight efforts to promote women's involvement through outreach, incentives, and flexible programs. Impact assessments will address gender-related challenges, ensuring equitable water access and reduced burdens on women. Policy and governance reporting will also reflect women's contributions to regulatory frameworks, ensuring inclusive and gender-responsive outcomes throughout the project.

3.1.2.8 Tracking the implementation status of the TAP

Rationale, Responsibility, and Content of TAP Tracking

Table 3:9 :Institutional responsibilities for implementing and managing the desalination TAP

Entity	Responsibilities	Related Activities
MEW & EPA	Lead technology integration, policy formulation, environmental assessments, and progress monitoring. Conduct training, manage reports, and engage stakeholders.	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.4, 4.5, 5.1, 5.2
MPIC	Align projects with national development goals, facilitate financial coordination, and establish Public-Private Partnerships (PPPs).	1.1, 1.5
Funding Entities (e.g., GCF, WB)	Provide financial resources, and technical assistance, engage in monitoring, support PPPs, and capacity-building initiatives.	1.1, 1.4, 1.5

Table 3:10 :Key activities and outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Facilitate Financing	Identify funding sources, submit proposals, develop PPPs	Approved proposals, secured funding	MEW, EPA, MPIC	Women involved in funding decisions and PPPs (GEN 1). Related Activities: 1.1–1.5
Training and Workshops	Conduct needs assessments, deliver training courses, hold knowledge-sharing events	Number of participants, feedback records, completion rates	MEW, EPA	50% women participation, tailored schedules for gender sensitivity (GEN 2). Related Activities: 2.1–2.4
Policy Integration	Identify gaps, update national policies	Number of policy updates and formal agreements	MEW, EPA	Ensure policies promote gender equality in access to resources (GEN 2). Related Activities: 3.1, 3.2
Feasibility Studies	TOR development, literature reviews, surveys, site selection	Completed studies, identified sites	MEW, EPA	Ensure safe access for women, involve them in consultations (GEN 2). Related Activities: 4.1–4.5
Strengthen Institutional Framework	Perform gap analysis, propose reforms, draft policies	Adopted frameworks	MEW, EPA	Policies supporting gender equality in hiring and governance (GEN 2). Related Activities: 5.1, 5.2

Table 3:11 :Monitoring, reporting, and risk management mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor key outputs, track financial progress, and compare actual achievements against targets	Monthly and quarterly	MEW, EPA
Progress Reporting	Submit reports detailing activities, challenges, financial expenditures, and outputs	Monthly & Quarterly	Project Management Unit
Stakeholder Engagement	Collect feedback, validate data, and ensure that outputs meet stakeholder needs	Ongoing	MEW, EPA
Risk Management	Identify and mitigate risks with contingency planning	Continuous	MEW, EPA, Stakeholders

Table 3:12 :Budget and Financial Tracking

Budget Component	Amount ($)	Description
Total Budget	475,000	Covers all activities for BRT implementation
Financing sources and mechanisms	150,000	Supporting the development of financing strategies and mechanisms for technology.
Training, workshops, and Capacity Building	45,000	Conducting sessions to familiarize local entities and policymakers and enhance experts' skills.
Integrate technology into national plans	105,000	Integrating the technology into national climate change and water plans and policies.
Technical and environmental feasibility studies	125,000	Conducting feasibility studies on desalination technologies.
Institutional, regulatory, and policy framework	50,000	Enhancing institutional, regulatory, and policy frameworks in the water sector.
Administrative Costs	5% of each activity	Covers reporting, monitoring, and financial oversight

Gender Considerations

Table 3:13 :Gender Inclusion Strategy with Role Transformation Ambition

Activity	Gender Marker and Transformation Ambition
Needs Assessments	Collect gender-disaggregated data to identify barriers and opportunities for advancing women's roles (GEN 2–GEN 3).
Training and Workshops	Ensure 50% women participation, and provide leadership and technical skills training to foster role transformation (GEN 2–GEN 3).
Policy Development	Promote policies that enable women's active leadership and ensure equitable access to decision-making roles (GEN 3).
Feasibility Studies	Assess gender-specific impacts, involve women in consultations, and promote participation in technical areas (GEN 2–GEN 3).
PPP Development	Establish PPPs that support women-led businesses and entrepreneurship in desalination and related industries (GEN 3).

3.1.3 Action Plan for Rainwater Harvesting (RWH)

3.1.3.1 Introduction

Rainwater harvesting (RWH) offers a practical, low-cost solution to alleviate Yemen's water crisis by collecting and storing rainwater from rooftops, streets, and other surfaces. This method supplements traditional water sources, reducing strain on the country's already overburdened water supply. In a region where rainfall is unpredictable and insufficient to meet demand, RWH provides a reliable source of water for agriculture, domestic use, and recharging groundwater supplies. Capturing rainwater during the wet season ensures a sustainable water supply, even during drought periods.

Despite its potential, RWH faces challenges in Yemen, including limited funding, and weak policy enforcement. Strengthening the approach requires microfinance programs, workforce training, and collaboration with NGOs. National policies are increasingly promoting rainwater harvesting through financial incentives and investments in water infrastructure, aimed at improving water security and climate resilience.

This ancient practice, historically used in Yemen and globally, is versatile, supporting applications such as irrigation, livestock watering, and domestic needs—provided proper treatment is applied. It can also serve institutions like schools and hospitals, ensuring access to water. RWH systems are scalable, fitting households, neighborhoods, and larger community-level installations.

These systems typically include rainwater tanks or cisterns to store rooftop runoff, offering multiple benefits. Stored water supports farming, livestock, and household activities while contributing to sustainable water management through long-term storage or groundwater recharge. By enhancing access to water and building resilience, RWH plays a critical role in addressing Yemen's water challenges.

3.1.3.2 Ambition for the TAP

Local communities in the highlands depend on groundwater for their water demands and rainwater for their agricultural and livelihood activities. Therefore, it is necessary to enhance their capacity to efficiently utilize the rainwater. For this purpose, rainwater harvesting is the ideal option for producing this service. The preliminary target is to support the local communities in storing 100,000m^3 of rainwater per year by 2035.

Gender Considerations

The TAP for rainwater harvesting ensures gender equity by actively involving women in community consultations and decision-making. It promotes capacity building by training women in technical skills for managing water systems and supporting agricultural entrepreneurship. The project guarantees equitable water access, reducing the burden on women and enhancing their livelihoods. Gender-disaggregated data will monitor participation and outcomes, ensuring the project benefits both men and women sustainably.

3.1.3.3 Actions and Activities selected for inclusion in the TAP

Summary of Barriers and Measures to Overcome Barriers

This section outlines all the barriers and measures that were identified during Phase II of the BA&EF to develop and diffusion RWH technology and also be summarized in this phase to be more concentrated. Summarized barriers and measurements are shown in the Table 3:14

Table 3:14: The summarized barriers and measures of rainwater harvesting

Category	Identified barriers	Summary Measure
Economic and Financial	• Capital and Installation Cost	• Facilitate the availability of financing sources and develop suitable financial mechanisms to support the construction implementation of rainwater harvesting systems in rural agricultural areas.
	• High Loan interest and Inadequate subsidy programs	• Initiate programs by the government, NGOs, philanthropy, and development banks to support rainwater harvesting construction through concessional and low-interest loans, blended finance, and grants.
Non-Financial	• The absence of integrated water resources management (IWRM) regulations and plans, that can control and monitor the use of all the available resources for efficient water management	• Integrate the rainwater harvesting technology in IWRM strategies/plans.
	• Inadequate awareness of the Existing RWH Technology	• Advocate for RWH and raise awareness amongst policymakers and institution leaders from one side, and communities, farmers, and other stakeholders on the other, about the benefits of water harvesting to address water scarcity, climate change impacts, and the role of water harvesting in sustainable water management by the traditional communication means, internet mass media, organize lectures, as well as conduct community workshops and townhalls to discuss various dimensions related to technology.
	• Outdated Strategies and Plans	• Integrate rainwater harvesting into climate change plans and strategies, especially, GCF country program NAPs and NDCs
	• Lack of training program for future operators and maintenance personnel	• Strengthen institutional capacity for water harvesting to provide an enabling environment for technology deployment in the householder and agricultural sector
	• Lack of Institutional and Policy Support.	

Actions Selected for Inclusion in the TAP for RWH

This section discusses the Actions and Activities selected for inclusion in the RWH TAP. The Actions are linked to the measures that were identified following detailed analyses of barriers facing the technology), as well as the enabling environment required to promote the technology. The assessment and ranking of identified measures have been done based on effectiveness, efficiency, interaction with other measures, suitability within the country, and benefits and costs as per guidelines for the preparation of TAP (see Annex 5).The Table 3:15 show all the actions selected to be in TAP.

Activities Identified for Implementation of Selected Actions

The selection of activities for each action was carried out through a stakeholder consultation process. This section summarizes the identified actions into more specific activities. These activities are things that need to be done to make each identified action work.

The Actions and accompanying Activities for implementing RWH are listed in Table 3:15

Table 3:15: Identification and description of specific activities to support actions to implement RWH.

Action 1: Facilitate access to the financing sources and develop financial mechanisms for RWH	
Activity 1.1	Identify funding sources and financial mechanisms for the technology.
Activity 1.2	Conduct an economic and financial viability assessment of RWH technology
Action 2: Strengthen institutional capacity for water harvesting for householders and agricultural sector	
Activity 2.1	Develop technical guidelines for water harvesting systems.
Activity 2.2	Establish platforms and materials for knowledge sharing and stakeholder collaboration.
Activity 2.3	Implement training programs on the use of these guidelines and manuals.
Action 3: Integrate rainwater harvesting into IWRM, climate change plans	
Activity 3.1	Review and assess the existing water and climate strategies.
Activity 3.2	Establish a long-term strategic vision for RWH into IWRM and national climate change plans.
Activity 3.3	Develop Policy Frameworks to Include RWH to IWRM strategy/plans and climate change plans

Actions to be Implemented as Project Ideas

The selected actions to be implemented as project ideas are actions 1,2,3 for many reasons. Where Action 1 (Financing Mechanisms) ensures the economic sustainability of RWH initiatives by identifying viable funding opportunities. Action 2 (Capacity Building) empowers stakeholders with the technical knowledge to adopt and manage RWH systems effectively, ensuring successful implementation. Action 3 (Policy Integration) embeds RWH into broader water management and climate policies, ensuring long-term institutional support and alignment with national priorities.

In other words, these actions were selected because they address the core elements required for the successful adoption of RWH technologies: financing, technical and institutional capacity, and policy integration. Together, they ensure the project is sustainable, scalable, and aligned with Yemen's climate adaptation strategies.

Gender Considerations

The TAP for rainwater harvesting promotes gender equity by ensuring women's access to financing and addressing gender-specific barriers to economic opportunities. Training programs and technical guidelines will actively involve women, equipping them with skills to operate and manage RWH systems. Knowledge-sharing platforms will ensure women's participation in collaborative efforts. Additionally, integrating RWH into IWRM and climate strategies will involve women in policy development, ensuring national plans reflect their needs and promote equitable water access for sustainable livelihoods.

3.1.3.4 Stakeholders and Timeline for Implementation of Rainwater Harvesting TAP

Overview of Stakeholders for the Implementation of the Rainwater Harvesting TAP

The roles of the main stakeholders in the implementation of the TAP for rainwater harvesting are given in The roles are attributed to specific Actions.

Table 3:16 Roles of main stakeholders involved in the implementation of the Rainwater Harvesting TAP

Key Stakeholders	Role
Ministry of Water and Environment (MWE)	Develop supportive policies, facilitate technology transfer, provide training, enforce regulations to integrate RWH into water management, and mobilize resources for effective implementation.
Ministry of Planning and International Cooperation (MPIC)	Plan and secure international funding, foster partnerships, coordinate stakeholders, integrate RWH into national strategies, obtain technical assistance from international organizations, and monitor project progress and effectiveness of RWH projects.
Ministry of Industry and Trade (MoIT)	Facilitate the local market introduction of RWH components, support local industries, implement incentive programs for businesses, establish quality standards with MWE provide workforce training, and promote innovation through incentives.
Ministry of Agriculture, Irrigation and Fisheries (MAIF)	Coordinating the process with the relative institutions, supervision, and managing the process.
Council of Ministers, Prime Minister Office	Admitting and passing the law and the attached executive regulations to the Parliament.
Presidential Council	Ratification and signing of the law and regulations.
Environment Protection Authority	Coordinating the process of funding, supervision, and managing the process.
University of Aden	Support R&D initiatives for adapting RWH technologies.
Rural water supply project	Follow-up, supervision, and management in rural areas
Public Work Project (PWP)	Participate in establishing the infrastructure.
Social Fund for Development (SFD)	Take part in the process of capacity building, and establishing the infrastructure
Civil Society Organizations (CSOs)	Coordinate capacity building, support infrastructure development, and prioritize vulnerable communities' inclusion
Vertical Climate Funds[11] , UN-accredited agencies[12], Multilateral Development Banks[13] and Bilateral donors[14]	Potential Donors and investors

[11] GCF, AF

[12] UNDP, FAO, WFP.

[13] KfW and Islamic Development Bank

[14] BmZ and FCDO.

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementation of the rainwater harvesting TAP's actions and activities leading to the creation of a robust policy framework for the deployment of the prioritized water sector technologies is six years (2025 -2030). This period is aligned with the finalization of the Nationally Determined Contributions, fourth national communication, and national adaptation plan. These are key national policies related to development priorities and climate change adaptation for the attainment of Yemen's water sector.

Table 3:17 shows the timeframe for implementing activities, the institution(s) responsible for preparation and implementation, and the cost and potential sources of funding available for each Activity related to the deployment of rainwater harvesting

Table 3:17: Planning table characterization of Activities for implementation of Tap

Action 1:	Facilitate access to the financing sources and develop financial mechanisms for RWH							
Activities	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Who will fund?
Activity 1.1: Identify funding sources and financial mechanisms for technology transfer.	1st Q 2025	1st Q 2025	MWE, EPA with coordination with MPIC.	3rd Q 2025	3rd Q 2025	MWE, EPA with coordination with MPIC.	25,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 1.2: Conduct an economic and financial assessment of RWH technology and identify optimal financing strategies.	4th Q 2025	4th Q 2025		2nd Q 2026	2nd Q 2026		35,000	
Action2:	Strengthen institutional capacity for water harvesting in the householder and agricultural sector							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Start	Complete
Activity 2.1: Develop technical guidelines for water harvesting systems.	3rd Q 2026	3rd Q 2026	MWE and EPA	1st Q 2027	1st Q 2027	MWE and EPA	30,000	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector
Activity 2.2: Establish platforms and materials for knowledge sharing and stakeholder collaboration.	2nd Q 2027	2nd Q 2027		4th Q 2027	4th Q 2027		15,000	
Activity 2.3: Implement training programs on the use of these guidelines and manuals.	1st Q 2028	1st Q 2028		3rd Q 2028	3rd Q 2028		30,000	
Action3:	Integrate rainwater harvesting into IWRM, climate change plans							
	Planning			Implementation			Costs and funding needs	
	Start	Complete	Responsible entity	Start	Complete	Responsible entity	Costs (USD)	Complete
Activity 3.1: Review and assess the existing water and climate strategies.	4th Q 2028	4th Q 2028	MWE and EPA	2nd Q 2029	2nd Q 2029	MWE and EPA	15,000	GCF, AF, GEF,

Activity 3.2: Establish a long-term strategic vision for RWH concerning IWRM and national climate change plans.	3rd Q 2029	3rd Q 2029		1st Q 2030	1st Q 2030		20,000	Bilateral, Multilateral WB, NGOs, Private Sector
Activity 3.3: Develop Policy Frameworks to Include RWH to IWRM strategy/plans and climate change plans	2nd Q 2030	2nd Q 2030		4th Q 2030	4th Q 2030		25,000	

Gender Considerations

The TAP for rainwater harvesting promotes gender equity by ensuring stakeholders like the MWE, MIT, CSOs, and SFD prioritize women's inclusion in policies, training, and resource mobilization. Financial mechanisms will address gender-specific barriers, enabling women-led projects to access funding. Training programs will actively recruit women, ensuring their participation in water management. Women's involvement in policy development ensures national strategies reflect their needs, promoting equal access to water resources and sustainable livelihoods.

3.1.3.5 Estimation of Resources Needed for Actions and Activities

This section discusses the capacity-building elements of the TAP, as well as an estimation of its implementation costs.

Estimation of Capacity Building Needs

In collaboration with stakeholders, we identified the critical capacity development needs necessary for the effective implementation of the TAP's actions and activities, as well as for reinforcing the enabling framework for water sector technologies. Key capacity-building priorities include securing funding, improving data accessibility, delivering comprehensive training, and updating and enforcing relevant policies and legal frameworks. Additionally, accrediting local personnel in the implementation of rainwater harvesting (RWH) is essential to promote the swift adoption and expansion of this technology throughout the country.

Estimations of Costs of Actions and Activities

The cost of each activity that makes up the technical action plan is shown in Reporting Table 3:20 .The total cost is estimated at US$ 195,000 which will be funded by several sources including the private sector, international organizations, and the government. The salary and administrative costs are not budgeted in the TAP, as it is proposed to be funded through the recurrent budget.

Gender Considerations

The TAP ensures gender-responsive capacity building by actively recruiting women for technical and managerial roles in RWH projects through flexible training and outreach. Budgets will support inclusive financial mechanisms, scholarships, and incentives to encourage women's participation. Women will also be involved in policy development to ensure water frameworks are equitable. Accreditation programs will provide equal opportunities for men and women to manage and operate RWH systems, promoting gender equity in the adoption and expansion of technology.

3.1.3.6 Management Planning

Risk and Contingency Planning

Risk and contingency plans must be identified to effectively implement the actions identified. Table 3:18 a detailed overview of identified risks and contingency plans.

Table 3:18: Risks associated with the seawater desalination TAP and their adaptive measures.

Type of risk	Related to Action or Activity	Description Of Risk	Contingency actions	
Financial Risks	All Activities	Challenges and delays in resource mobilization may impair the implementation. Challenges associated with the national macroeconomic challenges in the country.	The time interval for M&E:	-Quarterly and annually, or as per the financial regulations of donors.
			M&E responsibility:	-MWE and Ministry of Finance, Implementation Partners
			Contingency measures needed:	-Proactive engagement with donors, partners, and financial intermediaries to manage risks. -Review and update the funding plan regularly to identify potential delays or shortfalls early. -Diversify sources of funding, modalities, implementation partners, and donors by good management practices.
			Responsibility contingency measure	-MWE (NDA), MoF, MPIC, Implementation Partners
			Timing contingency measure:	-According to the type of event, but generally within 30 days.
Cost risk	All Activities	Costing is not accurate, and the required finance exceeds the allocated budget.	The time interval for M&E:	-Quarterly
			M&E responsibility:	-MWE, MPIC, and Implementation Partners
			Contingency measures needed:	-Evaluate procurement, identify overcasting causes, seek additional funding, allow time for relaunch, adjust targets, and amend the budget and plans.
			Responsibility contingency measure	-Implementation Partner, MWE (NDA)
			Timing contingency measure:	-Within 30 days of identifying a potential cost overrun
Scheduling risk	All Activities	Activities take longer to complete than originally	The time interval for M&E:	-Every 6 months and whenever there is a delay
			M&E responsibility:	-MWE (NDA) and Implementation Partners
			Contingency measures needed:	-The schedule considers delays, supplier readiness, seasonality, and procedures, with regular monitoring and

		planned. Delays in decision-making by MWE (NDA) or Implementation Partners		stakeholder involvement to enable timely adjustments and ensure successful execution.
			Responsibility contingency measure	-Implementation Partners, MWE (NDA)
			Timing contingency measure:	-Throughout the project implementation period.
Technical Performance Risks	Implementation of RHW systems, failure of the system due to poor quality of implementation, or extreme weather events exceeding design parameters	Lower quality of implementation in terms of quality.	The time interval for M&E:	-Continuous
			M&E responsibility:	-Implementation Partners, MWE, Local Authorities
			Contingency measures needed:	-Provide engineering supervision, support, and emergency plans for extreme weather to prevent storage system failures from endangering lives
			Responsibility contingency measure	-Implementation Partners
			Timing contingency measure:	-Engineering Quality control before, during, and after implementation.
Environmental and Social Risks	Implementation of RWH systems	Risks of altering the water flow courses impacting farms depending on flood water. Conflict between communities or within the community competing over water resources.	The time interval for M&E:	-Quarterly
			M&E responsibility:	-Implementing Partners, MWE, Local Authorities, and community committees.
			Contingency measures needed:	-Develop Environmental and Social Management Plans with risk identification and stakeholder engagement tailored to each intervention's context.
			Responsibility contingency measure	-Implementing Partners, MWE, Local Authorities, and community committees.
			Timing contingency measure:	-During project design and implementation.

Next Steps

Table 3:19: Provides a summary of the immediate requirements and critical steps for the successful implementation of the RWH TAP.

Immediate requirements:	a) The EPA should schedule a meeting with other key stakeholders to disseminate the outcomes of the TAP and to clearly define each stakeholder's roles, responsibilities, and overall timelines. b) GoY should develop a budget line for funding TAP activities
Critical steps:	a) The EPA should ensure that the TAP's outcomes are approved at the Cabinet level. b) Project proposals based on the project ideas should be developed as soon as possible. c) GoY must engage with donors early to secure financing for TAP projects to ensure that activity timelines are met.

Gender Considerations

The TAP for rainwater harvesting addresses gender risks by ensuring stakeholder engagement through community committees that include women, promoting equitable water access, and preventing conflicts over resources. Environmental and Social Management Plans (ESMPs) identify and mitigate risks that could disproportionately affect women. High-quality system design and engineering supervision ensure reliable water sources, reducing burdens on women. Regular monitoring by MWE and local authorities ensures that both men and women benefit equally, fostering gender equity throughout the project.

3.1.3.7 Reporting

Table 3:20: The overview of the TAP for seawater desalination technology diffusion.

Sector: Water							
Sub-Sector: Water Supply and Storage							
Technology: Rainwater Harvesting							
Ambition	The target is to increase rainwater harvesting, and storage systems by supporting the rural local communities to store 100,000m3 per year from rainwater by 2035.						
Benefits	Rainwater harvesting offers numerous benefits, especially in water-scarce countries like Yemen. Key advantages include diversifying potable water sources, reducing stormwater runoff and soil erosion, decreasing reliance on groundwater, and maintaining aquifer health. It fosters social cohesion through collective management, increases household and agricultural access to rainwater, and boosts water storage capacity, making it a sustainable water management solution.						
Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame (yr)	Risks	Success criteria and indicators for monitoring of implementation	Budget per activity (USD)

Action 1: Facilitate access to the financing sources and develop financial mechanisms for RWH	Activity 1.1: Identify funding sources and financial mechanisms	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MWE, EPA	9 months	Technical, scheduling, financial, and performance	-Several financial mechanisms and funding sources were identified, and a workshop report was completed.	25,000
	Activity 1.2: Conduct an economic and financial assessment of RWH technology.			9 months	Technical, scheduling, financial, and performance	-An economic and financial viability assessment report is conducted	35,000
Action 2: Strengthen institutional capacity for water harvesting for householders and agricultural sector	Activity 2.1: Develop technical guidelines for water harvesting systems	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs, Private Sector	MWE, EPA	9 months	Technical, scheduling, financial, and performance	-The guidelines and manuals are developed with high technical accuracy, clarity, and relevance to the target audiences.	30,000
	Activity 2.2: Establish platforms and materials for knowledge sharing and stakeholder collaboration.			9 months	Technical, scheduling, financial, and performance	-Knowledge-sharing and networking platforms are developed with the necessary functionality to support efficient information exchange among stakeholders.	15,000
	Activity 2.3: Implement training programs on the use of these guidelines and manuals.		MWE, EPA	9 months	Technical, scheduling, financial, and performance	-High levels of engagement and active participation in the training programs, and Participants are skilled in implementing the guidelines and manuals.	30,000
Action 3: Integrate rainwater harvesting into IWRM,	Activity 3.1: Review and assess the existing water and climate strategies	GCF, AF, GEF, Bilateral, Multilateral WB, NGOs,		9 months	Technical, scheduling, financial, and performance	-All relevant national strategies, plans, and policies are identified, especially regarding the integration of RWH, and a comprehensive report is produced that clearly outlines the findings of the review.	15,000

climate change plans.	Activity 3.2: Establish a long-term strategic vision for integrating RWH into IWRM and national climate change plans.	Private Sector		9 months	Technical, scheduling, financial, and performance	-long-term strategic vision for integrating RWH into IWRM and national climate change plans is formed.	20,000
	Activity 3.3: Develop Policy Frameworks to Include RWH to IWRM strategy/plans and climate change plans			9 months	Technical, scheduling, financial, and performance	-Policy Frameworks to include RWH in IWRM strategy/plans and climate change plans are adopted.	25,000

Gender Considerations

The TAP for rainwater harvesting ensures gender inclusion by tracking gender-disaggregated data and promoting women's participation in training, financial access, and policy development. Reports will highlight efforts to recruit women for technical training and support women-led projects through gender-sensitive financial mechanisms. Impact assessments will monitor how RWH systems reduce burdens on women and promote social equity in rural communities, ensuring equal opportunities and sustainable livelihoods for both men and women.

3.1.3.8 Tracking the implementation status of the TAP

Rationale, Responsibility, and Content of TAP Tracking

Table 3:21: Institutional responsibilities for implementing and managing the rainwater harvesting Action Plan

Entity	Responsibilities	Related Activities
MWE & EPA	Lead development of technical guidelines, policy formulation, and monitoring. Facilitate partnerships between government and communities to promote RWH adoption. Conduct training programs and oversee stakeholder collaboration.	1.1, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3
WB, NGOs, Private Sector	Provide technical assistance, co-finance initiatives, and engage in community-driven programs through public-private partnerships (PPPs). Support capacity building and knowledge sharing.	1.1, 2.2
Funding Entities (e.g., GCF, AF, GEF)	Offer financial support through grants and partnerships that encourage local community participation and long-term sustainability.	1.1, 3.1, 3.2

Table 3:22: Key Activities and Outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Facilitate Financing	Identify funding sources, develop financial mechanisms, and conduct economic assessments	Several funding mechanisms were identified; and a financial assessment completed	MWE, EPA, WB	Involve community groups and women in financial decision-making (GEN 1). Related Activities: 1.1, 1.2
Strengthen Institutional Capacity	Develop technical guidelines, establish knowledge-sharing platforms, and conduct training programs	Guidelines and manuals developed; high engagement from communities and stakeholders	MWE, EPA	Ensure community-driven platforms include women participants and promote leadership roles (GEN 2). Related Activities: 2.1–2.3
Policy Integration	Review and update national strategies, establish a long-term vision for RWH, and develop policy frameworks	Strategies reviewed; policy frameworks adopted	MWE, EPA	Align strategies with community interests and ensure gender equality in decision-making frameworks (GEN 2–GEN 3). Related Activities: 3.1–3.3

Table 3:23: Monitoring, Reporting, and Risk Management Mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor key outputs and financial progress, ensuring alignment with community and government objectives	Quarterly	MWE, EPA
Progress Reporting	Submit reports detailing activities, community engagement, and expenditures	Monthly & Quarterly	Project Management Unit
Stakeholder Engagement	Collect feedback from communities, validate data with local representatives, and ensure outputs meet needs	Ongoing	MWE, EPA
Risk Management	Identify and mitigate risks, with input from government agencies and community stakeholders	Continuous	MWE, EPA, Stakeholders

Table 3:24: Budget and financial tracking

Budget Component	Amount ($)	Description
Total Budget	195,000	Covers all RWH activities
Financing Mechanisms & Assessments	60,000	Identify funding sources and conduct assessments
Training Programs & Knowledge Sharing	75,000	Develop technical guidelines, training, and community collaboration platforms
Policy Development & Review	65,000	Review strategies, establish long-term visions, and develop frameworks
Administrative Costs	5% of each activity	Covers reporting, monitoring, and financial oversight

Gender Considerations

Table 3:25: Gender inclusion strategy with role transformation ambition

Activity	Gender Marker and Transformation Ambition
Needs Assessments	Collect gender-disaggregated data to identify barriers and promote participation of community women (GEN 2–GEN 3).
Training and Workshops	Ensure 50% women participation, provide leadership roles, and develop technical skills to foster transformation (GEN 2–GEN 3).
Policy Development	Develop policies that ensure equal participation of women in community governance and water management decisions (GEN 3).
Financial Assessments & PPPs	Engage community members, including women, in financing decisions and promote entrepreneurship through PPPs (GEN 2–GEN 3).
Knowledge Sharing Platforms	Create platforms that connect communities, government, and women-led initiatives, ensuring inclusive participation (GEN 2).

3.2 Project Ideas for Water Resources

3.2.1 A Brief Summary of the Project Ideas for the Water Sector

Yemen faces severe water scarcity due to climate change and groundwater overuse. To address these pressing issues, two innovative projects have been proposed for the water sector, focusing on sustainable solutions to enhance water availability. The first project, Seawater Desalination, targets coastal regions like Aden and the Tuban Delta. By utilizing reverse osmosis technology powered by solar energy, the project aims to produce 25,000m³ of fresh water per day by 2030, providing a reliable and sustainable source of water for domestic, agricultural, and industrial use. This initiative funded by the Green Climate Fund (GCF), is designed to mitigate the impacts of drought and enhance Yemen's overall water security while supporting public health and economic stability.

The second project**,** Integrated Water Harvesting Technologies, aims to address climate-induced water shortages in rural and urban communities across Yemen. Combining traditional rainwater harvesting with modern techniques, will benefit over 6,000 people, reduce groundwater dependence, and improve irrigation efficiency. Funded by the GCF, the project supports national climate adaptation goals, strengthens local technical capacities, promotes drought-resistant crops, and enhances long-term water security and sustainability.

3.2.2 Project Idea 01: R.O Seawater Desalination

Yemen's seawater desalination project aims to tackle severe water scarcity, especially in coastal regions like Aden and the Tuban Delta. As climate change exacerbates water shortages, the project seeks to provide 25,000m³ of fresh water daily by 2030, powered by solar energy. This USD 63 million initiative, primarily funded by the Green Climate Fund (GCF), will reduce dependence on depleted groundwater and ensure water security for domestic, agricultural, and industrial use. While it aligns with Yemen's national priorities and supports climate adaptation, risks such as brine discharge and high production costs must be managed for long-term sustainability.

Section	Details
Introduction/ Background	Yemen faces severe water scarcity, with one of the lowest per capita water availabilities in the world, driven by arid climate conditions, population growth, and unsustainable groundwater extraction. Most communities depend on diminishing aquifers or expensive water trucking, making access to safe drinking water a daily struggle. The ongoing conflict has further exacerbated the water crisis by damaging infrastructure and limiting investment in water management solutions. Desalination presents a viable option for coastal areas to secure a reliable water supply by converting seawater into potable water. Yemen's seawater desalination project aims to tackle severe water scarcity, especially in coastal regions like Aden and the Tuban Delta. Climate change exacerbates water shortages. The project seeks to provide 25,000 m³ of fresh water daily by 2030, powered by solar energy, thereby reducing the burden on women and improving their health and socio-economic status. The project will reduce dependence on depleted groundwater and ensure water security for domestic, agricultural, and industrial use
Objectives	The primary goal of seawater desalination is to enhance water security by providing a reliable, sustainable freshwater source, especially in water-scarce regions. It reduces groundwater dependence, preventing depletion and saltwater intrusion.
Outputs and Measurability	Output: ➢ Installation of seawater desalination plant with solar PV system. ➢ Training programs on O&M. ➢ Technical standards and guidelines.

	➢ Desalination policy and framework ➢ Private-public participation (PPP) engagement Measurability: ➢ Success is measured by producing fresh water daily, less dependency on groundwater, and climate resilience against climate change impact enhancement. ➢ Daily freshwater production, reduction in groundwater dependency, climate resilience
Relationship to Yemen's Sustainable Development Priorities	• Aligns with Yemen's INDC, TNA, NAPA, and GCF Country Programme to address critical water scarcity issues by increasing water security from the water sector. The proposed project aims of diversify water sources and protect the groundwater from depletion
Project Deliverables	Value/Benefits: ➢ Producing 25,000 m^3 of fresh water daily by 2030, thus reducing groundwater depletion, increasing water security, and enhancing climate resilience.
Project Scope and Possible Implementation	The project will cover Coastal regions, primarily Aden and the Tuban Delta . The possible implementations are: 1) Project Preparation through Stakeholder Engagement and Feasibility Studies 2) Project Design and Planning by conducting Technical Design and Financial Planning 3) Procurement and Contracting through a Procurement Strategy and Contract Management 4) Construction and Installation through Site Preparation and Plant Construction 5) Commissioning and Operationalization 6) Monitoring and Evaluation 7) Community Engagement and Capacity Building 8) Development of a Long-Term Sustainability Plan
Project Activities	1-Conduct feasibility studies, develop business plans, and site section 2-Install seawater desalination plants with PV solar. 3-Develop and implement O&M procedures and training.
Timelines	Duration: 60 months (5 years). - Phases: 1. Initial feasibility and planning and site section (Year 1-2). 2. Installation and training (Years 3-4). 3. Monitoring and evaluation (Years 5).
Budget/means of implementation	-Estimated Cost: $61 million. -Funding Sources: Green Climate Fund, Global Environment Facility, Government of Yemen in-kind co-financing of USD 2 million, including contributions from the government and potential private sector support. -The government will provide resources such as land, office space, pipe-laying work, and project staff.
Measurement/ Evaluation	Success Metrics: -Producing 25,000m3. -Reducing groundwater depletion Tools: Regular monitoring and evaluation reports.
Possible Complications/ Challenges	Challenges: 1-Political instability, security risks 2-logistical challenges in remote areas 3-Technical challenges

	4-Inadequate institutional policies and frameworks
	Mitigation: 1. Conduct security risk assessments implement contingency plans, and develop adaptive project plans with flexible timelines. 2. Build partnerships with local communities for logistical support 3. Provide continuous technical training and capacity building for local staff 4. Collaborate with stakeholders to create or revise enabling frameworks.
Responsibilities and Coordination	- Ministry of Water and Environment: Project management, coordination, technical supervision, and policy development. - International Partners and Donors: Funding and technical expertise.

3.2.3 Project idea 02: Integrated Water Harvesting Technologies to Adapt to Climate-Induced Water Shortages project

Yemen's Integrated Water Harvesting Technologies project aims to address severe water scarcity, worsened by climate change, by implementing traditional and improved rainwater harvesting techniques. Targeting vulnerable groups like rain-dependent farmers and poor households, the project offers technical and financial support to help them adapt to droughts, flooding, and irregular rainfall. With a USD 7 million investment from the Green Climate Fund, it focuses on sustainable water solutions to reduce groundwater overuse, improve health, raise incomes, and build resilience in communities across six governorates. The project aligns with Yemen's national climate adaptation goals and supports its UNFCCC commitments**.**

Section	Details
Introduction/ Background	Yemen faces severe water scarcity, worsened by climate change impacts like droughts and unpredictable rainfall, threatening agriculture, food security, and livelihoods. Reliance on depleting groundwater intensifies the crisis, necessitating sustainable solutions. Integrated Water Harvesting Technologies offer an essential adaptation by capturing and storing rainwater, reducing groundwater dependence, and ensuring reliable water for households, agriculture, and livestock. These systems mitigate risks such as crop failure, food insecurity, and economic instability, while enhancing public health, livelihoods, and social stability, building community resilience to climate shocks.
Objectives	• Provide a supplementary water source to reduce reliance on groundwater and surface water, ensuring availability during dry periods and enhancing resilience to climate variability.
Outputs and Measurability	Outputs: ➢ Implementation of Water Harvesting Structures to store 100,000m^3 of rainwater per year by 20235 ➢ Training farmers in water-efficient usage. ➢ Formation of local water management groups. ➢ Awareness of efficient water usage is increasing Measurability: • Number of RWH units installed and total water storage capacity. • Improved agricultural productivity and enhanced food security as key indicators of success.
Relationship to Yemen's Sustainable Development Priorities	Aligns with Yemen's INDC, TNA, NAPA, and GCF Country Programme to address this. Contributes to climate resilience, and critical water scarcity, especially in rural communities.

Project Deliverables	Value/Benefits: ➢ The RWH system is implemented to improve water security for over 6,000 people in local communities by supporting the storing of 100,000m^3 of rainwater per year, thus reducing groundwater depletion, increasing water security, enhancing climate resilience, reducing climate vulnerability, and improving living conditions, improved agricultural productivity
Project Scope and Possible Implementation	The scope of the project is 6,000 people in local communities across six governorates Possible Implementation: • Project Preparation through Stakeholder Engagement and Feasibility Studies. • Project Design and Planning by conducting Technical Design and Financial Planning • Construction and Installation of the RWH system. • Community Engagement and Capacity Building
Project Activities	• Carryout a survey to collect necessary data to identify suitable areas in the country for installation of rooftop rainwater harvesting systems • Strict enforcement of national rainwater harvesting policy and Raise awareness of this technology • Install RWH systems • Monitoring and evaluation
Timelines	Duration: 36 months (3 years). - Phases: 1. Survey as an assessment to select the locations and sites (Year 1). 2. Develop policies (Years 2). 3. Installation and training (Years 2). 4. Monitoring and evaluation (Years 3).
Budget/ means of implementation	The project will be funded by a GCF grant of USD 7,000,000 and in-kind co-financing from the government worth USD 1,048,334 to cover the project costs.
Measurement/ Evaluation	Success Metrics: -Storing 100,00m^3 for 6,000 beneficiaries. -Agricultural productivity -reducing groundwater depletion Tools: Regular monitoring and evaluation reports.
Possible Complications/ Challenges	Challenges: 1-Political instability, security risks 2-Logistical challenges in remote areas, potential local resistance Mitigation: 1. Conduct security risk assessments implement contingency plans, and develop adaptive project plans with flexible timelines. 2. Build partnerships with local communities for logistical support 3. Collaborate with stakeholders to create or revise enabling frameworks.
Responsibilities and Coordination	- Ministry of Water and Environment: Project management, coordination, technical supervision, and policy development. - International Partners and Donors: Funding and technical expertise

Agriculture Sector

Chapter 4 Technology Action Plan and Project A idea for the Agriculture Sector

4.1 TAP for the Agriculture Sector

4.1.1 Sector Overview

The agricultural sector is one of the most crucial in Yemen, supporting approximately 75% of the population. However, with the sector consuming 90% of the country's water resources, any shortage in water supply presents a direct threat to its growth. Fertile soil and water availability are the two essential pillars sustaining Yemen's agriculture.

Yemen, in its early stages, sought to develop policies and legislation related to water, especially in irrigation, where it created the Water Resources Policy and Strategy (1999-2000), Irrigation Water Policy (2001), Watershed Policy (2000) and Agricultural Sector Reform Policy (2000). Table 4:1 shows the main laws and policies that support the agricultural and irrigation sector.

Table 4:1: Show the main laws and policies that support the agricultural and irrigation sector.

Law and policy name	Description	Selected technology
Water Law No. 33 of 2002 and its amendment in 2006 by Law No. 41	• The first legislation enables and supports relevant government institutions to manage water resources in the country. And aim to regulate, develop, and rationalize the exploitation of water resources and protect them from depletion and pollution, protection and preservation.	Encouraging farmers to use modern irrigation methods and targeted technologies that achieve savings in water use. Protecting and maintaining agricultural terraces to reduce the severity of floods.
National Water Sector Strategy and Investment Program (NWSSIP) 2004	• Focused on five sectors; management and coordination, water resources management, urban water supply and sanitation, rural water supply and sanitation, irrigation and watershed management.	• Enhancing irrigation efficiency, including drip, sprinkler, and similar irrigation techniques. Rehabilitation of terraces/water structures to enhance recharge, divert surface water, or control floods.
Republican Decree No.61 of 2008, regarding the organizational regulations of the Ministry of Agriculture and Irrigation	• The regulation specified the Ministry's tasks with 27 tasks,	• The tasks of the ministry include organizing and encouraging the introduction and dissemination of appropriate modern technology and techniques in the field of agriculture and irrigation. Proposing policies and developing plans aimed at encouraging land reclamation and levelling. Protecting agricultural terraces and valleys from erosion.
National Agriculture Strategy 2012-2016	• Increase local food production, combating poverty by increasing farmers' income and job opportunities, ensure the sustainability of natural resources, and participation of rural communities including women, and improve	• Raise the efficiency of irrigation. Watershed management, rehabilitating agricultural terraces, and protecting valley banks

	marketing, harvesting, and export capacities. To achieve these goals, the agricultural development process includes four elements; improving agriculture productivity, water use efficiency, strengthening rural communities and women, and watershed management.	
Ministry of Agriculture, Irrigation and Fishery plan to enhance the role of the agricultural and fisheries sector in improving food security 2022-2027	• The overall objective of the plan is to contribute to alleviating poverty and improving food security in Yemen by improving agricultural and fish production in terms of quantity and quality through optimal use of natural resources and introduction of modern technologies. The plan includes 17 sub-objectives.	• The sub-objectives of the plan include rehabilitating irrigation infrastructure and improving water use.

There are current efforts to update the national strategy for agriculture and fisheries and develop a national strategy for food security. There are several other supported plans and strategies such as the National Plan to Combat Desertification 1992, Environmental Law No. 26 for the year 1995, Yemen Poverty Strategy Paper 2002, and National Biodiversity Strategy and Action Plan 2017.

The agriculture sector contributes significantly to Yemen's greenhouse gas emissions. According to Yemen's Climate Finance Country Program, projected GHG emissions for 2023[15] are estimated at 2.7 Mt CO_2 e, accounting for 28% of the country's total emissions. This estimate is based on the Biennial Update Report (BUR) pathway and other studies.

Given the current global situation of wars and the impact on agricultural production sources, there is an expectation of an increase in agricultural production in Yemen at the same time with the increasing effects of climate change, the agricultural sector will witness challenges represented in: water scarcity and frequent cyclones and flooding, in the other hand increase erratic precipitation and drought which lead to changing agriculture seasons and impact agriculture productivity and crop yield.

The first report identified the two technologies drip irrigation and soil conservation (terracing) as the most prioritized technologies in the agricultural sector, and the second report identified the barriers and measures to enabling the environment. The current report aims to identify the action plan for implementing the two technologies as well as identify the idea notes.

4.1.2 Action Plan for Drip Irrigation

4.1.2.1 Introduction

Drip irrigation technology ranked first in priority due to its efficiency in water use. It consists of a pressure pump, distribution pipes, and drip points, using water more effectively than traditional flood spate systems. Benefits include reduced water evaporation, increased crop production with less water, and suitability for various crops. Drip irrigation allows water to penetrate deep into the soil to the roots, reducing the cost of fertilizers and labour used in agriculture. Drip irrigation reduces the effects of climate change by reducing the amount of water used, thus increasing adaptation to water scarcity by using available water and increasing food security by being able to produce and gain income during prolonged droughts. Despite state encouragement, there is no comprehensive framework or accurate data on drip irrigation usage in Yemen.

[15] Yemen Climate Finance Country Program, 2023

4.1.2.2 Ambition for Drip Irrigation TAP

The aim is to expand drip irrigation across all 22 governorates of Yemen, targeting smallholder farmers, especially those with solar-powered water pumps, and key crops such as coffee in four governorates (Mahwit, Taiz, Abyan and Lahj). Four pilot sites in each governorate will cover 12 hectares, or 48 hectares per governorate per year, with a target area of 1,152 hectares over six years (2025-2030) in four governorates. The programme will build on successful drip irrigation projects and gradually expand, including farmer training, and will be implemented with key stakeholders, particularly the Ministry of Agriculture. The programme can be combined with terrace technology as coffee production is concentrated in terraced areas at altitudes of 100-2,500 metres above sea level. According to (Al- Hakimi A., 2012)[16] ,the total area of coffee in Yemen is 35 thousand hectares, 5% of coffee farmers use modern irrigation, meaning that there are 1650 hectares covered by modern irrigation - the average size of the terraces is one hectare[17], or less than 2 hectares[18], within 6 years the program can cover 1,152 hectares doubling the area irrigated by modern irrigation.

Gender Considerations

According to World Bank research on climate adaptation, almost two-thirds of Yemenis still rely on agriculture to make ends meet, with more than 75% living in rural areas where women comprise approximately 95% of the labor force. The project will target rural communities, making women the primary beneficiaries. While coffee, a crop historically cultivated by Yemeni women, will be a focus, the project will also implement targeted initiatives to ensure women's full involvement, including capacity building, leadership training, and equal participation in all stages of project activities."

4.1.2.3 Actions and Activities Selected for Inclusion in the TAP

Summary of Measures to Overcome Technology Barriers

This section outlines all the economic and non-economic barriers and measures that were identified during Phase II of the BA&EF to the enabling environment for the development and diffusion of the technology. Also, they summarized the consultation process to be more concentrated in this phase.

Table 4:2: Summarizes the barriers and measures identified for drip irrigation.

Category	Proposed Barriers	Summarized Measures
Economic and Financial	▪ High capital, installation, and maintenance cost per unit area	▪ Mobilize resources from local, international, and regional donors, including climate finance operating entities, and encourage private sector and microfinance participation to support the widespread technology
	▪ Lack of a stimulating investment environment	▪ Providing tax facilities on drip irrigation materials
Legal and Regulatory	▪ Absence of adequate quality standards and specifications.	▪ Reactivate the role of the Standards and Specifications Authority to ensure enforcement and inspection procedures on drip irrigation materials.

[16] Al- Hakimi A., 2012. Coffee cultivation and production in Yemen, Book published by Participatory foundation for research and dissemination, Sana'a, Yemen. in Arabic

[17] Yemen information Center

[18] Yemen Country profile, FAO 2008

	▪ Lack of policies, strategies, and regulations.	▪ Review and strengthen the national irrigation policy and programme
Institutional and Organizational	▪ Lack of coordination mechanism between all concerned parties including government institutions, private sector, service providers, and the end users.	▪ Strengthening and improving coordination and communication between irrigation stakeholders, especially local authorities' government and private sectors
Awareness and Knowledge	▪ Low community awareness and knowledge of the technology	▪ Design and implement knowledge and awareness Programs on the technology for the farmers and local communities on technology utilization
Technical Issues	▪ Lack of technical information and data about this technology besides ▪ Limited technical capabilities and skills to maintain the systems.	▪ Reactivate the role of agricultural extension and strengthening data and information services

Actions Selected for Inclusion in The TAP (Drip Irrigation)

According to the guidelines for evaluating technological technologies only, the specific measures were evaluated based on five basic criteria: effectiveness, efficiency, interaction with other measures, suitability within the country, and benefits and costs. See Annex 6.The measures that were selected as actions to be included in TAP are shown in Table 4:3

Activities Identified for Implementation of The Actions for Drip Irrigation

The activities were identified for the specific outcomes based on the available time, capabilities, and the necessary institutional and legislative structure, and it was taken into account that the activities were interconnected and implementable. The table below includes the actions and the activities for achieving the action.

Table 4:3: Drip irrigation main actions and activities

Actions and activities for implementing drip irrigation TAP	
Action 1: Mobilize resources from donors, including climate finance operating entities, and encouragement of private sector and microfinance participation.	
Activitiy1.1	Assess financial needs and available resources
Activitiy1.2	Building a bridge between the private sector, donors, and beneficiaries
Activitiy1.3	Integrate drip irrigation into the climate finance projects that target water and agriculture sectors.
Activitiy1.4	Establish financial mechanisms to support the widespread of technology
Action2: Strengthening coordination and communication between stakeholders, especially local authorities' government and private sectors	
Activitiy2.2	Developing a flexible communication and outreach plan with all stakeholders
Activitiy2.3	Organizing workshops to familiarize the stakeholders with the developed plan

Activitiy2.4	Conduct training programs to enhance the institutional and technical capacities of the Irrigation Department of MIA
Activitiy2.5	Establishing a coordination mechanism for drip irrigation stakeholders.
Action3: Design and implement knowledge and awareness Programs for the farmers and local communities.	
Activitiy3.1	Plan and implement a knowledge and awareness program
Activitiy3.5	Creating a guideline manual on irrigation techniques, their use, and maintenance

Actions to be Implemented as Project Ideas

The first step of the project is to secure funding, so efforts will be made to mobilize the necessary funds from available sources, especially international funding and national microfinance from the private or mixed sectors, especially banks (Action 1). The project idea will include several technologies, including drip irrigation technology, and will ensure maximum benefit from the technology and sustainability of the work. A guide will be created and training will be provided on it so that it can be referred to when needed (Action 3). Coordination between the parties is necessary, so there will be a need to establish a mechanism that ensures the support of local authorities for the project as well as providing technical support from government agencies, but the project idea will not produce a full coordination mechanism (Action 2).

Gender Considerations

Women will participate in most of the activities but to varying degrees. In action 1, women will participate in workshops and meetings to mobilize financial support, but when it comes to project proposals, especially in the field of agriculture, women will have a greater role because agriculture in Yemen, especially in rural areas, depends more on women. During the coordination mechanism, the authorities will be encouraged to include women in workshops and coordination committees. Women will be an important part of action 3, and attention will be paid to the special needs of women when dealing with the technology when developing the guide.

4.1.2.4 Stakeholders and Timeline for Implementation of Drip Irrigation TAP

Overview of Stakeholders for the Implementation of Drip Irrigation TAP

The main stakeholders in drip irrigation are farmers, the government, and the private sector. Farmers are motivated by increased income and improved water management. The government is invested in supporting the technology to enhance farmers' livelihoods and boost the economy. The private sector provides essential drip irrigation equipment and services, playing a crucial role in its adoption. The main stakeholders and their roles in drip irrigation technology can be summarized as follows:

Table 4:4: Roles of main stakeholders involved in the implementation of drip irrigation

Key Stakeholders	Role
Ministry of Water and Environment	Promote drip irrigation as a climate change adaptation and mitigation measure. Include drip irrigation technology in climate policies and reports and encourage project proposals containing drip irrigation for climate finance.
Ministry of Agriculture, Irrigation and Fishery	Encouraging and spreading drip irrigation technology, supporting farmers to use it, and mobilizing funding to support agricultural projects based on drip irrigation technology.
Environment Protection Authority	Focus on drip irrigation technology and encourage its use with solar energy when pumping. Confirm the environmental impact assessment of projects.
International organization	Financial and technical support for drip irrigation projects, technology transfer for water uses efficiency technologies including drip irrigation.

Climate Change Unit	Coordinate the stakeholders, build project proposals, and help mobilize climate finance. Training, and awareness in drip irrigation and climate change-related issues.
Micro-finance institutions	Finance the projects and support in implementation. Develop innovative financial mechanisms that fulfil the desires of donors and farmers.
Ministry of Education	Support the development of awareness programs and materials. Implement drip irrigation awareness programs in the school and include it in the study curriculum.

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementing the drip irrigation TAP's actions and activities leading to the creation of a robust policy framework for deploying the prioritized agricultural sector technologies is 6 years (2025 to 2030). This period is aligned with the finalization of the NAP, NDC, and FNC.

Gender Considerations

Women in Yemen are present in all public, private, and mixed sectors and represent an important element of the abovementioned stakeholders. Besides, they represent a significant percentage of the agriculture workforce. Therefore, it is crucial to engage them actively in all the agricultural aspects including irrigation technologies. In the TAP implementation, special training programmes will be provided to women and their role will be enhanced in both governmental and private sectors. Moreover, a key role will be given to women's associations to deploy the technology in the agricultural field. in addition to the importance of their presence as beneficiaries.

4.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of Capacity Building Needs

Several capacity needs may emerge when developing drip irrigation activities. There is technical capacity building related to the technology itself and its use, but what emerged is the urgent need to build capacity in mobilizing and managing funds, including the ability to write project proposals and market them. Capacity needs also include project management, reporting, monitoring and evaluation, and other training related to the project cycle. There is also a need to build capacity in awareness, production of knowledge and training materials, coordination, and supervision. We must not forget the importance of building capacity in gender, human rights, natural resource management, and climate change.

Estimations of Costs of Actions and Activities

The cost of each activity that makes up the technical action plan is shown in Table 4:7. The total cost is estimated at US$ 62,000 which will be funded by several sources including the private sector, international organizations, and the government. The salary and administrative costs are not budgeted in the TAP, as it is proposed to be funded through the recurrent budget.
It is pointed out that the estimated cost of the TAP includes only the immediate costs associated with the plan given in Table 4:7

Gender Considerations

There are three main opportunities for capacity building: technical, financial, administrative, training and awareness. As for training and awareness, women have always - and will have - an important role in the preparation and implementation process. As for capacity building, financial, and administrative, attention will be paid to ensuring that women have a clear role in the fundraising and management processes, and women have a clear role in this through their clear activity in government and public facilities. The greatest attention will be paid to the technical aspect, where

women participate less. Attention will be paid in all stages of work to sorting information according to gender, from the beginning of collecting basic information for the project to participation in activities and implementation to management and final evaluation. Everyone's opinions will also be heard during all stages.

4.1.2.6 Management Planning

Risks and Contingency Planning

The main risks for drip irrigation technology have been identified to ensure the success of the project and to discuss and implement prevention measures.

Table 4:5: Overview of risk categories and possible contingencies for drip irrigation

Type of risk	Related to Action/Activity	Description	Contingency Actions	
Financial (non-availability of funding)	Action 1	Changing currency rates makes it difficult for financial institutions to deal with. The current world conflicts can reduce international funding especially bi-lateral	The time interval for M&E:	Continues
			M&E responsibility:	Ministry of Finance, micro-finance institutions
			Contingency measures needed:	Financial map of available resources, training on project proposals. Active communication with donors
			Responsibility contingencymeasure:	Ministry of foreigner Affairs, CCU, MWE
			Timing contingency measure:	First Year
Scheduling risk	Integrate drip irrigation into the climate finance projects (activity 1.3)	Climate finance projects take longer time than normally funded projects.	The time interval for M&E:	Annual
			M&E responsibility:	CCU, MWE
			Contingency measures needed:	Current proposals should include drip irrigation activities
			Responsibility contingencymeasure:	CCU
			Timing contingency measure:	First 3 months
Performance Risk	Building a bridge between	There are different interests between	The time interval for M&E:	Continues

	the private sector, donors, and beneficiaries (activity 1.2)	stakeholders and some of them have low interest in drip irrigation.	M&E responsibility:	MWE, MPIC, and all other stakeholders
			Contingency measures needed:	Active meetings with different stakeholders, awareness
			Responsibility contingencymeasure:	MWE, MPIC, CCU
			Timing contingency measure:	Active, form the first month
Political instability and change in government policies risk	Action 1	Different political changes can happen, changing persons' positions including ministers and other government staff. Increase political conflict between government parties.	The time interval for M&E:	Continues
			M&E responsibility:	MPIC, MWE, MAIF, and all stakeholders
			Contingency measures needed:	Peacebuilding
			Responsibility contingencymeasure:	INGOs
			Timing contingency measure:	When needed

Next Steps

Table 4:6 provides a summary of the immediate requirements and critical steps for the successful implementation of the Drip Irrigation TAP.

Table 4:6: Summary of immediate requirements and critical steps for implementation of Drip Irrigation TAP

Immediate requirements:	a) The CCU should schedule a meeting with other key stakeholders to disseminate the outcomes of the TAP and to clearly define each stakeholder's roles, responsibilities, and overall timelines. b)GoY should develop a budget line for funding TAP activities
Critical steps:	a) The MWE should ensure that the TAP's outcomes are approved at the Cabinet level. b) Project proposals based on the project ideas should be developed as soon as possible. c) GoY must engage with donors early to secure financing for TAP projects to ensure that activity timelines are met.

Gender Considerations

Gender was integrated from the beginning of the work of the TAP, as a distinct presence of women was taken into account in all the workshops and meetings that were held, and their opinion was taken into account regarding the suitability of the actions and activities that were produced with the nature and interests of women. Gender was also integrated into the listed activities and the proposed project idea.

4.1.2.7 Reporting

Table 4:7 TAP overview table for drip irrigation actions, time frame, and proposed budget

Sector	Agriculture							
Technology	Drip Irrigation							
Ambition	The aim is to expand drip irrigation across all 22 governorates of Yemen, targeting smallholder farmers, especially those with solar-powered water pumps, and key crops such as coffee in four governorates (Mahwit, Taiz, Abyan and Lahj). Four pilot sites in each governorate will cover 12 hectares, or 48 hectares per governorate per year, with a target area of 1,152 hectares over six years (2025-2030) in four governorates. The programme will build on successful drip irrigation projects and gradually expand, including farmer training, and will be implemented with key stakeholders, particularly the Ministry of Agriculture. The programme can be combined with terrace technology as coffee production is concentrated in terraced areas at altitudes of 100-2,500 meters above sea level. According to (Al- Hakimi A., 2012), the total area of coffee in Yemen is 35 thousand hectares, 5% of coffee farmers use modern irrigation, meaning that there are 1650 hectares covered by modern irrigation - the average size of the terraces is one hectare[19], or less than 2 hectares[20], within 6 years the program can cover 1,152 hectares doubling the area irrigated by modern irrigation.							
Benefits	Drip irrigation in Yemen offers two key benefits: maximizing water use efficiency, especially in water-scarce areas, and addressing excessive groundwater pumping with solar energy. Additional advantages include: • Providing extra water for irrigation • Increasing productivity with the same water supply, boosting farmers' income • Suitability for various crops, including coffee • Using smart sensors for higher productivity and water efficiency • Reducing water loss through evaporation • Integration with water harvesting, solar pumping, and terrace farming.							
Action	Activity	Source of funding	Responsibility	Time frame	Risks	Success criteria	Indicators	Budget USD
Action 1: Mobilize resources from donors,	1.1 Assess financial needs and available resources	GCF readiness	EPA, MWE [21]	1st Q 2025-2nd Q 2025	Weak follow-up from government agencies	Partners effectively use and mobilize resources for drip irrigation	The assessment document was approved and distributed	7,000

[19] Yemen information Center

[20] Yemen Country profile, FAO 2008

[21] EPA: Environment Protection Authority, MoWE: Ministry of Water and Environment

including climate finance operating entities, and encourage private sector and microfinance participation.	1.2 Building a bridge between the private sector, donors, and beneficiaries	Private sectors, Bank, INGOs	EPA, MWE	3rd Q 2025 - 4th Q 2025	Weak participation and interest from some partners	Agreements on joint projects and memorandum of understanding regarding drip irrigation	At least 2 workshops and 5 meetings implemented	3,000
	1.3 Integrate drip irrigation into the current and future climate finance projects	GEF, AF, GCF, and other	CCU	1st Q 2026- 2nd Q 2026	No	Drip irrigation integrated into climate finance project	At least 2 climate finance projects have drip irrigation activities in 2025	2,000
	1.4 Establish financial mechanisms	Financial institutions and private sectors	MoF, MWE	3rd Q 2026 - 4th Q 2026	Weak follow-up from government agencies	Increase finance for drip irrigation, especially from microfinance institutions	The financial mechanism established and functioned	10,000
Action 2. Strengthening coordination and communication between stakeholders, especially local authorities' government and private sectors	2.2 Developing a flexible communication and outreach plan that facilitates vertical and horizontal communication with all stakeholders	MAIF, MWE, and other	CCU, MWE	1st Q 2027- 2nd Q 2027	Weak follow-up from government agencies	Increase meetings between stakeholders and communication materials and agreements	Approved plan	3,000
	2.3 Organizing workshops to familiarize the stakeholders with the developed plan	MAIF, MWE and other	CCU, MWE, EPA	3rd Q 2027 - 4th Q 2027		At least 70% of participants understand the communication plan (workshop pre-post evaluation)	No. of participants	1,000

	2.4 Conduct training programs to enhance the institutional and technical capacities of the Irrigation Department of the MIAF	Private sectors, financial institutions, and others	MAIF, CCU	1st Q 2028-2nd Q 2028	Weak follow-up from government agencies	The irrigation department can strengthen the drip irrigation process	No. of trainees	10,000
	2.5 Establishing a coordination mechanism for drip irrigation stakeholders.	MWE, MAIF	CCU, MWE, MAIF	3rd 2028 - 4th Q 2028	Irrigation Department with low capability to supervise and follow up the technology improvement	At least 2 meetings held in 2025 regarding drip irrigation	Coordination mechanism document	7,000
Action 3. Design and implement knowledge and awareness Programs on the technology for the farmers and local communities on technology utilization	3.1 Plan and implement a knowledge and awareness program	MAIF and other	MAIF	1st Q 2029-2nd Q 2029	Lack of budget to implement the programs	At least 3 programs implemented in 2025	Plan document, No. of programs implemented	12,000
	3.5 Creating a guideline manual on irrigation techniques, their use, and maintenance	Private sectors and donors	MAIF, CCU	3rd Q 2029 - 1st Q 2030	Weak use and acceptance of publications and awareness materials produced by decision-makers and the public	Guideline manual easy to use by stakeholders	Guideline manual published	7,000

Gender Considerations

Beneficiaries and participants during the work plan of the project will be disaggregated by gender, ensuring women's participation in all project activities.

4.1.2.8 Tracking the implementation status of the TAP

Table 4:8: Institutional responsibilities for implementing and managing the drip irrigation TAP

Entity	Responsibilities	Related Activities
Ministry of Water and Environment (MWE)	Lead resource mobilization, coordinate financial mechanisms and manage stakeholder collaboration.	1.1, 1.4, 2.5
Ministry of Agriculture, Irrigation, and Fisheries (MAIF)	Oversee technical training, implement outreach programs, and support farmer engagement.	2.2–2.4, 3.1, 3.5
Environment Protection Authority (EPA)	Integrate drip irrigation into climate finance projects and monitor environmental compliance.	1.1–1.3
Climate Change Unit (CCU)	Facilitate coordination, develop communication plans, and manage capacity-building initiatives.	1.3, 2.2, 2.3

Table 4:9: Key activities and outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Mobilize Resources & Establish Financial Mechanisms	Assess financial needs, secure donor funding, and establish microfinance schemes for farmers	Financial mechanisms established; increased funding from microfinance	MWE, MF, EPA	Ensure women farmers have access to microfinance and incentives (GEN 1). Related Activities: 1.1–1.4
Strengthen Coordination & Stakeholder Engagement	Develop communication plans, organize workshops, and establish coordination mechanisms	Approved communication plan; coordination mechanism operational	MAIF, MWE, CCU	Promote women's leadership in coordination efforts and stakeholder discussions (GEN 2). Related Activities: 2.2–2.5
Knowledge & Awareness Programs	Implement training, create manuals, and promote awareness among farmers and local communities	Knowledge programs implemented; manuals published	MAIF, CCU	Ensure women farmers are included in all awareness and training programs (GEN 2–GEN 3). Related Activities: 3.1, 3.5

Table 4:10: Monitoring, reporting, and risk management mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor progress on financial mechanisms and stakeholder engagement	Quarterly	MWE, MAIF, EPA
Progress Reporting	Submit reports on activities, financial status, and training outcomes	Monthly & Quarterly	CCU
Stakeholder Engagement	Engage farmers, private sector representatives, and local authorities to ensure inclusive processes	Ongoing	MAIF, CCU
Risk Management	Identify and mitigate risks, such as low institutional capacity or weak follow-up	Continuous	MWE, MAIF, CCU

Table 4:11: Budget and financial tracking

Budget Component	Amount ($)	Description
Total Budget	62,000	Covers all drip irrigation activities
Resource Mobilization & Financial Mechanisms	22,000	Assess financial needs, secure funding, and develop mechanisms
Coordination & Stakeholder Engagement	21,000	Develop communication plans and organize workshops
Knowledge & Awareness Programs	19,000	Implement training programs and create manuals for farmers
Administrative Costs	5% of each activity	Covers reporting, monitoring, and financial oversight

Gender Considerations

Women are an essential part of all stakeholders, and the budget will be monitored to ensure gender considerations are taken into account.

Table 4:12: Gender inclusion strategy with role transformation ambition

Activity	Gender Marker and Transformation Ambition
Resource Mobilization & Financial Mechanisms	Provide equal access to microfinance for women farmers and entrepreneurs (GEN 1).
Coordination & Stakeholder Engagement	Promote women's involvement in coordination bodies and decision-making processes (GEN 2).
Knowledge & Awareness Programs	Ensure women's participation in training programs and promote leadership roles within local communities (GEN 2–GEN 3).
Farmer Training & Outreach	Develop gender-sensitive manuals and ensure women farmers have access to all materials (GEN 3).

4.1.3 Action Plan for Soil Conservation (Terraces)

4.1.3.1 Introduction

Agricultural terraces, an ancient Yemeni method for cultivating mountainous areas, convert slopes into arable land by collecting soil and retaining water. This technique reduces soil erosion and runoff, preserving soil nutrients and increasing production. Terraces also help farmers adapt to climate change, especially drought because they improve rainfall absorption, reduce soil erosion, mitigate extreme summer temperatures, and mitigate flood risk while maintaining biodiversity and ecosystem services. However, they require regular maintenance, and rebuilding after floods is costly. The deterioration of one terrace can harm others. Due to their importance in soil conservation and climate adaptation, terraces are a key focus of this study, as recognized by stakeholders.

4.1.3.2 Ambition for Soil Conservation (Terraces) Technology

A 6-year (2025-2030) terrace maintenance program will focus on conserving 662,000 hectares of terraces across the southern highlands (Taiz, Aldhale, Lahej, and Abyan), targeting small farmers and crops like sorghum, wheat, barley, and coffee. According to a case study conducted by ARERA, the rate of deterioration in terraces ranges between 5-14%, meaning an approximate average of 10%, so there is an opportunity to conserve approximately 66,200 hectares (Muharram & Alsharjabi, 2019). This can be done through a 6 years terrace maintenance program with a focus on small farmers and crops of sorghum, wheat and barley, in addition to cash crops such as coffee. On the other hand, there is still the possibility of adding new stands. Each year, the program will build new terraces for coffee conservation on 1,200 hectares, benefiting 1,200 farmers. The long-term goal is to create terraces on 7,200 hectares over 6years.

Gender Issue

Yemen is one of the oldest coffee-growing regions in history, and Yemeni women have played a pivotal role in coffee cultivation and harvesting throughout history, as women work in all stages of coffee cultivation from nurseries to planting, harvesting, and processing. Coffee trees are grown on agricultural terraces in mountainous areas and usually in small plots, and women, especially rural women, are a key focus of this project, especially since coffee cultivation is still closely linked to rural life.

4.1.3.3 Actions and Activities Selected for Inclusion in the TAP

Summary of Measures to Overcome Technology Barriers

This section outlines all the economic and non-economic barriers and measures that were identified during Phase II of the BA&EF to the enabling environment for the development and diffusion of the technology.

Table 4:13: Summarizes the barriers and measures identified for Drip Irrigation.

Category	Proposed Barriers	Summarized Measures
Economic and Financial	• High capital, construction, and maintenance costs Economic and Financial • Weak market demand for this technology • Lack of Financial Support Program	• Mobilizing and directing resources from microfinance institutions, NGOs, Multilateral climate finance funds, and international donors' programs for soil conservation and terrace rehabilitation
Legal and Regulatory	• Lack of clear policies and strategies for land preservation and reclamation.	• Integrate the technology into the national agriculture, and climate change policies and plans such as NAPs, and NDCs

		• Develop tailored policies and plans for preserving and reclaiming agricultural lands, including building and rehabilitation of terraces
Institutional and Organizational	• No coordination mechanism between relevant government institutions, the private sector, and local communities. • Weak capacities of relevant government institutions and community-based institutions	• Establish coordination channels between the local communities, the private sector, and government institutions for terrace rehabilitation
Awareness and Knowledge	• Lack of awareness on the benefits of the technology • Limited data and information about the technology	• Design and implement awareness and knowledge programs on the importance and economic values of terraces technology including government, service providers, and farmers
Environmental	• Increased drought frequency, and changes in precipitation patterns	
Human skills and capabilities	• Poverty and leakage of trained and experienced labour due to migration to urban areas	

Action Selected for Inclusion in the TAP (Terraces)

The evaluation of terrace technologies was based on five criteria: effectiveness, efficiency, interaction with other measures, suitability, and cost-benefit. This process involved reviewing reports and consulting with stakeholders, including the Ministry of Agriculture, Irrigation, and Fishery, to identify key technologies for the Action Plan

Annex 7).

Activities Identified for Implementation of Selected Actions

The activities were identified for the specific outcomes based on the available time, capabilities, and the necessary institutional and legislative structure, and it was taken into account that the activities were interconnected and implementable.

Table 4:14: Framework for actions and activities of soil conservation (terraces) for inclusion in the TAP

Action	Activities
Action1: Mobilizing and directing resources from microfinance institutions, NGOs, Multilateral climate finance funds, and international donors' programs for soil conservation and terrace rehabilitation	
Activity 1.1	Integrating terrace technology within current prepared proposals to be submitted to climate funds
Activity 1.2	Assess financial and technical needs for soil conservation and terrace rehabilitation
Activity 1.3	Promoting terraces financial and technical needs to be part of local government financing, microfinance institutions, banks, regional, and international projects
Activity 1.4	Develop an innovative financial mechanism
Action2: Integrate the technology into the national agriculture, and climate change policies and plans such as NAPs, and NDCs	
Activity 2.1	Develop a baseline study of the status of agricultural terraces to be included in the National Plans
Activity 2.2	Conduct informative workshops on the importance of NAPs, CP, NC, and NDCs in enhancing the agriculture sector including terraces
Activity 2.3	integrate terraces into agricultural programs in the national plans and sectoral plans with relevant authorities
Action 3: Design and implement an awareness and knowledge programs on the importance and economic values of terraces technology	
Activity3.1	Design a work plan for an awareness program
Activity3.2	Conduct a detailed study of agricultural terraces and their benefits
Activity3.3	Preparing a guide on agricultural terrace techniques.
Activity3.5	Produce awareness materials on irrigation techniques and special materials for school students

Actions to be Implemented as Project Ideas

The first step of the project is to secure funding, so efforts will be made to mobilize the necessary funds from available sources, especially international financing and national microfinance from the private or mixed sector, especially banks (partially: Action 1), as the inclusion of terraces within the current projects is outside the scope of the project. The project idea will include several techniques, including soil conservation technology (terraces), and to ensure maximum benefit from the technology and sustainability of the work, a detailed study will be conducted for the terraces to also serve as a guide for any other projects, and attention will also be paid to raising awareness for all stakeholders including school students (Action 3).

Gender considerations

Women will participate in most activities but to varying degrees according to the required context. In Action 1, women will participate in workshops and meetings to mobilize financial support. The project will focus on actively involving women in the preparation of national plans, whether related to agriculture or climate change, due to the importance of women's perspectives, especially on the subject of soil conservation and terrace maintenance to ensure the success of

plans in the future, as women constitute the backbone of the agricultural sector, especially in rural areas. Women will be an important part of information gathering and education and awareness programs.

4.1.3.4 Stakeholders and Timeline for Implementation of Soil Conservation TAP

Overview of Stakeholders for the Implementation of Soil Conservation

The key stakeholders in soil conservation include farmers, the government, and the private sector. Farmers benefit from improved water management and income, while the government supports the adoption of technology to boost the economy.

Table 4:15: Roles of main stakeholders involved in the implementation of soil conservation

Key Stakeholders	Role
Ministry of Water and Environment	Promote terraces as a climate change adaptation and mitigation measure. Include terrace technology in climate policies and reports.
Ministry of Agriculture, Irrigation and Fishery	Strengthening the departments related to soil conservation and terrace maintenance. Conducting and encouraging studies related to terraces.
Environment Protection Authority	Focus on terrace technology biodiversity conservation tools. Confirm the environmental impact assessment of projects.
International organization	Financial and technical support for terrace projects. Support the access to climate change funds
Climate Change Unit	Coordinate the stakeholders, build project proposals, and help mobilize climate finance. Support training, and awareness in terraces and climate change-related issues.

Scheduling and Sequencing of Specific Activities

The timeframe established for planning and implementation of the Soil Conservation (Terrae) TAP's actions and activities leading to the creation of a robust policy framework for the deployment of the prioritized agricultural sector technologies is 6 years (2025 to 2030). This period is aligned with the finalization of the NAP, FNC, and NDC.

Gender Considerations

The stakeholders in the project are the private and public sectors, in which women are involved. Women are an important part of the climate unit, especially in project management and organizing workshops, which helps integrate women into other unit activities and the TAP. There are many women in the academic arena, which enhances their involvement - based on experience in studies related to agricultural terraces.

4.1.3.5 Estimation of Resources Needed for Action and Activities of Soil Conservation (Terraces)

Estimation of Capacity Building Needs

Several capacity needs have emerged in the development of the platform activities. There is technical capacity building related to conducting technical studies and research. Attention will be paid to capacity building in fund mobilization and management, including the ability to write and market project proposals. Capacity needs also include project management, reporting, monitoring and evaluation, and other training related to the project cycle. There is also a need for capacity building in awareness raising, knowledge production, training materials, coordination, and supervision. We must not forget the importance of capacity building in the areas of gender, human rights, natural resource management, and climate change.

Estimations of Costs of Actions and Activities

The cost of each activity that makes up the technical action plan is shown in Table 4.18. The total cost is estimated at US$ 54,000 which will be funded by several sources including the private sector, international organizations, and the government. The salary and administrative costs are not budgeted in the TAP, as it is proposed to be funded through the recurrent budget. It is pointed out that the estimated cost of the TAP includes only the immediate costs associated with the plan given in the table.

Gender Considerations

Attention will be paid to building research, financial, administrative, training, and awareness capacities. As for training and awareness, women have played and will continue to play an important role in the preparation and implementation process. As for building financial and administrative capacities, attention will be paid to ensuring that women have a clear role in the fundraising and management processes and that women have a clear role in this through their clear activity in government and public facilities. As for research, female researchers from the academic community will be involved as prioritized. Attention will be paid at all stages of work to sorting information by gender, from the beginning of collecting basic information for the project to participation in activities and implementation to management and final evaluation. Everyone's opinions will also be heard during all stages.

4.1.3.6 Management Planning

Risks and Contingency Planning

The main risks for drip irrigation technology have been identified to ensure the success of the project and to discuss and implement prevention measures.

Table 4:16: Overview of risk categories and possible contingencies for soil conservation (terraces)

Type of risk	Related to Action/Activity	Description	Contingency Actions	
Financial (non-availability of funding)	Action 1	Changing currency rates makes it difficult for financial institutions to deal with. The current world conflicts can reduce international funding especially bi-lateral	The time interval for M&E:	Continues
			M&E responsibility:	Ministry of Finance, micro-finance institutions
			Contingency measures needed:	Financial map of available resources, training on project proposals. Active communication with donors
			Responsibility contingency measure:	Ministry of foreigner Affairs, CCU, MWE
			Timing contingency measure:	First Year

Scheduling risk	Integrate drip irrigation into plans (Action 2)	The development of plans can take longer time, especially with the current war and political conflict	The time interval for M&E:	Annual
			M&E responsibility:	CCU, MWE
			Contingency measures needed:	Create focal points in all related ministries
			Responsibility contingency measure:	CCU
			Timing contingency measure:	Annual
Performance Risk	Low quality of terraces and soil conservation study	Lack of expertise and data	The time interval for M&E:	Monthly
			M&E responsibility:	MWE, MAIF, Academia
			Contingency measures needed:	Building good TOR and taking enough time for the selection of experts
			Responsibility contingency measure:	MWE, CCU, Academia
			Timing contingency measure:	Active
Political instability and change in government policies risk	Action 1	Different political changes can happen, changing persons' positions including ministers and other government staff. Increase political conflict between governments parties.	The time interval for M&E:	Continues
			M&E responsibility:	MPIC, MWE, MAIF, and all stakeholders
			Contingency measures needed:	Peacebuilding
			Responsibility contingency measure:	INGOs
			Timing contingency measure:	When needed

Next Steps

Table 4:17: Summary of immediate requirements and critical steps for implementation of soil conservation (terraces) TAP

Immediate Requirements:	a) The CCU should schedule a meeting with other key stakeholders to disseminate the outcomes of the TAP and to clearly define each stakeholder's roles, responsibilities, and overall timelines. d) GoY should develop a budget line for funding TAP activities
Critical steps:	a) The MWE should ensure that the TAP's outcomes are approved at the Cabinet level. b) Project proposals based on the project ideas should be developed as soon as possible. c) GoY must engage with donors early to secure financing for TAP projects to ensure that activities timelines are met.

Gender Considerations

The gender issue has been integrated since the beginning of the project, as a distinct presence of women was taken into account in all workshops and meetings that were held, and their opinion was taken into account regarding the suitability of the works and activities that were produced to the nature and interests of women. The gender issue was also integrated into the included activities and the idea of the proposed project. Gender considerations will also be taken into account during the implementation of the TAP.

4.1.3.7 Reporting

The table presents the overall planning of Soil Conservation (Terraces)

Table 4:18: TAP overview table for soil conservation (terraces) actions, time frame and proposed budget

Sector	Agriculture							
Technology	Soil conservation Terraces							
Ambition	A 6-year (2025-2030) terrace maintenance program will focus on conserving 662,000 hectares of terraces across the southern highlands (Taiz, Aldhale, Lahej, and Abyan), targeting small farmers and crops like sorghum, wheat, barley, and coffee. According to a case study conducted by ARERA, the rate of deterioration in terraces ranges between 5-14%, meaning an approximate average of 10%, so there is an opportunity to conserve approximately 66,200 hectares (Muharram & Alsharjabi, 2019). This can be done through a 6 years terrace maintenance program with a focus on small farmers and crops of sorghum, wheat and barley, in addition to cash crops such as coffee. On the other hand, there is still the possibility of adding new stands. Each year, the program will build new terraces for coffee conservation on 1,200 hectares, benefiting 1,200 farmers. The long-term goal is to create terraces on 7,200 hectares over 6 years.							
Benefits	The benefit of agricultural terraces is known due to the practice of the technique for thousands of years. The benefit of this technique lies in the following: - Effective use of mountain slopes and turning them into productive sites - Preserving soil from erosion - Preserving flowing water and utilize it effectively An important source of income for many low-income families							
Action	Activity	Source of funding	Responsibility	Time frame	Risks	Success criteria	Indicators	budget
1 Mobilizing and directing resources from microfinance institutions, NGOs, Multilateral climate finance funds, and international	1.1 Integrating terrace technology within current prepared proposals to be submitted to climate funds	Financial institutions, climate finances, and other donors	CCU, MAIF	1st Q 2025-2nd Q 2025	No	Terraces become an important part of climate finance projects	At least 3 climate finance projects have terraces activities in 2025	2,000
	1.2 Assess financial and technical needs for soil conservation and terrace rehabilitation	MWE, MAIF, donors	MWE, MAIF,	3rd Q 2025 -4th Q 2025	Weak follow-up by	Partners effectively use and mobilize resources for terrace	The assessment document was	7,000

donors' programs for soil conservation and terrace rehabilitation					government agencies	construction and rehabilitation	approved and distributed	
	1.3 Promoting terraces financial and technical needs to be part of local government financing, microfinance institutions, banks, regional, and international projects	MWE, MAIF, local governments, donors	CCU, MWE, MAIF, local authorities	1st Q 2026-2nd Q 2026	Low interest from financial institutions	At least 2 projects implemented in 2025 supported by national financial institutions	No. of events for promoting terraces' financial and technical needs	1,000
	1.4 Develop a financial mechanism to support the terrace construction and rehabilitation initiatives through partnerships with development and microfinance entities	MAIF, donors	MAIF (fund), CCU	3rd Q 2026 -4th Q 2026	Weak participation and interest from some partners	Increase finance for soil conservation, especially from microfinance institutions	The financial mechanism established and functioned	12,000
2 Integrate the technology into the national agriculture, and climate change policies and plans such as NAPs, and NDCs	2.1 Develop a baseline study of the status of agricultural terraces to be included in the National Plans	MAIF, donors	MAIF, MPIC, CCU	1st Q 2027-2nd Q 2027	Lack of budget to implement the programs	Terraces become part of all related national plans	The baseline study was approved and distributed	7,000
	2.2 Conduct informative workshops on the importance of NAPs, CP, NC, and NDCs in enhancing the agriculture sector including terraces	MWE, CCU	CCU, MAIF	3rd 2027 - 4th 2027	No	Participants become more knowledgeable about the link between terraces and climate change	No. of participants	2,000

	2.3 Discussing ways to integrate terraces into agricultural programs in the national plans and sectoral plans with relevant authorities	MAIF, MWE, finance institutions	MPIC, MWE, MAIF, CCU	1st 2028-2nd 2028	Weak institutional structure for integrating technologies into sectoral plans	Terraces integrated within national planning	At least 4 national plans integrated terraces	2,000
3 Design and implement awareness and knowledge programs on the importance and economic values of terrace technology including government, service providers, and farmers	3.1 Design a work plan for an awareness program on terraces	MWE, donors	MWE, MAIF, CCU	3rd Q 2028 -4th Q 2028	No	Comprehensive work with easy-to-implement actions	Workplan document	5,000
	3.2 Conduct a study of agricultural terraces	MAIF, financial institutes, climate finance	MAIF, CCU	1st 2029-2nd 2029	No	Document used by stakeholders	Study document	8,000
	3.3 Preparing a guide on agricultural terraces	MAIF, MWE, financial institutes	MWE, CCU	3rd Q 2029 -4th Q 2029	No	Document used by stakeholders and financial institutions	Guideline document	3,000
	3.4 Produce awareness materials on irrigation techniques and special materials for school students	MAIF, MWE	CCU	1st 2030-2nd 2030	Weak use and acceptance of publications and awareness materials produced by decision-makers and the public	High-quality material distributed and accepted by all target groups' level	No. of copies distributed	5,000

Gender Considerations

Beneficiaries and participants during the work plan of the project will be disaggregated by gender, ensuring women's participation in all project activities.

4.1.3.8 Tracking the implementation status of the TAP

Table 4:19: Institutional responsibilities for implementing and managing the soil conservation terrace TAP

Entity	Responsibilities	Related Activities
Ministry of Agriculture, Irrigation, and Fisheries (MAIF)	Lead soil conservation initiatives, manage farmer engagement, and oversee terrace construction and training programs.	1.2–1.4, 2.1, 2.3, 3.2–3.4
Ministry of Water and Environment (MWE)	Coordinate resource mobilization, financial mechanisms, and policy integration. Support awareness campaigns and training.	1.1, 2.1–2.2, 3.1, 3.3
Climate Change Unit (CCU)	Facilitate stakeholder coordination, conduct workshops, and develop communication strategies.	1.1–1.3, 2.2, 3.1
Local Governments (LGs) and Donors(Ds)	Provide financial support, ensure local implementation, and promote terraces through microfinance initiatives.	1.3–1.4

Table 4:20:Key Activities and Outputs

Action	Activities	Output Indicators	Responsible Body	Gender Inclusion Efforts with Marker
Mobilize Resources & Establish Financial Mechanisms	Assess financial needs, secure donor funding, and establish financial mechanisms through microfinance and partnerships	Financial mechanisms established; terraces integrated into climate projects	MAIF, MWE, CCU	Promote women's access to microfinance and leadership roles (GEN 1–GEN 2). Related Activities: 1.1–1.4
Integrate Terraces into National Plans	Develop a baseline study, conduct workshops, and integrate terraces into agricultural and climate change policies	Baseline study completed; terraces included in national plans	MAIF, MWE, MPIC	Involve women-led groups in national planning discussions (GEN 2). Related Activities: 2.1–2.3
Knowledge & Awareness Programs	Design awareness campaigns, create guides, and produce educational materials for farmers and students	Programs implemented; materials distributed	MAIF, MWE, CCU	Ensure women's participation in training and develop gender-sensitive educational content (GEN 2–GEN 3). Related Activities: 3.1–3.4

Table 4:21: Monitoring, reporting, and risk management mechanisms

Mechanism	Description	Frequency	Responsible Body
M&E Framework	Monitor progress of terrace projects and assess financial mechanisms	Quarterly	MWE, MAIF, CCU
Progress Reporting	Submit reports detailing activities, financial status, and training outcomes	Monthly & Quarterly	CCU
Stakeholder Engagement	Engage farmers, private sector representatives, and local governments to ensure inclusive processes	Ongoing	MAIF, MWE
Risk Management	Identify and mitigate risks, such as low interest from partners or weak follow-up	Continuous	MWE, MAIF, CCU

Table 4:22:Budget and financial tracking

Budget Component	Amount ($)	Description
Total Budget	50,000	Covers all terrace conservation activities
Resource Mobilization & Financial Mechanisms	23,000	Assess needs, secure funding, and develop financial mechanisms
Integration into National Plans	14,000	Conduct workshops and integrate terraces into national policies
Knowledge & Awareness Programs	17,000	Implement awareness campaigns and create educational materials
Administrative Costs	5% of each activity	Covers reporting, monitoring, and financial oversight

Gender considerations

Greater emphasis will be placed on involving women in studies related to terracing. Although many women are present in academic institutions, these studies are predominantly male-dominated. This approach aims to encourage more balanced representation and benefit from diverse perspectives in the field.

Table 4:23: Gender Inclusion Strategy with Role Transformation Ambition

Activity	Gender Marker and Transformation Ambition
Financial Mechanisms & Microfinance	Ensure equal access to financial resources for women farmers (GEN 1–GEN 2).
Policy Integration	Promote women's participation in policy development and planning processes (GEN 2).
Awareness & Training Programs	Encourage women's involvement in technical training and leadership roles within local communities (GEN 2–GEN 3).
Educational Materials	Develop gender-sensitive educational materials and promote their use among women farmers and students (GEN 3).

4.2 Project Ideas for the Agriculture Sector

4.2.1 A Brief Summary of the Project Ideas for the Agricultural Sector

Yemen faces severe climate change impacts like drought, water scarcity, and floods. Unsustainable agricultural water use has worsened with the rise of cheap solar-powered water pumps. This project aims to improve water efficiency through drip irrigation and solar energy, targeting farmers with solar pumps. It will also restore 40 hectares of agricultural terraces for coffee cultivation and enhance water harvesting technologies. By integrating modern irrigation and water conservation, the project supports rural agriculture, boosts food security, and strengthens economic stability while adapting to climate change through drought resistance and soil moisture improvement.

Note: The project idea integrated the two agriculture technologies in the TAP, drip irrigation and soil conservation (terraces)

4.2.2 Project Idea 01: Agricultural Resilience in the Mountains

Section	Details
Introduction/Background	This project integrates four key technologies: agricultural terraces, water harvesting and storage, solar water pumping, and drip irrigation. It addresses climate change-induced rainfall patterns by building large water tanks near waterways to store floodwater for use during dry seasons, equipped with solar pumps. Farmers will receive water storage tanks with gravity-fed drip irrigation systems for their terraces (0.5-1 hectare). Agricultural inputs will be supported through low-interest or interest-free loans/grants. The project, excluding qat cultivation, targets small and medium-sized farmers who have terraces and aims to optimize water resources, enhancing the resilience of agricultural systems to climate change. The idea came from the fact that drip irrigation requires water, and as a result of climate change there is an increase in floods which can be exploited to store quantities of water for use in this project. These quantities can be stored in areas that may be close to the paths of valleys and then solar energy can be used to pump it to the agricultural terraces, and with the provision of agricultural inputs the production cycle is completed.
Project Objectives	Providing small and medium-sized farmers in mountainous areas “terraces” of Yemen with rainwater harvesting and storage systems supported by solar pumping systems, along with giving farmers tanks, drip irrigation systems, and agricultural inputs.
Project outputs	• Improve water harvesting and storage capacity of farmers • Enhance water use and distribution • Improve agriculture best practices activities • Mostly the three outputs of the project are on-ground activities easily to be measured, set of indicators will be developed.
Relationship to Yemen’s Sustainable Development Priorities	Aligns with Yemen's poverty strategy, agriculture plan and strategy, INDC, TNA, NAPA, and GCF Country Programme to address this. Contributes to climate resilience, and critical water scarcity, especially in rural communities also contribute to mitigation by using solar energy.
Paradigm Shift Potential	This project can be expanded in two ways: increasing the targeted hectares of agricultural terraces through other funded projects and increasing the percentage of loans to farmers to expand their agricultural hectares. The principle of floodwater harvesting can be applied to the private sector, especially for large farmers, where large facilities can be built to store water and reclaim and cultivate new agricultural lands. Crops can also be diversified and high-value crops such as coffee

	can be introduced. The drip irrigation system is also suitable for a variety of soil types and across different terrains. The sustainability of this project can be facilitated through: • Training farmers, the Ministry of Agriculture, Irrigation and Fisheries, the Ministry of Water and Environment, microfinance, and civil society institutions in agricultural development, support services, technology advantages, and sustainability. • Financing through local entities such as microfinance institutions, commercial banks, development and climate finance. • Personal investment by farmers after seeing the benefits and increased yields and profits. • Promoting the successes of the project among farmers to encourage replication
Project deliverable, values/benefit	This is likely to: • Increase water use efficiency, which also saves time and money as rainwater and floodwater harvesting infrastructure secure water resources for use during periods of water shortage. • Provide new sources of food, improve nutrition and potentially add income to the household. • Gravity-fed drip irrigation technology saves pumping energy and improves the efficiency of the irrigation water distribution system. • Prevent plant diseases by reducing water contact with the leaves, stems, and fruits of plants. • Eliminate the use of open water channels, thus reducing water loss, allowing rows between plants to remain dry, improving access, and reducing weed growth. • Distribute water more evenly between crops, thus helping to avoid waste while increasing farm production.
Scope and Implementation Narrative	The main steps for implementing this project include: 1. Identifying target districts in collaboration with the Ministry of Agriculture, Irrigation and Fisheries 1. Identifying target farmers through partnerships with national NGOs and the Ministry of Agriculture, Irrigation and Fisheries and assessing eligible farmers for the project. 2. Developing criteria and application and approval process for access the financial support to the expansion system in collaboration with national microfinance institutions. 3. Partnering with civil society organizations and microfinance institutions to obtain support in purchasing equipment and services to help install the systems. 4. The project will be implemented in two districts (two sites in each) where 10 farmers will be supported in each site with an approximate area of 10 hectares, and a total area of 40 hectares in the four sites. A reservoir in the valley with a capacity of 1000 m3 and 10 kW solar energy for vertical water pumping, and tanks for farmers with a capacity of 6 m3. 5. Implementing capacity-building programs across the agricultural areas to improve technical knowledge, including efficient irrigation system setup and use. 6. Monitor participation and improve measurement through feedback from farmers who have received the system.
Project main activities	Improve water harvesting and storage capacity of farmers • Constructing and engineering studies for water storage facilities • Constructing water harvesting and storage facilities (water from the wadies) • Distributing plastic water /constructing tanks for agriculture family Enhance water use and distribution • Provide central solar water pumping within the storage facility (in the wadi) • Construct water pipes and distribution network Improve agriculture best practices activities

	• Support farmer with agricultural inputs • Train farmers with agriculture best practices • Encourage farmers to plant climate tolerant cash crops such as coffee • Develop community agriculture plan (include water use)
Timeline	• Selecting of the sites and target communities (first year) • Writing project proposal and search for funding (first year) • Community plan approved by local authority • Making engineering studies and construction work (first-second year) • Installing solar system and water distribution network (third year) • Implementing community plan and provide farmers with inputs (third year) • Monitoring and evaluation and leases learned (third year)
Budget	The project can be part of the pipeline projects that are submitted to climate finance (GCF, AF, and GEF), and also can be supported by bi-lateral funding in co-finance with national micro-finance institutions. The project main outputs is constructing so there will be need for contracting consultation and constructing companies, also a planner/lawyer to set up a community plan to be respected and enforced.
	Measuring and evaluation will be done first by pre-feasibility assessment for the project and setup indicators The indicators will measure the project progress and construction work impact of the project on water uses and farmers income for example, the project can measure amount of water stored and used, and in the other side measure the crop yield and income improvement. The evaluation will be yearly during the implementation of the project and at least two year after the accomplishment to measure sustainability.
Challenges and risk	• The current state of the country may affect the implementation of the project in some areas. • Small farmers lack the appropriate qualifications and capacity to obtain loans. • Micro-finance and the private sector may not be interested in supporting such projects. • Stored water may not be sufficient for long farming periods
Responsibility	MWE-CCU writing project proposal with help of other partners especially MAIF and INGOs MAIF to design the construction work with consultants and supervised the project on ground implementation Micro-finance institution to help in formulating community plan and provide solar systems and agriculture inputs, also ensure financial sustainability of the project and scale up Local government to supervise the work and enforce community plan

Annex

1) Energy

Annex 1: Ranking of measures for inclusion in the solar and wind turbine systems TAP

S.N	Measures to overcome barriers	Considerations	Assessment	Ranking
1	Expanding and facilitating access to all the available finance sources from national and international bilateral and multilateral funds through innovative financial mechanisms	Effectiveness	➢ Expanding and facilitating access to national and international bilateral and multilateral funds through innovative financial mechanisms is highly effective for implementing renewable energy technologies in Yemen. This approach directly tackles financial barriers, a critical obstacle in deploying solar PV and wind turbines. By securing diverse funding sources, the financial burden on the Yemeni government and local stakeholders is significantly reduced, allowing for more projects to move forward. Innovative financial mechanisms, such as grants, concessional loans, public-private partnerships, and green bonds, can lower initial capital costs and attract more investors, thereby increasing the likelihood of achieving renewable energy deployment goals despite Yemen's current economic challenges.	(5)
		Efficiency	➢ Facilitating access to finance through this action is efficient as it leverages external resources to achieve substantial financial inflow, offsetting the higher initial coordination costs. Although coordinating with various stakeholders, including government agencies, financial institutions, and international bodies, can be resource-intensive, the significant payoff in terms of securing funding justifies the effort. Utilizing international funds and innovative financing methods can enable Yemen to achieve greater implementation at a lower cost compared to relying solely on domestic resources. The efficiency comes from leveraging external expertise and financial instruments designed to de-risk investments in renewable energy, thus maximizing the effectiveness of the action.	
		Interactions with other measures	➢ Expanding and facilitating access to funding sources interacts positively with the rest of the measures as long as legislation and laws regulate and protect these projects.	

		Suitability within the country/ sector	➢ The suitability of expanding access to finance for renewable energy projects within Yemen's context is high, though it requires tailored implementation strategies to address the country's unique challenges. Local acceptance by stakeholders, including government officials, private sector players, and the general public, is essential for the success of this action. Yemen's current political and economic instability poses challenges, but the pressing need for energy solutions and the potential for international support for reconstruction and development create a conducive environment for such measures. Previous examples of successful renewable energy projects in similar contexts can provide a blueprint for adapting these measures effectively within Yemen.	
		Benefits	➢ The costs associated with expanding and facilitating access to financial sources include initial administrative expenses, capacity building for local institutions to manage funds, and potential fees for securing international financing. However, these costs are outweighed by the long-term benefits of renewable energy deployment. Benefits include reduced dependency on fossil fuels, improved energy security, job creation, and positive environmental impacts. These long-term benefits align with the goals identified in the TNA report on barrier analysis and enabling framework, making this measure highly beneficial. Overall, the substantial benefits justify the initial costs, ensuring a positive return on investment in the long run	
2	Updating the legislation system and enhancing the regulatory framework for solar and wind energy in Yemen	Effectiveness	➢ Updating the legislative system and enhancing the regulatory framework for solar and wind energy in Yemen is highly effective in promoting the deployment of renewable energy technologies. Clear and supportive legislation can create a conducive environment for investment and development by providing certainty and stability to investors and project developers. Effective regulations can streamline the permitting process, set quality standards, and ensure the integration of renewable energy into the national grid. By addressing legal and regulatory barriers, this action can significantly increase the adoption of solar and wind technologies, leading to a more sustainable and resilient energy sector in Yemen.	(2)
		Efficiency	➢ Improving the legislative and regulatory framework is an efficient way to achieve the implementation of renewable energy technologies. While the initial process of updating laws and regulations requires significant effort and resources, the long-term benefits in terms of reduced bureaucratic hurdles, improved investment climate, and facilitated project development outweigh these initial costs. Enhanced regulations can lead to more efficient use of resources, as streamlined procedures reduce delays and lower transaction costs for developers and investors. This efficiency ensures that renewable energy projects can be implemented more swiftly and at a lower overall cost.	

		Interactions with other measures	➢ The existence that legislation and regulatory frameworks interact positively with financial measures (Measure 1) in terms of imposing interest rates in banks and reducing taxes and customs. It also reassures the private sector (Measure 5) about their investments. This measure also helps Enforcement of the specified standards (Measure 7).	
		Suitability within the country/ Energy sector	➢ Updating the legislative system and enhancing the regulatory framework is highly suitable within the context of Yemen's energy sector. Given the country's political and economic instability, a clear and robust regulatory environment can provide much-needed stability and attract international and domestic investors. The action aligns well with Yemen's need for energy security and sustainable development. Local acceptance is likely to be high, especially if the updated regulations are developed through inclusive processes that engage key stakeholders, including government agencies, private sector players, and civil society organizations. Tailoring the regulations to address local conditions and challenges can further enhance their effectiveness and acceptance.	
		Benefits	➢ The costs associated with updating legislation and enhancing regulatory frameworks primarily involve administrative, legal, and capacity-building expenses. However, these measures can generate significant long-term benefits, including increased investment in renewable energy, job creation, energy security, and environmental sustainability.	
3	Spreading awareness by developing studies and research on the economic, social, and environmental benefits of Solar PV and wind energy	Effectiveness	➢ Developing studies and research on the economic, social, and environmental benefits of Solar PV and wind energy is highly effective in promoting the implementation of these technologies. By providing evidence-based insights, these studies can significantly increase understanding and acceptance among policymakers, investors, and the general public. This informed awareness can lead to higher adoption rates and more robust support for renewable energy initiatives, driving the successful implementation of Solar PV and wind energy projects in Yemen.	(1)
		Efficiency	➢ This action is efficient as it can leverage existing academic and research institutions, which minimizes the costs associated with human and financial resources. By utilizing the expertise and infrastructure already in place, the research can be conducted and disseminated effectively, ensuring that the information reaches a wide audience without requiring substantial additional investment. This efficiency ensures that the action maximizes its impact while keeping costs low.	
		Interactions with other measures	➢ Spreading awareness interacts with all other measures positively, as all other measures would not have been achieved without awareness of the benefits of solar and wind energy technologies in the economic, social, and environmental aspects.	

		Suitability within the country/sector	➢ The action is particularly suitable for Yemen, given the country's high potential for solar and wind energy. However, local acceptance may vary based on social and cultural factors, which could influence the overall success of the initiative. It is important to consider these local dynamics and incorporate strategies to address potential resistance or scepticism, ensuring that the action is well-received and effectively implemented within the Yemeni context.	
		Benefits	➢ The costs associated with conducting research and spreading awareness are relatively low compared to the potential benefits. These benefits include reduced energy costs, improved public health, and enhanced environmental sustainability. This cost-benefit balance underscores the value of the action in supporting the deployment of Solar PV and wind energy in Yemen.	
4	Update the RE Strategy to prioritize solar PV and wind energy among the RE options and enhance the institutional framework of RE.	Effectiveness	➢ Updating the renewable energy (RE) strategy to prioritize solar PV and wind energy is highly effective in promoting technology implementation. By focusing on these technologies, the strategy ensures alignment with global and national renewable energy goals. Prioritizing solar PV and wind energy leverages their proven effectiveness and scalability, making them suitable for diverse environments. Furthermore, an updated strategy provides clear directives and incentives, facilitating a more focused and organized deployment of these technologies. Enhancing the institutional framework further supports effective implementation by establishing robust governance and regulatory structures, essential for overcoming barriers and ensuring the successful rollout of renewable energy projects.	(3)
		Efficiency	➢ The action to update the RE strategy and prioritize solar PV and wind energy is efficient in terms of cost and resource allocation. By concentrating on proven technologies like solar PV and wind turbines, the action capitalizes on existing technological advancements and reduces the need for extensive research and development costs. Enhancing the institutional framework ensures streamlined processes, reducing administrative overhead and promoting efficient use of financial and human resources. This approach minimizes duplication of efforts and leverages existing expertise, thereby achieving the desired outcomes cost-effectively.	
		Interactions with other measures	Achieving this measure constitutes a strong foundation for the success of the rest of the measures	
		Suitability within the country/sector	➢ Updating the RE strategy to focus on solar PV and wind energy is highly suitable for Yemen's context. Solar PV and wind energy are well-suited to Yemen's climatic conditions, which include high solar insolation and significant wind potential in certain areas. The action reflects good practice from other countries with similar conditions, where solar and wind technologies have successfully been implemented. However, local acceptance and readiness may vary, necessitating community engagement and capacity building to address any challenges and ensure the smooth adoption of these technologies. Tailoring the strategy to local conditions and needs will enhance its relevance and effectiveness.	

		Benefits	➢ The costs and benefits of updating the RE strategy and prioritizing solar PV and wind energy are generally favourable. The initial investment in solar PV and wind technology can be significant, but these costs are offset by long-term benefits, including reduced energy bills, lower greenhouse gas emissions, and enhanced energy security. The action also offers the potential for international funding and technical support, which can further mitigate costs and amplify benefits.	
5	Provide facilities for the private sector to establish local factories for PV and wind energy systems or parts of them.	Effectiveness	➢ This action is highly effective in advancing technology implementation by establishing local factories for PV and wind energy systems. It enhances local production capacity, making renewable energy systems more accessible and affordable, which can accelerate their adoption. The effectiveness is contingent on the quality of the local manufacturing facilities and the availability of skilled labour and advanced technology.	(8)
		Efficiency	➢ The action can be efficient by reducing import costs for renewable energy components and generating local employment. This approach can lower overall costs and stimulate local economic growth. Initial setup costs for factories can be high, and the action's efficiency will depend on successfully attracting private investment and managing resources effectively.	
		Interactions with other measures	➢ This measure interacts positively with the rest of the measures.	
		Suitability within the country/sector	➢ Establishing factories is considered very appropriate, as it will contribute to providing the requirements for solar and wind energy systems, such as spare parts, which will be on hand faster. It will also contribute to reducing unemployment. However, there are some challenges such as political instability, limited infrastructure, and financing constraints that may impede successful implementation and acceptance.	
		Benefits	➢ This action includes significant initial investments in infrastructure, equipment, and training. The long-term benefits, such as reduced renewable energy system costs, job creation, and improved energy security, can substantially outweigh these costs. In the meantime, the high upfront costs and the need for sustained investment may pose financial challenges, but the overall impact on economic and energy sustainability can be highly beneficial.	
6	Updating and expanding the national grid	Effectiveness	➢ Expanding and updating the national grid directly supports the integration of renewable energy technologies. A modern grid infrastructure is essential for efficiently managing and distributing energy from solar PV and wind turbines. It ensures that the renewable energy produced can be effectively transported to where it is needed, minimizing energy losses and maintaining grid stability.	(4)

		Efficiency	➢ The efficiency of updating and expanding the national grid is moderate, influenced by the high initial investment required for such a large-scale infrastructure project. Significant capital is needed for construction, technology upgrades, and grid management. However, the long-term benefits often outweigh these initial costs. Over time, the shift from fossil fuels to renewable energy sources can lead to substantial savings in fuel costs and lower operational expenses. Efficient project management, strategic planning, and securing appropriate funding or investment can enhance the efficiency of this action, helping to manage costs and ensure that the project delivers its intended benefits at a reasonable expense.	
		Interactions with other measures	➢ Expanding the national grid is consistent with the national energy strategy and interacts positively with the rest of the measures, despite the high initial cost.	
		Suitability within the country/sector	➢ The action is suitable given the global trends toward renewable energy and modern infrastructure. However, Yemen's specific context, such as its current grid condition and potential local resistance, needs to be considered. Successful implementation would require addressing these local challenges and leveraging good practice examples from other countries.	
		Benefits	➢ The costs associated with updating and expanding the national grid are significant, with substantial initial investments required for infrastructure upgrades and expansion. Ongoing operational and maintenance costs also need to be considered. Despite these costs, the benefits are considerable. In the long term, the move towards renewable energy can lead to reduced operational and fuel expenses. Additionally, a modernized grid enhances energy security and reliability, making the energy supply more stable and less susceptible to disruptions. The action also has the potential to stimulate economic growth through job creation and technological development, further supporting its overall value.	
7	Developing manuals and quality standards for solar PV and wind turbine systems and components and ensuring enforcement of quality standards to avoid	Effectiveness	➢ Developing manuals and quality standards for solar PV and wind turbines will ensure that only high-quality systems are imported and used. This directly contributes to the successful implementation of renewable energy technologies by minimizing the risk of system failures and inefficiencies. Quality standards can enhance the reliability and performance of the systems, leading to better overall technology adoption.	(6)
		Efficiency	➢ While the development of manuals and standards requires an initial investment in terms of expertise and resources, it can lead to long-term cost savings by reducing the likelihood of system failures and the need for repairs or replacements. Ensuring enforcement of these standards helps avoid the costs associated with poor-quality systems. However, there may be ongoing costs related to monitoring and enforcement.	
		Interactions with other measures	➢ Applying quality and labelling standards interacts positively with the rest of the measures, despite the high initial cost.	

	importing poor-quality systems.	Suitability within the country/sector	➢ In the context of Yemen, developing and enforcing quality standards is highly suitable given the current challenges with infrastructure and the potential for importing substandard equipment. Ensuring quality is critical for the successful deployment and operation of renewable energy systems. Good practice examples from other countries where quality standards have improved renewable energy projects can serve as useful models.	
		Benefits	➢ The long-term benefits include improved reliability and performance of renewable energy systems, reduced maintenance and replacement costs, and greater overall success of renewable energy initiatives. These benefits can outweigh the initial costs, especially when considering the potential for increased energy security and reduced environmental impact	
8	Integrating solar PV and wind energy into the engineering faculties, and technical institutions programs and conducting training programs for engineers and technicians.	Effectiveness	➢ . Integrating solar PV and wind energy into the engineering curricula and technical programs is highly effective for technology implementation. This action directly addresses the need for skilled professionals in the renewable energy sector, fostering the development and deployment of these technologies. By equipping engineers and technicians with the knowledge and skills to design, install, and maintain solar and wind systems, it creates a skilled workforce that can drive the adoption and scaling of renewable energy solutions in Yemen.	(7)
		Efficiency	➢ The action can be efficient if implemented properly. Integrating renewable energy topics into existing programs is often less costly than creating new standalone training programs. By leveraging existing educational infrastructure and integrating new content, the action can maximize resource use. Additionally, partnerships with international organizations or local businesses in the renewable energy sector could provide financial and technical support, further reducing costs. However, the initial setup may require significant investment in training materials and faculty development.	
		Interactions with other measures	➢ This measure does not conflict with other measures but rather interacts with them positively.	
		Suitability within the country/sector	➢ This action is suitable given the global and national focus on transitioning to renewable energy sources. In Yemen, where there is a significant need for renewable energy solutions due to energy shortages and environmental challenges, integrating these technologies into educational programs is highly relevant. However, success will depend on local acceptance and the capacity of educational institutions to adopt and deliver new curricula. Engaging local stakeholders and tailoring the programs to fit local needs and contexts will be crucial for acceptance and effectiveness.	

		Benefits	➢ The costs of integrating solar PV and wind energy into engineering programs include initial investments in developing new curricula, training instructors, and updating educational materials, as well as ongoing expenses for program maintenance and equipment. Despite these costs, the long-term benefits are substantial. A skilled workforce will enhance the deployment and maintenance of renewable energy systems, potentially lowering future energy costs.	

2) Transport Sector

Annex 2: Ranking of measures for the introduction of the BRT system

Measures	Considerations	Assessment	Rationale	Ranking
Financial Capital for the BRT System and Infrastructure Assess the capital cost for the BRT system by carrying out a feasibility study, including the required infrastructure, to facilitate and encourage private sector investment and attract donors from various climate change funds to finance the BRT project, and to put a just transfer mechanism for the affected people.	Effectiveness	• Finding financial capital for the BRT system is crucial for the success of the implementation of the BRT project. Before what is mentioned above, it is important to carry out a feasibility study for the BRT system, and the infrastructure needed for the system, which will provide an estimate of the financial cost for the entire BRT project. There will be adverse effects from the implementation of the BRT projects, therefore, the feasibility study will put a just transfer mechanism for the affected people.	• The financial capital for the BRT system and the needed infrastructure constitute a crucial step in the "Introduction of BRT" project, since, without financial capital the BRT project can't start. • The feasibility study will pave the way for international donors and local investors to provide the financial capital for the BRT project. Also, the feasibility study will prepare a just transfer mechanism for the adverse effects from the BRT project, towards the affected people. Ranked 1 • Please see comments in the	(1)
	Efficiency	• The international donors and local private investment companies or local Banks will be reluctant to finance the BRT project without knowing the capital cost for the BRT project, how it is going to operate and by whom, expected annual revenues gained, and the period in which they can get even, and get their initial investment back. Therefore, carrying a feasibility study for the entire BRT project (BRT system and infrastructure) can be considered an efficient procedure to attract investment from international donors and local private companies.		
	Interaction or conflict with other measures	• The feasibility study measure interacts positively with other measures, notably the financial policies measure and the legal and regulatory measure.		
	Suitability within the country/sector	• The feasibility study and finding capital cost measures for the BRT project is suitable for the Transport sector, since the Transport authority and the government cannot provide the investment cost at the present time. • The BRT system is suitable for the country since the Transport authorities have problems in dealing with the congested roads in city centres. The BRT system will reduce traffic on the roads, provide more options for movement, limit the use of private vehicles, and cut down the CO2 emissions in main roads.		

	Benefits and costs	• The feasibility study can increase the opportunity of finding the capital cost for the BRT project First it will attract international donors and local investors in financing the BRT project. Second, it will clarify any doubts about the success of the BRT system. Third. it will estimate the revenues that can be gained by the investor. Fourth, it will demonstrate the advantages of the BRT system for society in general. • The cost of the feasibility study can be between 15,000 – 20,000 US$. This will be distributed among the feasibility study teamwork and the financial consultant.	assessment column, and above for the rationale of the measure.	
Financial Policies Set financial and economic policies to facilitate investment in the BRT system by the private sector and facilitate government/private sector partnership.	Effectiveness	• Giving tax incentives to reduce the capital cost of the BRT system to encourage the private sector in the BRT investment, and possible co-investment with Government Transport Authorities. Providing financial incentives for the private sector can be an effective way to make the implementation of the BRT project possible. The private sector investment in the BRT system can be extended to other cities in Yemen. Also, Government Transport Authorities can co-invest with private sector to meet the increase in demand of BRT system throughout the country.	• The involvement of the private sector in the development of road transportation, particularly public mass transport – BRT, constitutes the important role of the private sector in economic and social development. • Providing financial schemes such as loan facilities, increased access to soft-term loans, tax and tariff incentives, partnerships between government and private sector, and introducing private investors to international donors/aid	(2)
	Efficiency	• The outcome of the financial policies to encourage and attract local companies to invest in the BRT project, or co-invest with the Transport Authority, will lead to more efficiency in the process of the implementation of the BRT system. Moreover, the participation of the private sector in investing in the BRT system can lead to the spread of the BRT system throughout the country. • The participation of the government in partnership with the private sector in the BRT system can increase the efficiency of introducing the BRT system to all major cities in Yemen.		
	Interaction or conflict with other measures	• Such a measure in part meets the financial and economic measures that support the implementation of the BRT system. According to the previous reports and national communications by the Environment Protection Authority EPA, measures were suggested to limit the CO2 emissions on the roads, which include increasing public mass transport, and the provision of financial incentives.		

	Suitability within the country/sector	• This measure is suitable for the transportation sector, and the country in general. Since, it encourages private investors to participate in the development and operation of public mass transport and will enhance the private/government partnership to establish a BRT network in all major cities.	agencies will enhance the implementation of BRT technology in a very effective and efficient way. Ranked 2.	
	Benefits and costs	• The measure will have direct benefits to the BRT investor because the investor will find that the facilities of financial incentives can reduce the initial cost of the BRT by the provision of low-interest, soft-term loans. • The cost of the measure will be covered by the donor of the BRT system.		
Legal and Regulatory Setting up a financial, and legal regulatory framework to enhance public mass transport such as BRT and create an active investment for new transport technologies.	Effectiveness	• Due to the current political turmoil in the country, the existing transport legislations are not fully implemented. It is important to set up a legal and regulatory framework to increase the transfer of new transport technologies and enhance their markets, such as the BRT market.	• Setting up a legal and regulatory framework for the public mass transport such as BRT, is crucial for the regulations, guidelines, and rules to have an efficient operation of the BRT system and create an active market for new transport technologies. This will be carried out in parallel to the measures that are selected as actions. Ranked 4.	(4)
	Efficiency	• Setting up a legal and regulatory framework to regulate the operation of BRT, managing and applying the guidelines, and issuing the rules for the BRT system can enhance the efficiency on which the BRT system operates, which is a step towards the success and spread of the BRT technology.		
	Interaction or conflict with other measures	• The measure will have to be arranged with the already existing Legislations and Bylaws of the Transportation sector in the country. New sections and sub-sections in the existing Legislations and Bylaws can be issued to deal with the regulations of new transport technologies such the public mass transport and bus Rapid Transit BRT system. The measure is crucial for the BRT system operation, which must abide by the guidelines, legislations, and rules that will improve the quality of service provided by the BRT system.		
	Suitability within the country/sector	• A legal and regulatory framework to enhance the mass public transport is suitable for the transport sector and for also for the country		
	Benefits and costs	• The benefits will be that there will be clear and strict regulations to limit unauthorized semi-mass transport and		

		to act as a guide for the transport authorities for those who don't abide by the standards for mass transport. • The cost of setting up the legal and regulatory framework is limited, which can be part of the Ministry of Legal Affairs activities.		
Communication and Coordination Set a plan for coordination mechanism between relevant government institutions and various stakeholders.	Effectiveness	• The current crises hindered the coordination and communication efforts between various government institutions relevant to transport. Also, the coordination and communication efforts between various government institutions relevant to transport and private transport companies. The private sector is not involved in decision-making regarding transport policies and development. It is important to include the private sector in any future development of the transportation system in Yemen, they could play an important role, through sole investment or co-investment with the government.	• The coordination mechanism between relevant government institutions the private sector and other various stakeholders is of significance because it will assist in the exchange of opinions, and partners can offer better solutions to address any challenges that might arise in the implementation of the BRT system. Hence, such a measure has to be carried out in parallel with the main actions selected for the BRT TAP. Ranked 6.	(6)
	Efficiency	• The communication and coordination factors between governmental transport authorities and other stakeholders/private sector can have greater efficiency in the success of planning future projects, and the establishment of the BRT system needs these measures.		
	Interaction or conflict with other measures	• The measure is important for more robust coordination between relevant stakeholders and interacts positively with other measures such as the financial policies, feasibility study, regulatory framework, information and public awareness, and capacity building.		
	Suitability within the country/sector	• The communication and coordination measures are suitable for the transport sector, which contributes positively towards the success of any project in the transport sector.		
	Benefits and costs	• There are many benefits to this measure, one of them is to understand what the other stakeholders want and require from the main correspondent. Also, exchange ideas and opinions on introducing future Transport technology implementation such as the BRT system.		
Institutional, Organizational, Human Capacity, Technical, and	Effectiveness	• The setting up of clear policies that could enhance the implementation of the BRT system, would encourage the private sector to participate and offer proposals for the future BRT system. Moreover, the country requires a more	• Create professional institutions for the transportation sector, to support	(3)

Information Management System" Form professional institutions for the transportation sector, to support technical standards, to carry out training workshops for capacity building in all new transport technologies such as the BRT system and provide scientific data by establishing "Information System Management" for the Transportation sector.		modern centre to set the standards and certifications for the new transport technologies such as the BRT system. Also, do the testing, demonstration, and training programs for new transport technologies. These would facilitate the transfer of the new transport technologies and reduce the customer complaints of any malfunctions of the technology. The establishment of an "Information Management System" for the Transport Authority is essential to provide the scientific data for future development of the transportation sector.	technical standards, to carry out training workshops for capacity building in all new transport technologies, for capacity building and quality assurance. This measure constitutes an important step for making sure that transport institutions and all relevant authorities have the qualified personnel to organize, monitor, penalize, and set regulations for new transport technologies such as the BRT system. The setting up of a Technical Centre for the quality assurance of new transport technologies such as the BRT, which checks the standards, codes, certify, carries testing, and demonstration for new transport technologies can contribute to the
	Efficiency	• The creation of professional institutions for the transportation sector, to support technical standards, and to carry out training workshops for capacity building in all new transport technologies, which include a centre for certifications, standards, codes, testing, and demonstration of all new technologies such as the BRT. This measure will enhance the efficiency of the establishment of the BRT system and will assist in the implementation of BRT systems in other major cities in Yemen.	
	Interaction or conflict with other measures	• interacts positively almost with all measures. Since, for the implementation of a BRT system there need to be professional institutes to provide the know-how, technical support, and capacity building for the relevant stakeholders that are involved in the implementation of the BRT system.	
	Suitability within the country/sector	• The setting up of professional institutions to support technical standards is very much suitable of the transport sector, and the country. Also, carrying out capacity building for personnel in relevant authorities.	
	Benefits and costs	• The formation of professional institutions like "The Technical Institute for Transportation" has many benefits to meet the new advancement of new transport technologies, by providing technical standards support, and capacity building. Also, the foundation of an "Information Management System" will be beneficial for future development plans in the transportation system, by providing data for planners and developers. • There will be costs for establishing these institutions which must be sought by the Transport Authority from international donors.	

		• There will be costs for training workshops that will be carried out in the preparations of qualified personnel from the transport authorities, and private investors. Also, the capital cost of setting up a Technical Centre, considerations will be covered in more detail in meetings with transport authorities, and climate change funds.	trust between BRT operators and the commuters (passengers), in the process of meeting the required standards that will provide a comfortable, cheap, fast journey for the daily passengers. Ranked 3.	
Social, Cultural, Behavioural, Public Awareness and Information Dissemination of information and public awareness campaigns on the economic and environmental benefits of the BRT system.	Effectiveness	• The dissemination of information and public awareness of the BRT system and its social, environmental, and economic benefits can contribute to the acceptance of the BRT technology by the public and contribute to the spread of the BRT systems throughout the country.	• Carrying out public awareness campaigns and information dissemination for the public mass transport – BRT system, which will include information about the social, environmental, and economic benefits of using this transport technology. However, this measure can be carried out by the BRT operator/investor. This measure is important and can be carried out in parallel to the measures selected as actions.	(5)
	Efficiency	• Informing the public of the social, economic, and environmental benefits of the BRT system is an efficient method to make the use of the BRT system more acceptable to commuters.		
	Interaction or conflict with other measures	• This measure interacts positively with other measures because letting people know about the benefits of the BRT system can lead to more people who would prefer to use it.		
	Suitability within the country/sector	• This measure is suitable for the transport sector as well as the country. It is the process of letting people know of the importance and benefits of the BRT system for them and the country as a whole.		
	Benefits and costs	• The benefits of this measure are that the commuters (passengers) will be persuaded to use the BRT system to get by, instead of the inefficient transportation they normally use. • The cost of information dissemination and public awareness campaigns has to be covered by the operator of the BRT system or by the investor if it is not the operator.		

Annex 3: Assessments, and rationale, using the criteria of ranking the measures for the introduction of the HEV.

Measures	Considerations	Assessment	Rationale	Ranking
Financial and Economic Constitute financial policies to reduce HEV cost, which includes financial incentives schemes, such as market and consumer incentives, and Bank facilities through providing an extension of loan period, and reduced loan interest.	Effectiveness	➢ The HEV market in Yemen is not developed yet and needs to be enhanced, this could be done through invigorating financial policies. The cost of HEV is still high for an average-income family in Yemen. Thus, a new financial policy to encourage the acquisition of HEV is crucial for the Yemen context. These could be through providing market incentives, such as reduction or exemption of custom and excise fees on HEV, and spare parts (battery, electric motor, etc.), and consumer incentives, such as reduction or exemption from registration fees, and annual road tax at registration. Also, Bank facilities, such extend the loan period, and reduced loan interest. The government should also take steps to prevent the import of old pre-owned inefficient vehicles, by carrying out disincentive policies towards the import of old used cars.	The implementation of the suggested financial policies will enhance the market conditions, which can increase the uptake and accommodate new transport technologies such as the HEV. This financial measure will make the HEV technology more affordable and attractive.	(1)
	Efficiency	➢ Applying financial incentives measures comprised of market and consumer incentives and Bank facilities that include an extension of the loan period and reduction in interest rate will increase the purchase of HEV greatly. Hence, the outcome of such a measure has a clear advantage, indicating that the measure is a very efficient means for enhancing the spread of HEV acquisition all over the country.		
	Interaction or conflicts with other measures	➢ Providing financial incentives for consumers and the market together with the Bank facilities will interact nicely with other measures such as the legal and regulatory framework, institutional, organizational, technical, capacity building, and information and public awareness campaigns. It might have certain conflicts with already existing Custom and Excise applied on conventional vehicles.		
	Suitability for the country/sector	➢ The measure is suitable for the country since most of the public can't afford to buy the HEV. Through providing financial incentives, which include Bank facilities, the transport sector will benefit greatly, by introducing new transport technology that cuts the consumption of fossil fuel and reduce GHG emissions. Therefore, the measure is suitable for both the Transportation sector and the country.		
	Costs and Benefits	➢ The costs for developing and preparing the financial incentives scheme will be around 20,000 US$, as allowances for the Financial Consultant and the working Team (Steering Committee SC). The benefits from the measure can be explained from different points of view, notably economic benefit for low-income families, and environmental benefit, which as the reduction in GHG		

			emissions, which is part of the commitments made by Yemen to reduce CO2 emissions in major GHG emissions sectors, such the energy and transport sectors.		
Legal, Institutional, and Technical Policies Enact legal, regulatory, institutional, and technical procedures to develop and enhance the HEV market by creating professional institutions to support technical standards.	Effectiveness	➢	Setting up a legal and regulatory framework to create a HEV market, such action will create trust and confidence in both car dealers and consumers. The establishment of professional institutions to support technical standards for the new transport technologies such as HEV, will enhance the quality of the imported HEVs. The customer's constant worries related to after-sales service and availability of spare parts can be overcome by a regulated market where legally authorized car dealers are selected by the MT, which will increase the confidence and acceptability of HEV. The same procedures are applied to spare-part dealers.	Establishing the right legal enabling environment for the acquisition of HEV, which includes setting the technical standards approved by a professional institute specialized in new transport technologies, will increase the desire of the public to purchase the HEV. It is necessary to create market confidence between authorized car dealers and consumers. Ranked 2	(2)
	Efficiency	➢	The legal and regulatory, institutional, and technical measure is a very crucial step for the regulations and standards needed to enhance the purchase and spread of HEV technology. Therefore, by introducing this measure the outcome of such action will be reflected greatly towards the goals of increasing the sale of HEV, which can be considered an efficient method to achieve this purpose.		
	Interaction or conflicts with other measures	➢	This measure interacts positively with other measures, such as the financial incentives scheme, communication and coordination, human capacity and training programs, information and public awareness campaigns measures. The conflicts that may arise due to such measure can be accommodated with existing measures and procedures applied for the conventional vehicles.		
	Suitability for the country/sector	➢	The measure is a suitable for having appropriate legal, institutional, organizational, technical procedures to enhance the acquisition and spread of HEV. Hence, its suitability for the Transportation sector, since it is within the ministry of Transport policies of introducing new low CO2 transport technologies on the roads. Also, its suitability for the country as whole because of the advantages that HEV have, with its low CO2 and less consumption of fossil fuel, suitable for average-income families.		
	Costs and Benefits	➢	The costs for such a measure are around 5,000 US$, for the legal and technical consultants and the Steering Committee (SC), it involves introducing new legal, institutional, organizational, and technical procedures for HEV, into the already existing procedures for the conventional vehicles. However, the establishment of professional institutions, and the technical standards for new transport technologies, might need financial and technical support, this financial support can be sought from Climate Chane Funds, these requirements should be part of the Transport Authorities plans to improve and sustain the transport sector.		

		➢ There are a number of benefits from this measure, the important one is the creation of the legal enabling environment to the uptake and acquisition of new transport technologies.		
Communication and Coordination Set a plan for coordination and communication mechanism between relevant government institutions and various stakeholders particularly from private sector.	Effectiveness	➢ It is quite clear that when there is a lack of coordination and lack of communication, the functioning of government authorities tends to be bureaucratic, slow and ineffective. The future development plans cannot succeed without involving all relevant government authorities in the decision making, in addition, when the transport authorities ignore the participation of the private sector, which can limit the diversity of opinions that could enrich the development plans. Therefore, it is necessary to set a plan for coordination and communication mechanisms between relevant government institutions and various stakeholders including the private sector to orient the deployment of the technology.	Setting a plan for coordination and communication mechanisms between relevant government institutions and various stakeholders, particularly from the private sector. Ranked 5	(5)
	Efficiency	➢ The coordination and communication measure can be considered as an important procedure. The outcome of such measure will lead to more efficiency in the performance of relevant transport authorities and result in better understanding, exchange of knowledge, express opinions and ideas. The future development plans for the transport sector can benefit from such measures, through the coordination of plans and projects that are related to transportation, and how to introduce new environmentally friendly transport technologies, that consume less fossil fuel and have low or no CO2 emissions. Moreover, involving the private sector in transport development plans can be considered an important step towards successful projects in the transportation sector.		
	Interaction or conflicts with other measures	➢ The measure contributes positively to the implementation of other measures, such as the financial incentives scheme, the legal, institutional, technical, social, cultural, behaviour, human capacity, public awareness, and info measures, and has no conflicts with other measures.		
	Suitability for the country/sector	➢ The measure is suitable to improve the performance of relevant transport authorities, and to enhance the communication and coordination between government transport authorities and the private sector, therefore, it is suitable for the transport sector, and for the country as a whole.		
	Costs and Benefits	➢ Developing a plan for the communication and coordination mechanism measure will require a cost, which should be part of the future budget for the Transport ministry, and government as a whole. To have better communication and coordination between various relevant transport authorities and the private sector can have benefits for future development plans carried out by the transport sector and the government.		

Human Skills Carry out education and training workshops as part of capacity building for technicians and mechanics in the maintenance and services of HEV, with accredited certification for qualified technicians.	Effectiveness	➢ It is necessary to have a skilled workforce to carry out the maintenance and services for the HEV, this will increase the spread of HEV acquisition throughout the country. Therefore, capacity building and training programs for the technicians needed to perform the HEV maintenance and services can be a very effective way to create confidence between consumers and HEV-dealer and will increase the HEV purchase by consumers.	There are currently none or limited trained and qualified local experts to maintain and repair the HEV. The maintenance and service of HEV should be handled by appropriately trained and accredited technicians. One of the enabling market conditions is to train technicians to provide specialized technical services to owners of HEV. The measure will consist of developing a new course and having it accredited by the Ministry of Technical Education. The measure will support	(3)
	Efficiency	➢ By preparing qualified personnel through training and capacity-building programs for mechanics and technicians, such a measure will increase the efficiency of maintenance and service provided for HEV. Also, will reduce the complaints by customers, and will convince the public to purchase the HEV, because the maintenance and services for HEV exist, and qualified technicians. Therefore, implementing such a measure will increase the efficiency of the desired spread and acquisition of HEV throughout Yemen to be achieved.		
	Interaction or conflicts with other measures	➢ The measure interacts positively with other measures, such as the financial subsidy scheme, legal, institutional, technical, social, cultural, behaviour, public awareness, and information on the social, economic, and environmental benefits. The measure does not have conflicts with other measures. ➢ On the contrary, having maintenance and services for the HEV by qualified technicians will enhance the acquisition of HEV by the consumers, once they find that they can have the maintenance and services by qualified mechanics and technicians.		
	Suitability for the country/sector	➢ New environmentally friendly transport technologies, that has low fossil fuel consumption, with less or no CO2 emissions, have not penetrated the car market effectively in Yemen. The HEV, with its dual energy use (electric energy from the battery and fossil fuel combustion engine), will decrease the consumption of fossil fuel particularly by private vehicles. Hence, limiting the dependence on fossil fuel in the transport sector. This can play a positive in Favor of the country's economy because the government will not be required to import more fossil fuel for the transport sector. Therefore, the suitability of the measure for the country and the transport sector is very much obvious.		
	Costs and Benefits	➢ There will be costs for the training workshops, to qualify the mechanics and technicians, these can be done by the authorized HEV dealers, and also, by the manufacturing company (country of origin), these training and financial requirements must be sought and organized by the transport authorities and private stakeholders.		

		➢ There will be huge benefits to the new transport technologies market including the HEV market. Having the maintenance and services requirements for the new transport technologies such as HEV, will increase the acquisition and spread of these technologies throughout the country, besides the economic and environmental benefits of these technologies.	acceptance of the new transport technologies and boost consumer confidence to purchase the HEV. Ranked 3	
Social, Cultural and Behaviour, Information and Public Awareness Set up a public awareness campaign, and dissemination of information on the performance and economic and environmental benefits of HEV.	Effectiveness	➢ An effective method to attract customers to purchase the new transport technologies such as HEV, is to have a public awareness of the performance and benefits of HEV. By spreading the information required effectively throughout the car market, and media, such data and information campaigns can convince many hesitant buyers to purchase the HEV, this can be done by enforcing car dealers to include factsheets on the HEV, also, by marketing campaigns (billboards, TV, Radio, newspapers, etc.). The dissemination of information to the public on HEV performance, and environmental, and economic benefits will lead to an increase in the acquisition of HEV by consumers and can reduce the social, cultural, and behavioural challenges regarding HEV amongst the public.	Dissemination of information to consumers on the HEV performance, environmental, and economic benefits.	(4)
	Efficiency	➢ This is an efficient method to increase the acquisition of HEV by consumers and penetrate the car market. Many consumers are unaware of the performance and the benefits of HEV, which drives them away from buying the HEV. Once, the consumers know the performance of HEV, and that it consumes less fossil fuel, they can save money, besides the environmental benefits, which can contribute to the health of society, having known all the benefits of HEV, many consumers will be driven to buy the HEV.		
	Interaction and conflicts with other measures	➢ The measure has a positive interaction with social, cultural, and behavioural habits. Dissemination of information on the HEV performance and benefits will reduce the social, cultural, and behavioural challenges such as the reluctance and mistrust of the new transport technologies such as HEV.		
	Suitability for the country/sector	➢ The HEV which emits less CO2 emissions and consumes less fossil fuel compared to other conventional vehicles, will be suitable for the transport sector, which seeks to limit fossil fuel consumption and to cut down the air pollution such as smog and CO2 on the roads. Also, the government can meet its commitments towards the UNFCCC, and at the same time import less fossil fuel for transportation. Therefore, the suitability of the measure for the country and the transport sector is very much obvious.		

	Costs and Benefits	➢ There will be costs of broadcasting and publishing the necessary information and data on the HEV performance and benefits and spreading the information in the media. ➢ The benefits of the measure are many, since it can inform the public about the performance of the HEV, and purchase of HEV will be increased greatly, and the acquisition of HEV by consumers will spread throughout the country.		

3) Water Sector

Annex 4: Ranking of measures for inclusion in the Seawater Desalination TAP

S.N	Measures	Considerations	Assessment	Ranking
1	Facilitate the availability of financing sources including climate financing channels and develop financial mechanisms to support the technology transfer, installation, operation, and maintenance	Effectiveness	➢ This measure facilitates access to finance, and it is fundamental for a wider-scale implementation of the technology and allows it to be more affordable for a larger segment of society. This measure will de-risk investment of local businesses and expand the base of supply, allowing competition to thrive to provide the best quality solutions for lower prices.	(1)
		Efficiency	➢ the measure is cost-effective to implement as it mainly requires workshops a few consultations and other means of communication regarding the development of a financial mechanism to build confidence between private sector stakeholders. ➢ This measure provides diversity in funding sources, including grants, and loans. Share the financial burden and reduce the need for excessive spending from a single source. Thereby reducing the cost for each participant by utilizing multiple funding streams spreading financial risk and efficiently utilizing resources. Additionally encourages the private sector to invest.	
		Interactions with other measures	➢ Improved access to financing resources will support the private sector in propagating and advancing desalination in the local market (Measure 7) and reducing costs and taxes will make finance more efficient in advancing and spreading desalination (Measure 3).	
		Suitability within the country/ sector	➢ This measure provides financial support from International financial institutions and climate funds such as GCF and encourages private sector involvement through Public-Private Partnerships (PPPs) to leverage additional resources and expertise. By Leveraging climate financing, developing supportive policies, and establishing transparent and accountable financial management systems, the sustainability of this project can be enhanced, and archiving suitability for desalination projects.	
		Benefits and costs	The measure has many benefits such as: ➢ Secure and diverse financing ensures that the necessary capital is available for all project stages. ➢ Leveraging multiple funding sources can reduce the financial burden on any single entity and allow for economies of scale in procurement and implementation. ➢ Enables the adoption and transfer of cutting-edge technologies, which might be unaffordable. ➢ Fund training programs and technical assistance, build local expertise, and ensure effective project management and operation. ➢ finance mechanism spreads financial risks and provides a safety net.	

			➢ Builds trust and synergy between private sector actors, mainly businesses working in manufacturing and fabrication, importers of systems from one side, and financial with the finance sources such as the funding agencies and intermediate channels such as commercial and Islamic banks.	
2	Provide training courses, workshops, and seminaries to familiarize the technology for the local entities and policymakers and enhance the local experts' knowledge and skills on technology installation, operation, and maintenance	Effectiveness	➢ This measure aims at building the technical skills and knowledge of local experts, enabling them to handle the complexities of desalination technology throughout its lifecycle. ➢ Implementation of this action will contribute to removing the barriers associated with technical deficiency skills and will facilitate the transfer of knowledge from international experts to local stakeholders and practitioners through different knowledge exchange modalities such as training.	(2)
		Efficiency	➢ Although the initial costs for training programs can be high as they include the costs of travel of expert practitioners who are not from Yemen, and the costs of equipment and tools needed to enrich the training and ensure practical experience, the gains from the success of the program will save the country the cost of international consultants on the medium and long terms, and ensure the creation of local work opportunities for local practitioners.	
		Interactions with other measures	➢ Training and capacity building for the community working on water issues integrates with the need to enhance quality control and management, and the development of manuals, standards, and guidelines for the desalination technology (Measure 4).	
		Suitability within the country/ sector	➢ Training programs enhance local capacity ensure effective installation, operation, and maintenance, and improve their technological readiness and operations sustainably.	
		Benefits and costs	➢ Desalination systems will incur large upfront costs associated with the costs of equipment. To preserve this investment and ensure that it is not squandered, capable and well-trained technical skills are needed to design, implement, and operate desalination systems in Yemen. Such training will contribute to the following elements: ➢ Ensuring that local staff can handle long-term maintenance, ensuring the sustainability of the desalination projects. Thus, reduces dependency on costly foreign specialists and empowers local technicians and engineers. ➢ Educating policymakers on desalination technology enables them to create supportive policies and regulatory frameworks. ➢ Building trust, protection, and support for desalination projects through training programs targeting communities and community leaders and representatives. ➢ Enhancing the collaboration between government entities, local communities, and international partners.	
3	Exempting the import duties	Effectiveness	➢ Exempting import duties and eliminating or alleviating taxes on seawater desalination technology and related components can be highly effective in reducing costs, attracting investment, and accelerating project implementation. These measures can enhance the	(7)

	and eliminating or alleviating Taxes.		financial viability of desalination projects, encourage innovation, and generate economic and social benefits. ➢ However, careful policy design and implementation are necessary to address potential challenges such as revenue loss for the government, implementation complexity, and market distortions. By engaging stakeholders, monitoring impacts, and adapting policies as needed, governments can maximize the effectiveness of these tax incentives and support the sustainable development of seawater desalination projects.	
		Efficiency	➢ This measure is relatively cost-effective and affordable as it mainly requires a workshop a few consultations and other means of active communication. This measure can potentially improve the economic efficiency and accessibility of the technology. Policymakers must conduct thorough cost-benefit analyses and design the policy interventions accordingly.	
		Interactions with other measures	➢ Exempting the imports, and duties, and reducing taxes on the desalination technology components is synergetic with other financial measures such as encouraging local capital to invest in desalination technologies (Measure 7) and should be presented in tandem with widening the finance resources to capitalize on the opportunities provided for the finance of desalination (Measure 1).	
		Suitability within the country/ sector	➢ Ensure they continue to meet the country's economic and developmental goals.	
		Benefits and costs	➢ Development projects, especially those funded by international organizations like the Green Climate Fund, can benefit from lower costs related to importing necessary equipment and materials. ➢ Facilitate smoother and quicker implementation of projects, contributing to the country's development goals. ➢ Encourage the private sector to investigate this technology.	
4	Enhance quality control and management by developing manuals and guidelines for the technologies	Effectiveness	➢ Enhance their quality assurance practices, improve operational efficiency, and deliver high-quality services consistently.	(11)
		Efficiency	➢ The costs for this measure are affordable and cost-efficient since they are mainly associated with the costs of programming only discussions, workshops, and meetings with stakeholders at the technical and political levels.	
		Interactions with other measures	➢ Quality control and management should align with efforts to update the national water strategies (Measure 5). Quality control and management and the development of technical standards can only be beneficial when it is disseminated and implemented, which necessitate training and capacity building to the community of practice (Measure 2). Quality control should be backed with a regulatory and legal framework to define the mandate for the relevant authorities and their relationship with the relevant stakeholders within a refined regulatory policy framework (Measure 6 & Measure 10).	

	and provide technical support for the responsible entities to activate their quality control.	Suitability within the country/ sector	➢ Ensure the continuing enhancement and improvement of the quality and safety of technologies and services, as well as build institutional capacities.	
		Benefits and costs	➢ Reduce the risk of defects and failures, thereby improving safety and protection for consumers. ➢ Increasing access to international markets by meeting export standards, and potentially boosting economic growth. ➢ Supports national development plans by fostering a more reliable and competitive industrial base. ➢ Encourage collaboration among various stakeholders, including government agencies, private sector entities, international organizations, and professional and technical societies working in standardization such International Standards Organization (ISO), and	
5	Update the national water strategies to include desalination technologies among the key priorities of the country.	Effectiveness	➢ Addressing climate adaptation strategies that help the country cope with the impacts of climate change on water availability.	(6)
		Efficiency	➢ The costs for this measure can be low due to its need for discussion meetings with stakeholders at the technical and political levels. Updates that include desalination can be done at the upcoming periodic update rounds at no additional costs.	
		Interactions with other measures	➢ National water strategies should align with the efforts to update the laws and policy framework and should mirror the cross-sectoral country-driven priority plans from the climate sector (Measures 6, Measure 7, Measure 10, and Measure 11).	
		Suitability within the country/ sector	➢ Ensure the continuing updating of national water strategies to cope with the Yemeni context.	
		Benefits and costs	➢ Updating Yemen's national water strategies to prioritize desalination technologies offers numerous benefits, including enhanced water security, economic growth, public health improvements, technological advancements, and environmental sustainability. This strategic move aligns with global best practices and can attract significant international support, positioning Yemen for a more resilient and sustainable water future.	
6	Update the water law to include	Effectiveness	➢ Provides a clear legal framework for the development, implementation, and regulation of desalination projects, ensuring consistency and accountability.	(8)
		Efficiency	➢ Costs for drafting and amending the new water law, including legal consultations and stakeholder engagement are relatively low. Amending the law will streamline and cement this technology as a considerable solution to tackle water challenges in Yemen and will ensure funding from governmental budgets.	

	desalination technologies	Interactions with other measures	➢ Regulatory and policy frameworks, as well as sectoral and cross-sectoral national plans and documents, should align with each to reach to a clear direction for implementation.	
		Suitability within the country/ sector	➢ Ensure the water law is continuously updated to adapt to the evolving needs and conditions of the Yemeni context.	
		Benefits and costs	➢ updating water laws to include desalination technologies can significantly enhance the sustainability, resilience, and equity of water management systems. It provides a solid legal foundation for the adoption and regulation of desalination, encourages investment and innovation, and ensures that desalination is integrated into broader water management strategies to address current and future water challenges.	
7	Integrate the technology into the national climate change plans and policies, such as NAPs and NDCs.	Effectiveness	➢ Position adaptive water technologies within the climate change national documentation which facilitates climate action in the water sector	(3)
		Efficiency	➢ Developing and updating climate change plans and policies to include desalination technologies requires no additional costs as these plans will be drafted and developed as part of Yemen's nationally determined commitments. The benefits are significant as they will ensure desalination as one of the eligible technologies for climate finance.	
		Interactions with other measures	➢ Regulatory and policy frameworks, as well as sectoral and cross-sectoral national plans and documents, should align with each other to reach a clear direction for implementation.	
		Suitability within the country/ sector	➢ Ensure continuing to insert more adaptive technologies in the water sector associated with the Yemeni context which provides expansion of seawater desalination	
		Benefits and costs	➢ This measure provides critical support in maintaining water availability for both domestic use and agricultural activities. This would enhance water security, support livelihoods, and contribute to overall national stability and resilience against climate change impacts.	
8	Encourage local businessmen to invest in the manufacturing of parts of the system and to	Effectiveness	➢ this measure can lead to the successful development of a local industry that supports seawater desalination efforts, ultimately contributing to economic growth and improved water security.	9)
		Efficiency	➢ This measure is cheap, it only needs to arrange meetings with policymakers.	
		Interactions with other measures	➢ Local capital should be encouraged to invest in the manufacturing of solutions for desalination, one of the means to do so is by improving access to financing sources (Measure 1).	

	develop businesses of this kind.	Suitability within the country/ sector	➢ This measure ensures long-term economic viability, environmental responsibility, and social equity, supporting the growth of local businesses and also contributing to the broader goals of sustainable development and resilience.	
		Benefits and costs	➢ This measure offers significant benefits, including economic growth, job creation, technological innovation, and enhanced sustainability. It empowers local communities, builds local capacity, and contributes to long-term economic resilience while aligning with national development goals.	
9	Development of feasibility studies and research about the technical and environmental feasibility of desalination.	Effectiveness	➢ The development of feasibility studies and research is instrumental in ensuring that desalination projects are technically sound, environmentally sustainable, economically viable, and socially acceptable. These studies provide the foundation for successful implementation, long-term operation, and the overall effectiveness of desalination as a solution to water scarcity.	(4)
		Efficiency	➢ Costs for conducting in-depth technical, and environmental feasibility assessments are high due to the need to recruit experts to conduct the study. The returns are high as investments will be directed towards the most efficient approaches towards desalination, reducing the overall cost of desalination over project cycles.	
		Interactions with other measures	➢ The development of feasibility studies and research on desalination is one part of the role of a capacitated technical cadre. Studies and research will guide the development of quality control measures and influence the design of technical standards and manuals. (Measures 2 and 4).	
		Suitability within the country/ sector	➢ By providing a foundation for informed decision-making, minimizing environmental impacts, improving water security, engaging communities, supporting policy development, and fostering technological innovation, this measure contributes to a more sustainable, resilient, and equitable approach to managing water resources.	
		Benefits and costs	➢ This measure provides the necessary information to make informed decisions, optimize resources, protect the environment, and secure public and stakeholder support, ultimately contributing to the success and sustainability of desalination initiatives.	
10	Enhance and strengthen the institutional, regulatory, and policy framework of the water	Effectiveness	➢ Streamlining regulatory processes and reducing bureaucratic hurdles improve the efficiency and effectiveness of water management and facilitate faster decision-making and implementation of water projects.	(5)
		Efficiency	➢ The cost of this measure is high due to its decency in conducting workshops, meetings for discussion and monitoring	
		Interactions with other measures	➢ Regulatory and policy frameworks, as well as sectoral and cross-sectoral national plans and documents, should align with legislation as well as with each other to reach a clear direction for implementation.	

	sector in the country	Suitability within the country/ sector	➢ Encourage the continuous improvement of the institutional, regulatory, and policy framework in the whole water sector effectively while managing, regulating, and scaling up the technologies that encourage the diversity of water resources and facing water scarcity.	
		Benefits and costs	➢ enhancing and strengthening the institutional, regulatory, and policy framework of the water sector leads to more sustainable, equitable, and efficient water management. This holistic approach not only addresses current water challenges but also ensures the long-term viability and resilience of water resources and services, supporting national development goals and improving quality of life.	
11	Integrate desalination purposes into the agenda of the renewable energy plans of the government.	Effectiveness	➢ Renewable energy is an effective method for highly stable, cost-efficient, and accessible energy to operate desalination plants. Renewable-powered units are functional and less prone to operational issues synonymous with fossil fuel power generation.	(10)
		Efficiency	➢ Renewable energy is the most sustainable form of energy in terms of environmental impact and cost efficiency. Since Yemen is a net importer of fossil fuel derivatives and aspires to increase its share of renewable energy, desalination will form one of the primary applications for renewable energy. Furthermore, renewable energy is the most accessible form for remote areas as the need for constant transportation of fuel to the site is avoided.	
		Interactions with other measures	➢ Regulatory and policy frameworks, as well as sectoral and cross-sectoral national plans and documents, should align with legislation as well as with each other to reach a clear direction for implementation.	
		Suitability within the country/ sector	➢ Renewable energy in Yemen is the fastest source of energy in terms of growth and has established itself as one of the primary sources of energy in the country.	
		Benefits and costs	➢ Adopting renewable energy for desalination enhances energy security by decreasing the dependency on imported fuels and stabilizing energy costs, thus reducing the environmental impact of water production, also renewable energy could lead to lower operational costs for desalination plants and become cheaper and more efficient. Additionally contributes to greater water security, particularly in regions where water scarcity is a critical issue, thereby supporting economic development and social stability.	

Annex 5: Framework for ranking measures of promoting rainwater harvesting for inclusion as Actions selected for inclusion in the TAP

S.N	Measures	Considerations	Assessment	Ranking
1	Facilitate the availability of financing sources and develop suitable financial mechanisms to support the construction implementation of rainwater harvesting systems in rural agricultural areas.	Effectiveness	➢ This measure helps provide financial accessibility, technical support, and an enabling environment to support the construction and implementation of rainwater harvesting systems, ultimately contributing to improved agricultural productivity and rural development	(1)
		Efficiency	➢ The measure is highly cost-effective, needing only a workshop and a few consultations to develop a financial mechanism. It introduces a variety of funding sources, such as grants and loans, which help distribute the financial burden more equitably.	
		Interactions with other measures	➢ Access to finance will support programmes by NGOs, development banks, and governments to support this technology (Measure 2). Improved finance access must also be a part of the national strategies of the country (Measures	
		Suitability within the country/ sector	➢ Diversifying funding sources, fostering local ownership, ensuring environmental alignment, supporting policy development, and focusing on capacity building, this measure can achieve sustainability for rainwater harvesting in rural areas. These efforts ensure that the systems are not only implemented but also maintained and expanded in a way that supports long-term agricultural productivity and water resource management.	
		Benefits and costs	➢ The measure has many benefits such as: 1-Secure and diverse financing resolves the challenges that face the communities and households securing the costs of construction and installation of RWH systems with proper safety nets. 2-Promote and spread the technology within different communities. 3-Build trust and synergy between contractors, skilled labourers, and suppliers from one side, and with communities, local authorities, and NGOs from the other side.	
2	Initiate programs by the government, NGOs, philanthropy, and development banks to support rainwater harvesting construction through concessional and	Effectiveness	➢ Combining financial accessibility with technical support and community engagement thus can lead to significant environmental, social, and economic benefits	(5)
		Efficiency	➢ leverage the financing sources from philanthropy, NGOs, and urban-rural programs.	
		Interactions with other measures	➢ Incorporating this measure into national strategic plans and programs will facilitate access to funding and encourage local businesses to invest in rainwater harvesting opportunities.	

	low-interest loans, blended finance, and grants.	Suitability within the country/ sector	➢ Yemen has a strong civil society base of organizations capable of delivering these programs, along with considerable amounts of finance of philanthropy going to finance water projects.	
		Benefits and costs	➢ This measure will increase the efficiency	
3	Integrate the rainwater harvesting technology in IWRM strategies/plans.	Effectiveness	➢ Strategies remain relevant, effective over time, inclusive, and equitable. Also, track the effectiveness of water management strategies make data-driven decisions, and ensure continuous improvement and adaptation to new challenges and opportunities	(3)
		Efficiency	➢ Highly efficient, as the negligible cost of emphasizing the status of RWH as one of the key technologies will not bear additional costs but will support efforts for financial mobilization from donors interested in addressing the overall water scarcity challenge in Yemen.	
		Interactions with other measures	➢ Emphasis on RWH with IWRM will lead to the prioritization of RWH as one of the main technologies for water adaptation, allowing for focused financial mobilization from various sources and as a part of different programmes (Measures 1 and 2). Consistency with regulatory frameworks and national plans of climate is critical to give a clear vision for the way forward to the Government and donors.	
		Suitability within the country/ sector	➢ IWRM must be one of the highly prioritized plans to address water issues. RWH is one of the natively developed solutions, and the communities in Yemen are not only highly familiar with it but also advocate for it to mitigate water shortage in their regions.	
		Benefits and costs	➢ Mitigate risks associated with water scarcity, floods, and other water-related challenges, enhancing the resilience of communities and ecosystems. ➢ Ensure that water is managed in a way that balances economic, social, and environmental needs, reducing conflicts and promoting equitable access. ➢ provide clear guidelines on water rights, usage, allocation, and conservation. ensures that water is allocated fairly among different users. ➢ Ensure that water is allocated efficiently to support economic activities such as agriculture, industry, and energy production, while still meeting the needs of households and the environment. ➢ Address the interconnections between various aspects of water use, including agriculture, industry, domestic supply, and environmental conservation. ➢ Establish regulatory mechanisms to enforce these guidelines, ensuring compliance and holding violators accountable. This is crucial for maintaining the integrity of water resources. ➢ Create a favourable environment for investment in water-related infrastructure and technologies, driving economic growth and innovation.	

4	Advocate for RWH and raise awareness amongst policymakers and institution leaders from one side, and communities, farmers, and other stakeholders on the other, about the benefits of water harvesting to address water scarcity, climate change impacts, and the role of water harvesting in sustainable water management by the traditional communication means, internet mass media, organize lectures, as well as conduct community workshops and townhalls to discuss various dimensions related to technology.	Effectiveness	➢ This measure allows for broad outreach, deep engagement, and practical capacity building. increases awareness, fosters behavioural change, empowers stakeholders to adopt and sustain water harvesting practices, and sustainable management of water resources at the community level.	(6)
		Efficiency	➢ Raising awareness on the importance and potential of RWH amongst policymakers and organizations will effectively help raise funds to address the potential of RWH. Raising awareness is relatively cheap as it does not require materials and can utilize mass media and social media to reach out to large segments of society, however, it can translate to significant opportunities.	
		Interactions with other measures	➢ Increasing awareness is a parallel process to the other measures, and it does not directly affect the implementation of other measures. However, increased awareness can be reflected in the views of policymakers leading national strategies, and successful advocacy will pressure significant stakeholders to take action.	
		Suitability within the country/ sector	➢ Awareness and advocacy in many cases is necessary to push for changes in Yemen. It is cheap and the issue of water scarcity is a big concern for Yemeni households. Thus, there is a need to raise awareness of the potential of RWH to minimize the impacts of water scarcity.	
		Benefits and costs	➢ Enhancing water security and climate resilience fosters economic development and social cohesion. Utilizing mass media, lectures, and workshops promotes sustainable water management practices with local and global benefits.	
5	Integrate rainwater harvesting into climate change plans and strategies, especially, GCF country program NAPs and NDCs.	Effectiveness	➢ Enhancing water security, building climate resilience, and promoting sustainable development. This measure aligns national strategies with international climate goals, supports sustainable water management practices, and provides economic and social benefits to vulnerable communities.	(4)
		Efficiency	➢ Integrating rainwater technologies into updated climate change plans involves minimal costs, as they align with Yemen's national commitments. The benefits are significant, making rainwater harvesting eligible for climate finance.	
		Interactions with other measures	➢ Regulatory and policy frameworks, as well as sectoral and cross-sectoral national plans and documents, should align with each other to reach a clear direction for implementation.	

		Suitability within the country/ sector	➢ Yemen is currently working to update its national plans despite the national circumstances. For the RWH, minimum cost is anticipated, and it is one of the primary water sector's recommended interventions.	
		Benefits and costs	➢ Integrating rainwater harvesting (RWH) into NAPs and NDCs aligns national strategies with the Paris Agreement, demonstrating a commitment to sustainable water management. This supports key SDGs, including Clean Water (SDG 6), Climate Action (SDG 13), and Zero Hunger (SDG 2). It promotes sustainable agriculture by providing reliable water sources and ensures policy coherence in climate adaptation and mitigation strategies. ➢ Access to Climate Finance By including RWH in climate change strategies, countries can enhance their eligibility for funding from sources like the Green Climate Fund (GCF). This funding can be crucial for scaling up RWH projects and implementing them on a larger scale.	
6	Strengthen institutional capacity for water harvesting to provide an enabling environment for technology deployment in householder and agricultural sector	Effectiveness	➢ Ensuring the success of water harvesting initiatives is crucial for sustainable development. Key components create an enabling environment for widespread adoption, effective management, and integration into broader water strategies. This leads to resilient water systems, improved water security, and enhanced climate adaptation.	(2)
		Efficiency	➢ This measure will require a considerable amount of time and effort; however, it can be more cost-effective when tackled in plural with other measures related to water and water-related technologies.	
		Interactions with other measures	➢ Strong institutions are vital for mobilizing resources, ensuring quality interventions, and sustaining benefits. They regulate NGO efforts, attract investors, and support a skilled workforce to implement effective rainwater harvesting (RWH) initiatives.	
		Suitability within the country/ sector	➢ Due to years of difficult national circumstances, the institutional capacity needs strengthening, especially in the water governance to manage the scarce water resources available within the country. Activities of institutional capacity building in different sectors enjoy significant support from the government in Yemen.	
		Benefits and costs	➢ Building institutional capacity boosts water harvesting adoption, enhances climate resilience, and promotes economic and environmental sustainability by securing water resources, supporting agriculture, and reducing pressure on natural water bodies.	

4) Agricultural Sector

Annex 6: Framework for ranking measures of drip irrigation for inclusion as Actions selected for inclusion in the TAP

S.N	Identified Measures	Considerations	Assessment	Ranking
1	Financial: Mobilize resources from local, international, and regional donors, including climate finance operating entities, and encourage private sector and microfinance participation to support the widespread technology	Effectiveness	➢ An effective way to obtain funds, which is an important driver for implementing the TAP	(1)
		Efficiency	➢ Mobilizing funds from various sources is an important measure to secure necessary support for the plan.	
		Interactions with other measures	➢ It is linked to all actions because it is the engine for their implementation	
		Suitability	➢ War, a weak economy, with the existence of several international organizations.	
		Benefits & Costs	➢ Most of the sources will be mobilized outside the government budget, and collecting financial resources will cost little, and its benefits are important and influential.	
2	Providing tax facilities on drip irrigation materials	Effectiveness	➢ It will directly reduce the price of materials and thus reduce the burden on farmers. It will need a system for the quality control of materials	(2)
		Efficiency	➢ Easy measures will increase exports, on the other side the government will lose some income	
		Interactions with other measures	➢ Way of financial support, law, and legislation needed to implement the measures	
		Suitability	➢ Will be supported by farmers and materials importers	
		Benefits & Costs	➢ Can be implemented at a low cost, and get great benefits but as mentioned before the government will lose some income	
3	Reactivate the role of the Standardization, Metrology & Quality Control Organization (YSMO) to ensure	Effectiveness	➢ The effect of the measure is moderate, as the entry of high-quality materials will be accompanied by an increase in their price, and this may constitute an obstacle to the spread of the technology, especially with the presence of alternative, less expensive materials on the market “at present.”	(3)
		Efficiency	➢ Improve the quality of products and reduce the costs of replacing materials for farmers	

	enforcement and inspection procedures on drip irrigation materials.	Interactions with other measures	➢ Laws and legislation needed, awareness and coordination between different stakeholders	
		Suitability	➢ With the current weak government, institutional and technical capacity building is needed to re-activate YSMO	
		Benefits & Costs	➢ Some costs will be associated with capacity-building programs	
4	Review and strengthen the national irrigation policy and program	Effectiveness	➢ Due to the current weakness in law enforcement, its impact may be limited	(3)
		Efficiency	➢ Reviewing policies requires time and efforts	
		Interactions with other measures	➢ It interacts with all measures because it will draw the way government institutions work and deal with the technology	
		Suitability	➢ The measure is important, but with other immediate priorities such as food, health, and education, it will receive less support and can be implemented in some parts of the country.	
		Benefits & Costs	➢ It requires time, money, and effort, with many obstacles that reduce its usefulness	
5	Strengthening and improving coordination and communication between irrigation stakeholders, especially local authorities' government and private sectors	Effectiveness	➢ Coordination is important and it will remove many obstacles to the spread and use of the technology	(1)
		Efficiency	➢ It requires effort in follow-up, understanding, and good faith from those involved	
		Interactions with other measures	➢ Coordination will improve efficiency, effectiveness, and implementation of other measures	
		Suitability	➢ Coordination mechanisms are one of the important goals for the current climate change action in Yemen	
		Benefits & Costs	➢ Some funds will be needed to strengthen and facilitate the coordination mechanism and activities	
6	Design and implement knowledge and awareness Programs on the technology for the	Effectiveness	➢ Awareness is an essential part of the success of the technology, as it will help in the efficient use of the technology, reduce losses from misuse, and sustain drip irrigation systems for a longer period.	(1)
		Efficiency	➢ Despite the need for a long time to see its effect, it is one of the most important means of sustaining the technology and its success	

	farmers and local communities on technology utilization	Interactions with other measures	➢ Cross-cutting issues that needed for each measure	
		Suitability	➢ The most suitable measure that can be used and is an important part of climate action programs	
		Benefits & Costs	➢ Low cost and high benefit, some costs will be needed for delivering the programs	
7	Reactivate the role of agricultural extension and strengthening data and information services	Effectiveness	➢ Agricultural extension plays an important and pivotal role in disseminating and using technology.	(2)
		Efficiency	➢ The challenge facing this measure is its sustainability (workers' salaries, operating costs), which reduces its efficiency.	
		Interactions with other measures	➢ It is linked directly to the spread of technology, quality control	
		Suitability	➢ It is one of the most important actions that helped agricultural work flourish in Yemen, and it enjoys the support and confidence of farmers, so reactivating it will help spread the technology and support other agricultural activities.	
		Benefits & Costs	➢ Costs associated with salaries and operations, but have high benefit	

Annex 7: Framework for ranking measures of soil conservation (terraces) for inclusion as Actions selected for inclusion in the TAP

No	Identified Measures	Considerations	Assessment	Ranking
1	Mobilizing and directing resources from microfinance institutions, NGOs, Multilateral climate finance funds, and international donors' programs for soil conservation and terrace rehabilitation	Effectiveness	➢ There is an enabling environment for implementing this measure, especially since some microfinance fund mechanisms already operate such as social development funds, Al-amal, and CAC Banks. Some challenges come that the technology is not attractive to international donors.	(1)
		Efficiency	➢ With the presence of many international organizations in Yemen, part of their funding can be directed to restoring agricultural terraces. Government and local communities have experience, especially in microfinance and will support this measure	
		Interactions with other measures	➢ Finance is a driver for implementing other measures	
		Suitability	➢ This measure reinforces the existence of previous government programs in the same field.	
		Benefits & Costs	➢ It needs a clear strategy to mobilize resources and an action plan to spend these funds.	
2	Design and implement awareness and knowledge programs on the importance and economic values of terraces technology including government, service providers, and farmers	Effectiveness	➢ Awareness is an essential part of the success of the technology, as it will help in the efficient use of the technology, reduce losses from misuse, and sustain drip irrigation systems for a longer period.	(1)
		Efficiency	➢ A successful means of changing concepts and behaviours that encourage and facilitate the use of technology	
		Interactions with other measures	➢ Cross-cutting issue	
		Suitability	➢ Terraces are a long-life tradition and are strongly linked to small landholders and low-income communities	
		Benefits & Costs	➢ Low cost and high benefit, some costs will be needed for implementing education and awareness programs	
3	Develop tailored policies and plans for preserving and	Effectiveness	➢ This measure is important for organizing the work in the terraces and can greatly influence the development of technology. It is possible to establish simple guidelines and frameworks for this technology.	(2)
		Efficiency	➢ It requires time, money, and effort and can't be enforced in all parts of the country	

	reclaiming agricultural lands, including building and rehabilitation of terraces	Interactions with other measures	➢ Policies and plans will interact with other measures, especially integrating technology into national policies and plans.	
		Suitability	➢ With the current situation, clear and simple guidelines or an operation manual will be more suitable for implementation.	
		Benefits & Costs	➢ Costs will be associated with the facilitation of the procedures and consultancy with stakeholders	
4	Integrate the technology into the national agriculture, and climate change policies and plans such as NAPs, and NDCs	Effectiveness	➢ This measure is important to prioritize the technology at the national level gain political support, and facilitate access to international and climatic funding	(1)
		Efficiency	➢ It will help direct efforts and money on specific goals	
		Interactions with other measures	➢ Integrated the technology into the national plans means linking it to other measures that support the agriculture and water sectors	
		Suitability	➢ Already part of climate action activities	
		Benefits & Costs	➢ Low cost but with a high impact on the general performance of technology and its opportunity to be implemented	
5	Establish coordination channels between the local communities, the private sector, and government institutions for terrace rehabilitation	Effectiveness	➢ Coordination will help focus efforts, facilitate financing and implementation, and thus spread this technology	(2)
		Efficiency	➢ The results of coordination are not guaranteed if the necessary financial and institutional support is not available	
		Interactions with other measures	➢ Coordination will facilitate other measures	
		Suitability	➢ The technology is known and there is prior interest from the government in it	
		Benefits & Costs	➢ Yes, the Process needs strong efforts, and it will benefit other measures but also other technologies and resolve many obstacles	