



**State of Palestine**

Environment Quality Authority (EQA)

Climate Technology Centre & Network (CTCN)

*“Technology Roadmap for the Implementation of Climate Action  
Plans in Palestine”*

# **Financial and Non-Financial Derisking Measures (to scale-up the development and transfer of prioritized technologies) Identification Report**

Version 2

September 2019

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## Acronyms

BSP	Biogas Sector Partnership
CSA	Climate-Smart Agricultural
CTCN	Climate Technology Center and Network
DREI	Derisking Renewable Energy Investment
EQA	Environmental Quality Authority
EV	Electrical Vehicle
GHG	Greenhouse Gas
GHI	Global Horizontal Irradiance
GPS	Global Positioning System
ICA	Israeli Civil Administration
IEC	Israel Electric Corporation
INCR	Initial National Communication Report
JICA	Japan International Cooperation Agency
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
PENRA	Palestinian Energy and Natural Recourse Authority
PETL	Palestinian Electricity Transmission Company Ltd.
PPP	Private-Public Partnership
PV	Photovoltaic
PWA	Palestinian Water Authority
SUNREF	Sustainable Use of Natural Resources and Energy Finance
SWH	Solar Water Heating
UNFCCC	United Nations Framework Convention on Climate Change
WSRC	Water Sector Regulatory Council

## **1. Introduction**

The State of Palestine is vulnerable to the impacts of climate change with severe implications for its economy. Impacts significant to the region include decreased precipitation, significant warming, more frequent extreme weather events, and rise in sea level. These could lead to greater water scarcity, decreased agricultural productivity, and water saline intrusion.

The Palestinian Government is committed to addressing these climate change vulnerabilities while at the same time, achieving its national development and policy objectives. This is reflected in its submissions to the United Nations Framework Convention on Climate Change (UNFCCC) namely, Initial National Communication Report (INCR), National Adaptation Plan (NAP) and Nationally Determined Contribution (NDC).

To achieve sustainable economic development while contributing to the reduction of greenhouse gas emissions, it is important to prioritize various adaptation and mitigation measures through the development and diffusion of climate friendly technologies. In order to identify relevant technologies which could be applied in the Palestinian context and can be implemented to achieve the country's climate change mitigation and adaptation objectives, there is a need to identify how the barriers identified for the development and transfer of these technologies can be overcome.

This report identifies and assesses financial and non-financial measures which could be used to successfully introduce prioritized technologies in the State of Palestine. This will include the identification and assessment of derisking arrangements related to private, public and financial derisking.

## 2. Derisking approach

UNDP's approach to derisking Renewable Energy Investment (DREI) framework has been chosen to assess derisking measures within this assignment. The framework is based on the assumption that higher financing costs in developing countries reflect a number of perceived or actual informational, technical, regulatory, financial and administrative barriers and their associated investment risks.

Rather than a problem of capital, the key challenge for developing countries and emerging countries in financing their climate actions, especially those in relation with the private sector, is to address existing investor risks that affect the financing costs and competitiveness of projects.

The theory of change underlying the framework is that one of the main challenges for scaling-up technologies contributing to climate change mitigation adaptation and mitigation in developing countries is to lower the financing costs that affect their competitiveness against other technologies.

Although the DREI framework focuses on the derisking in the field of renewable energy, it is also highly relevant to other measures related to climate change mitigation and adaptation, including for energy transfers. The approach adopted by this report draws from the DREI framework and builds on it. The first phase, the assessment of the risk environment, has been conducted in the key barriers assessment report. This report will focus on the public instruments available to derisk each technology identified in the long-list.

Each level of risks implies different measures for derisking. The different types of derisking can be categorized as:

- Private risk: risks directly related to a project, such as risks arising from the unavailability of the material required, limitations in infrastructure, credit quality (counterparty risk), and others;
- Public risks: risks related to policy and regulatory frameworks, such as risks arising from limitations and uncertainties in the market, and/or suboptimal regulations to address these limitations, permit risks and others;
- Financial risks: risks related to the cost of capital, such as risks arising from scarcity of investor capital (debt and equity) in Palestine for a particular sector, from the country's macro-economic performance and others.

Potential derisking approaches for each type of risk is summarized in the table below.

**Table 1 Type of derisking and derisking approaches**

Type of risk	Derisking approaches
Private derisking	1 Capacity building
	2 Awareness programmes
Public derisking	3 Policy measures
	4 Regulatory instruments
	5 Standards and codes, i.e., grid codes, building codes, etc.
Financial derisking	6 Feed in tariffs
	7 Tax breaks
	8 Payments against results (Result based finance)
	9 Carbon derisking

### 3. Energy sector

The following technologies for the energy sector have been prioritized.

- National grid assessment and electricity grid upgrade
- Various applications of photovoltaic (PV) technologies
- Energy efficiency
- Solar water heating

These technologies were based from priorities and strategic goals as described under Palestine’s INCR, NAP, and NDC, in line with the National Development Plan and sectoral strategies. These were also based on inputs received during the consulting team’s stakeholder engagement during the inception workshop and bilateral meetings with key ministries and agencies.

#### 3.1 National grid assessment and electricity grid upgrade

Upgrading the Palestinian grid is crucial for the efficient distribution of electricity throughout its network meeting domestic demand, as well as to diversify energy sources and develop the integration of renewable energy sources as part of its energy mix. The following barriers, risks and derisking approaches have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Political	Lack of access to energy sources / energy generation	Agreement with Israel
Public risk	Regulatory	Lack of concrete measures related to improving the grid	Development of detailed regulations
Public risk	Institutional	Sectoral fragmentation	Development of a cooperation framework
Private risk	Technical	Lack of technical capacity and know-how (O&M, upgrading assessment)	Capacity building
Financial risk	Financial	Lack of financial resources	External financing

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

Grid upgrading will require several measures related to public derisking. First, it is important to emphasize that grid upgrading will focus on a number of grids that are in Area A under full Palestinian control. This will enable Palestine to introduce the technology without having to negotiate with the Israel Electric Corporation (IEC). As upgrading the grid aims at accommodating additional energy capacities, including renewable energy, it is important to ensure that Palestine has access to energy resources and energy generation capacities.

However, Palestine is both limited in its access to energy resources and energy generation. Under the current environment, Palestine cannot use its own resources in natural gas and has to rely on imports from Israel. Additionally, Palestine depends on Israel to import electricity, as there are no significant power plants in the West Bank. It is also important to take into account that land is limited in areas A and

B, where Palestine could set up new power plants, especially for renewable energy.

The importation of resources for energy generation, the use of Palestinian resources, such as natural gas, as well as the development of new power plants in the West Bank will require significant negotiations with Israel.

It will also be important to develop clear regulations for upgrading the grid. This is especially important in terms of institutional set-up. Upgrading the grid is a complex process which involves a number of stakeholders at different levels. In order to be successful, the process needs to be integrated and coordinated between the stakeholders. Clarifying the institutional framework in Palestine will enable to clearly understand what each organization is responsible for and to reduce risks of delays in the execution.

This can be clarified in detailed regulations related to stakeholders' roles in managing the grid and in upgrading it.

Public derisking can be achieved at low-costs. However, this may require extensive stakeholder engagement with local stakeholders as well as with Israel. This also requires technical understanding of how grid upgrading should be conducted and of the roles for each stakeholder, which may be done through capacity building (see next section).

#### **Private derisking**

Grid upgrading requires significant knowledge related to how the grid is operated, to operational requirements as well as grid integration. This also heavily related to public derisking, which will require technical capabilities and understanding in order to be conducted efficiently.

Capacity building to Palestinian Energy and Natural Resources Authority (PENRA) and other related stakeholders is thus crucial for this. Technical assistance may include the grid assessment, which is a preliminary condition to upgrading the grid, but also modules related to how the grid can be upgraded concretely and on the roles of stakeholders involved in grid management.

#### **Financial derisking**

Grid upgrading requires significant financial resources. At this stage, it is highly unlikely that the private sector would get involved in upgrading the grid in Palestine, if there are no opportunities related to energy generation. In an independence scenario or if negotiations are successful, it will be important to consider potential derisking measures to engage the private sector in power generation and transmission. In the meantime, it seems more probable to rely on external resources to support the State of Palestine in financing the upgrade of the grid.

While public derisking can mainly be led and implemented by the Palestinian Government without external support or with almost no external support, technical assistance and financial derisking will require significant external support from donors. Overall, the development of the technology will require lengthy negotiations related with energy access and generation, which will come in addition to measures required to assess grid upgrading requirements. This suggests that grid upgrading may be implemented on the long term.

### **3.2 Solar PV technologies**

With 3,000 sunshine hours per year and Global Horizontal Irradiance (GHI) over 2,000 kilowatt-hours per meter square, West Bank and Gaza rank amongst the world's top locations for construction of solar

systems<sup>1</sup>. Moreover, amongst the available renewable energy sources, solar energy can be produced fully independently in Palestine. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Political	Limitations in terms of integrations to the grid	Negotiations
Public risk	Geographical	Limitations in terms of land-use	Negotiations
Public risk	Regulatory	Palestinian Electricity Transmission Company Ltd. (PETL)'s capacity in off-taking renewable energy is unknown	Development of regulations and incentives
Financial risk	Financial	The risk perceived by investors may remain too high to support further penetration of solar PV in the market	Financial scheme

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

Solar PV technologies face a number of barriers related to public derisking for their diffusion in Palestine. The three main barriers are heavily inter-related. First, Palestine is limited in the integration of renewable technologies to the grid. Although, PENRA and Palestinian electricity distribution companies are responsible for the electricity distribution network in Palestine, and PETL is responsible for transmission since 2018, Israeli Electricity Company (IEC) controls the electricity generation and owns the high voltage grid outside areas A and B. IEC has high standards for grid stability, which limits the integration of all renewable energy in the grid.

Moreover, PETL is now responsible for the off-taking of power and providing transmission infrastructure in the West Bank, but has no strong track record yet, which might deter potential investors for solar PV plants. Finally, there is very few lands available in areas A and B for solar PV plants. While land may be available in Area C, this requires permits from Israel, which are complex and lengthy to obtain at best.

The diffusion of rooftop PVs may be a solution to avoid land availability issues and stability issues, as power could be provided at household level or through net-metering. However, derisking larger PV plants may prove more complex. In a non-independence scenario, Palestine will need to negotiate with Israel for land available in Area C. Even then, PETL will need to prove that it is able to integrate the power provided into the grid, which will require the approval from IEC. If these conditions are met, it will be necessary to provide guarantees to potential investors that power will be bought at a pre-agreed price. This may be done through the development of a feed-in-tariff system.

### **Financial derisking**

While there are already derisking programmes for solar PV technologies in Palestine, such as SUNREF, those mainly target small and medium scale projects. Larger projects may require additional support as the risks involved can be perceived as higher by investors. Given the land limitations in Palestine, pursuing financial derisking should remain the priority, while additional programmes for larger scale projects could also be considered.

Although financial derisking for smaller scale projects may be conducted by Palestine with fewer support from international partners, Palestine will require external support for the capacity building of PETL and the

<sup>1</sup> Securing Energy for Development in West Bank and Gaza, World Bank, 2017

development of regulations such as feed-in-tariffs. Other types of public derisking mainly involve negotiations with Israel, and require a significant involvement from Palestine. However, it is important to emphasize that negotiations will be crucial in order to implement the technology in integration with the grid.

### 3.3 Energy efficiency

Achieving energy efficiency in Palestine is extremely important as the country is completely dependent on imported energy products. In Palestine, buildings consume approximately 43 percent of the total energy consumption per year and this is expected to double by 2020. Additionally, buildings and construction is the fastest growing sector in Palestine, with 2,585 building licenses issues in the last quarter of 2017 in the West Bank.<sup>2</sup> The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Regulatory	No mandatory standards for energy efficiency in buildings and no clear standards for green buildings	Development of standards
Financial risk	Financial	Significant initial investment required for retrofits and new buildings	Financial incentives and financial schemes
Private risk	Information	Lack of adequate information about potential energy-efficient technologies	Awareness campaigns
Private risk	Behavioral	Habits and routines may be difficult to change	Awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

One of the main barriers faced by energy efficiency in Palestine is the absence of mandatory standards for energy efficiency in buildings and of clear standards for green buildings. The absence of such standards does not give the private sector the signals it requires to invest in energy efficiency. With mandatory standards both for new buildings and retrofits, building owners and contractors would have to comply, and energy efficiency would therefore progress in Palestine.

Formulating the relevant policy environment for energy efficiency, which define the standards for each building, will be extremely important to support the transfer and replicability of the technology in the country.

#### **Private derisking**

Energy efficiency also faces a number of barriers related to the lack of information provided to building owners and potential behavioral barriers. In both cases, awareness campaigns, which would explain the merits of energy efficiency measures could constitute a mitigation option. Some of the best practices include the development of awareness campaigns explaining potential financial and environmental benefits as well as the development of publicly available tools to calculate potential energy savings and GHG emission reductions.

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<sup>2</sup> Mohammed F. Alsayed, Rawan A. Tayeh. *Life cycle cost analysis for determining optimal insulation thickness in Palestinian buildings*. 2019. Accessed from [https://staff.najah.edu/media/published\\_research/2019/01/22/Life\\_cycle\\_cost\\_analysis\\_for\\_determining\\_optimal\\_insulation\\_thickness\\_in\\_Palestinian\\_buildings.pdf](https://staff.najah.edu/media/published_research/2019/01/22/Life_cycle_cost_analysis_for_determining_optimal_insulation_thickness_in_Palestinian_buildings.pdf)

### **Financial derisking**

Energy efficiency measures entail high initial investment costs for potential off-takers, both for new buildings and retrofits. This will require large financial investment upfront by individuals and buildings owners. It is therefore extremely important that financial schemes incentivizing energy efficiency measures are developed, with the support of the Government.

A potential scheme includes the payment of up-front costs for the incremental costs related to energy efficiency measures by distribution companies or a third party, which could then be reimbursed based on electricity payments. This requires developing benchmarks and calculating the difference between the benchmark and the actual energy costs. Other schemes may include the provision of tax incentives for the implementation of measures or of concessional financing to finance incremental costs.

Although outreach campaigns may be conducted by Palestine with almost no support from international partners, Palestine will require external support for the development of capacity building programme related to the development of standards for energy efficient building. While Palestine will need to design an attractive scheme for private sector engagement, it is expected that it could rely on external financing sources to fund part of the incentive scheme.

The potential engagement of the private sector, the potential market for energy efficiency and the fact that derisking measures do not require complex negotiations suggest that energy efficiency may be feasible on a short-term basis.

### **3.4 Solar water heating**

Solar water heating systems is currently a proven technology in Palestine. It is extensively used in the residential sector, while limited in the service and industrial sectors. This technology is highly relevant in the Palestinian context as most of the electricity is supplied from external sources which the country has no control of, and thus fetch high costs, the most expensive compared with other countries in the region. The following risks and barriers have been identified for this sector.

<b>Type of risk</b>	<b>Type of barrier</b>	<b>Summary</b>	<b>Derisking approach</b>
<b>Public risk</b>	Regulatory	No regulations to support integration of solar water heating into buildings	Development of detailed regulations
<b>Public risk</b>	Market	Limited market for local producers	Support to local producers
<b>Private risk</b>	Technical	Lack of technical capacities in terms of effectively manufacturing, designing and installing new and efficient technologies for solar water heating systems	Capacity building
<b>Financial risk</b>	Financial	High initial investment costs	Incentives and financial schemes to support investments

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

Solar-water heating faces several barriers which can be mitigated through public derisking. One of the main barriers faced by solar-water is the lack of a sufficient market for local producers. This is heavily related with the absence of regulations which would allow for the integration, either voluntarily or

mandatorily, of solar water heating technologies in the design, planning and construction of new infrastructures such as buildings, or for retrofits. Although the technology has been integrated as a national priority in Palestine, such regulations would allow increase in the demand for solar water-heating in Palestine, which would in turn boost local markets.

At the same time, it is also important to emphasize that for local producers, the local market is the only market available for their products. It is therefore important to protect the industry, for example by providing incentives to the producers or by developing standards which would ensure the quality provided to customers, while at the same time protect Palestinian providers.

Public derisking can be achieved at low-costs. However, this may require extensive stakeholder engagement with local stakeholders to determine the standards most relevant to Palestine. This also requires technical understanding of technical standards, both in terms of quality and for the integration to new infrastructure and retrofits. This may be done through capacity building (see next section).

### **Private derisking**

The development of standards related to water-heater systems and to their installation in new infrastructure or retrofits, as well as practical know-how related to effectively manufacturing, designing and installing solar water heating systems, especially for collective systems for larger installations such as buildings, hotels and hospitals requires significant technical capacities.

Support in the development of standards as well as in the development of knowledge material on the technical aspects of solar water heating systems such as manuals, handbooks and software that could be applied in the Palestinian context, as well as enhanced capacities and skills of staffs through trainings, will be crucial for its mainstreaming.

### **Financial derisking**

Solar technologies including solar water heating systems entail high initial investment costs for potential off-takers, given the relatively low-income level of its end users. Developing incentives and financing schemes that will support investments from building owners as well as small-holders in solar water heating systems will be paramount for the development of the technology in Palestine. This will be linked with the development of a local market and thus contribute to the public derisking of the technology.

Palestine will require external support for the development of capacity building programme related to the development of standards and of local capacities in manufacturing, designing and installing solar water heaters. While Palestine will need to design an attractive scheme for private sector engagement, it is expected that it could rely on external financing sources to fund part of the incentive scheme.

Overall, the development of the technology will require building the market for local producers. While this requires time and efforts, the potential engagement of the private sector, given that it is supported by the relevant enabling environment, suggests that solar water-heating technologies are feasible on a short term basis.

## 4. Agriculture sector

For the agriculture sector, the following technologies have been prioritized.

- Climate smart agriculture (precision agriculture)
- Efficient irrigation
- Resilient animal fodder
- Conservation agriculture
- Water harvesting

### 4.1 Climate smart agriculture (precision agriculture)

Climate change both directly and indirectly impacts agricultural productivity, ranging from changing rainfall patterns, higher temperatures, drought, flooding and spread of pests and diseases. Climate-smart technologies have been applied in many parts of the world to manage climate change impacts on landscape such as, cropland, livestock, forests and fisheries. These technologies aim to achieve increased and sustainable productivity, enhanced resilience and reduced emissions. This is significantly important in the context of Palestine where agriculture plays an important role in the country's culture, food security, economy and employment. Most importantly, Palestine has identified applying climate-smart agricultural (CSA) practices to at least 50 percent of farmers by 2040 as a target in its NDC. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
<b>Financial risk</b>	Financial	Significant initial investment required	Incentives and financial schemes to support investments
<b>Private risk</b>	Cultural	Resistance towards changing traditional agricultural practices	Awareness campaigns and development of farmers' organizations and cooperatives
<b>Public risk</b>	Geographical, access to water and equipment	Limitations in terms of access to land, water, and CSA tools and equipment	Incentives and financial schemes to support investments and negotiations

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Financial derisking**

One of the key challenges facing CSA is scale limited by lack of access to sufficient and adequate finance. CSA requires significant initial investment for equipment, which is often not made available to producers and companies, or not at relevant conditions. Financing is critical for incentivizing farmers and communities, public institutions and private sectors to invest in development and promotion of CSA. In addition, it is important to develop a strategy that guides the financing of CSA technologies and activities by the different players, such as from government, private and multilateral institutions and bilateral financial partners.

Blended finance has proven as one of the most successful ways of funding CSA<sup>3</sup>. Many blended finance schemes include a grant component from a government body, development or philanthropic organization which, when mixed with funds from a commercial investor, reduces the interest that borrowers have to pay. Some blended schemes include a guarantee that some investors will receive back a proportion of their investment should the borrower fail to repay<sup>4</sup>. This reduces the risks that financial institutions take, encouraging them to offer more or bigger loans to borrowers or sectors that they perceive as high risk, or to offer them more favorable terms such as interest-free periods (grace periods) or favorable repayment schedules<sup>5</sup>. In addition, the private sector participation opportunity can be supported through private-public partnership (PPP) for investments in knowledge and technology development and dissemination, credit and insurance access for smallholders<sup>6</sup>.

### **Private derisking**

CSA requires changes in farming households' behavior and strategies, as well as changes in the usual timing of agricultural practices. Successfully managing change demands accurate and up-to-date information<sup>7</sup>. This requires producing and sharing information and help people translate this information into knowledge and action. Some of the activities could include farmer field schools (or similar approach that train and enable farmers to adopt new techniques), farm radio shows that provide easily accessible information, useful and useable (i.e. needs driven) agricultural and weather-related information to rural households, local agricultural demonstration plots and events, and farmer-to-farmer exchanges<sup>8</sup>.

Farmer's union, cooperatives and organizations play a key role in supporting the adoption of CSA technologies. They actively lead their members to embrace CSA principles and practices, and become information and service provider serving as 'CSA knowledge platforms'. Developing these partnerships are essential in de-risking private risks.

### **Public derisking**

Adopting CSA practice requires access to CSA inputs, equipment, machineries and water. The practice may not necessarily require more equipment than conventional agriculture but some of these tools are specific and may not be easily available. Purchasing these inputs, such as particular fertilizers and machineries may become costly for farmers as these are expensive. Therefore, it is important to explore options in providing these tools, such as through subsidies for inputs such as fertilizers, farm equipment and machineries. Exploring the opportunity to lease these equipment and machineries to farmers supported by private sector participants may also present as a derisking solution. It requires, however, to encourage private sector stakeholders to enter this market when it is still limited. This may require subsidies or tax cuts.

With respect to limited access to land and water for advancement of CSA technologies, some technologies may require additional space for installation of technologies as well as for establishment of storage and processing facilities. In order to secure additional land, Palestine will need international solidarity and may need to negotiate with Israel for land available in Area C for potential expansion of its

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<sup>3</sup> A Business Case for Engaging the Private Sector in Climate-smart Solutions for Smallholder Farmers. CTA Discussion Paper. 2018. Accessed from < [https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038\\_PDF.pdf](https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038_PDF.pdf)>

<sup>4</sup> A Business Case for Engaging the Private Sector in Climate-smart Solutions for Smallholder Farmers. CTA Discussion Paper. 2018. Accessed from < [https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038\\_PDF.pdf](https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038_PDF.pdf)>

<sup>5</sup> A Business Case for Engaging the Private Sector in Climate-smart Solutions for Smallholder Farmers. CTA Discussion Paper. 2018. Accessed from < [https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038\\_PDF.pdf](https://cgspace.cgiar.org/bitstream/handle/10568/97494/2038_PDF.pdf)>

<sup>6</sup> World Bank. 2017. Climate-Smart Agriculture in Zambia. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT), Washington, D.C. pg. 25

<sup>7</sup> Food and Agriculture Organization of the United Nations (FAO). Climate-Smart Agriculture Sourcebook. 2013.

<sup>8</sup> Food and Agriculture Organization of the United Nations (FAO). Climate-Smart Agriculture Sourcebook. 2013.

agricultural land and practice. Access to water is subject to similar constraints. Water supply is controlled by Israel in Palestine, which makes it an important barrier. While CSA technologies may not use more water, and some even less, than conventional agriculture, it remains important to negotiate with Israel to secure the water resources needed for application of the technology.

While financial and public derisking will require external support and the involvement of the private sector, given that the private derisking could be led by the Palestinian government, with an effort from local farmers' group, this technology is feasible in the short term.

This is strongly supported by the fact that there are already some success stories in Palestine in the use and application of climate smart agriculture technologies, such as bio-digesters for the production of biogas for electricity generation. With respect to the land and water availability related to public derisking, this will require negotiation with Israel. However, Palestine could focus on the area that is currently available for the application of CSA technologies.

#### 4.2 Efficient irrigation

Improving irrigation efficiency aims at minimizing water use within the agricultural sector while continuing to maintain optimal crop productivity rates. Water efficient irrigation also provides a number of environmental and socio-economic benefits. High irrigation efficiency is becoming increasingly important due to the current decrease in available water resources and growing populations that drive expansion of agricultural activities<sup>9</sup>.

Technological advances for improved irrigation include more efficient irrigation systems where water release can be controlled so that crops receive only the amount needed. Other modern irrigation systems are self-propelled and include wireless sensors and GPS technology to improve site-specific and volumetric precision of water applications to match the needs of the soil and crops. Irrigation efficiency can also be improved through altering farming practices, such as crop rotation and conservation tillage that help improved soil moisture conservation<sup>10</sup>.

Regular monitoring equipment and repairing damages/leakages in irrigation systems are also important in improving water use efficiency for crops. Improving access to information in regards to these measures, for example through farmer education programs, can help create incentive and influence the behavior of farmers toward greater water-efficient management or irrigation systems<sup>11</sup>. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Financial risk	Financial	Significant initial investment required	Incentives and financial schemes to support investments
Private risk	Cultural	Need for education and training of farmers on efficient irrigation practice	Capacity building

Concrete potential measures to derisk the introduction of the technology are detailed below.

<sup>9</sup> Climate Change Adaptation Technologies for Water: A practitioner's guide to adaptation technologies for increased water sector resilience (2017), UN Environment – DHI Centre, Climate Technology Centre and Network (CTCN) and the UNEP DTU Partnership

<sup>10</sup> Climate Change Adaptation Technologies for Water: A practitioner's guide to adaptation technologies for increased water sector resilience (2017), UN Environment – DHI Centre, Climate Technology Centre and Network (CTCN) and the UNEP DTU Partnership

<sup>11</sup> Climate Change Adaptation Technologies for Water: A practitioner's guide to adaptation technologies for increased water sector resilience (2017), UN Environment – DHI Centre, Climate Technology Centre and Network (CTCN) and the UNEP DTU Partnership

### **Financial derisking**

The lack of access to finance to purchase efficient irrigation equipment is considered to be the main constraint to technology adoption. This presents as additional challenge to small farmers due to their lack of credit history, collateral, and financial skills, as well as limited or no prior experience with efficient irrigation equipment<sup>12</sup>. One of the ways in which this could be overcome is the introduction of financial incentives to overcome the high costs associated with these systems<sup>13</sup>. These financial incentives could be provided by introducing schemes on installation of the irrigation systems as capital subsidy and remaining amount could be sourced through low interest debts and farmer contributions. The subsidy could be provided through a special fund created for promotion of micro irrigation schemes<sup>14</sup>. Additionally, incentives could be provided to local banks to provide loans to farmers at lower rates of interest by introducing re-financing and credit risk guarantee schemes. Another way to address this is through a leasing company or a financial institution which will provide upfront costs to overcome the initial investment cost that is often seen as the issue for smallholder producers. Farmers, will then, reimburse the initial investment through participation in water cooperatives and associations.

### **Private derisking**

Lack of management skills in managing irrigation systems results in reduction of crop yields and wastes water resources. Capacity building activities should include educational component which could be delivered formally or informally through the form of basic, vocational and professional experience<sup>15</sup>. Additionally, capacity building activities should also include training component on competency and tasks in the form of vocational, on the job training, seminars, workshop, courses, and coaching<sup>16</sup>. It is essential that farmers as users of the system fully understand the technology and benefits for appropriate use of the technology.

Palestine will require external support in financial derisking related to the technology. However, the technology has minimal barriers related to occupational challenge. Thus, this technology is feasible in the short term.

## **4.3 Resilient animal fodder**

Recurring droughts and overgrazing in the West Bank, including in limited open areas as a result of Israeli occupation, have resulted in herders facing decreased access to grazing land, which increases their dependency on imported fodder and making them more vulnerable to fodder price volatility. To help address this issue, the use of hydroponic technology (soil-less plant propagation) by vulnerable herders and their

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<sup>12</sup> International Finance Corporation (IFC). Impact of Efficient Irrigation Technology on Small Farmers. Accessed from: < <https://www.ifc.org/wps/wcm/connect/2a54040046a86bc6989db99916182e35/Impact+of+Efficient+Irrigation+Technology+on+Small+Farmers+-+IFC+Brochure.pdf?MOD=AJPERES>>

<sup>13</sup> Climate Technology Centre & Network (CTCN). Action Plan for Drip Irrigation and Sprinkler Irrigation Systems. 2013. Accessed from: < [https://www.ctc-n.org/sites/www.ctc-n.org/files/UNFCCC\\_docs/tap\\_bhutan\\_adaptation\\_drip\\_and\\_sprinkler\\_irrigation\\_systems\\_0.pdf](https://www.ctc-n.org/sites/www.ctc-n.org/files/UNFCCC_docs/tap_bhutan_adaptation_drip_and_sprinkler_irrigation_systems_0.pdf)>

<sup>14</sup> Climate Technology Centre & Network (CTCN). Action Plan for Drip Irrigation and Sprinkler Irrigation Systems. 2013. Accessed from: < [https://www.ctc-n.org/sites/www.ctc-n.org/files/UNFCCC\\_docs/tap\\_bhutan\\_adaptation\\_drip\\_and\\_sprinkler\\_irrigation\\_systems\\_0.pdf](https://www.ctc-n.org/sites/www.ctc-n.org/files/UNFCCC_docs/tap_bhutan_adaptation_drip_and_sprinkler_irrigation_systems_0.pdf)>

<sup>15</sup> Food and Agriculture Organization of the United Nations (FAO). Keynote paper 2: Capacity building for water and irrigation sector management with application in Indonesia. Accessed from < <http://www.fao.org/3/y5524e/y5524e08.htm>>

<sup>16</sup> Food and Agriculture Organization of the United Nations (FAO). Keynote paper 2: Capacity building for water and irrigation sector management with application in Indonesia. Accessed from < <http://www.fao.org/3/y5524e/y5524e08.htm>>

cooperatives has been promoted in Palestine<sup>17</sup>. This provides them with a low-cost, high quality, sustainable source of fodder which is available year-round. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
<b>Financial risk</b>	Financial	Significant initial investment required	Incentives and financial schemes to support investments
<b>Private risk</b>	Cultural	Hesitation to adopt new practice	Capacity building
<b>Public risk</b>	Access to local market and geographical	Limited local market and supplier for seeds; limited access to the necessary water and electricity due to limited access to land	Negotiation; support to local producers

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Financial derisking**

Each hydroponic cost is high, in addition to a regular maintenance cost that may hinder uptake of the technology in Palestine. Subsidy program should be developed and provided to drive increase in demand, as well as creating an enabling environment for potential private sector involvement. Currently, utilizing local feed suppliers is preferred due to fluctuation of quality in imported seeds. However, local market suppliers are limited. In order to expand the local market, a financing infrastructure should focus on promoting market demand and creation of the local market.

### **Private derisking**

As the technology is considerably new, there is hesitation from local farmers to adopt new practice. This is mainly driven by uncertainty in financial return from this technology investment. Capacity building is critical in encouraging local farmers to adopt new agricultural production practices. This may be most effective through the development of demonstration plots where this technology could be applied and tested, providing local farmers an opportunity to experience benefits of this technology. Further establishment of farmers' cooperatives will also contribute in de-risking as they play the essential role in being the knowledge platform that supports local farmers.

### **Public derisking**

As mentioned in the above section, there is currently limited local suppliers which limit local farmers from accessing high quality feed. As a way to overcome this barrier, a financing model that promotes market demand and increases local supplier is needed in scaling up this technology. With respect to physical access, each hydroponic unit requires access to water and electricity, which may present as challenge to some farmers due to limited availability. It may be possible to explore options in introducing this technology along with solar PV and wastewater treatment / water harvesting technologies for agricultural use as a de-risking solution.

Overall, the development of the technology will require building the market for local producers. While this requires time and efforts, the potential engagement of the private sector, given that it is supported by the

<sup>17</sup> Food and Agriculture Organization (FAO). "Alternative fodder production for vulnerable herders in the West Bank: Increasing profitability of livestock production to strengthen resilience to drought and market volatility within protracted crises". Resilience promising practice, 2015.

relevant enabling environment in which this technology is already applied in Palestine, suggests that this technology is feasible on a short term basis.

#### 4.4 Conservation agriculture

Conservation agriculture is a farming system that maintains a permanent soil cover to assure its protection, avoids soil tillage, and cultivates a diverse range of plant species to improve soil conditions, reduce land degradation and increase water and nutrient use efficiency. It enhances biodiversity and natural biological processes above and below the ground surface for improved and sustained crop productivity<sup>18</sup>. Most importantly, conservation agriculture can enhance productivity of farmland already in use and can generate land left in poor condition by past misuse<sup>19</sup>. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Financial risk	Financial	High cost to acquire no-till farm equipment and external inputs	Incentives and financial schemes to support investments
Private risk	Cultural	Resistance towards behavior and commitment change	Capacity building
Private risk	Information	Poor flow of information to farmers	Awareness campaign

Concrete potential measures to derisk the introduction of the technology are detailed below.

##### **Financial derisking**

For adoption of conservation agriculture, practices such as the no-till seeding, weed control and cover crop management require some level of mechanization and access to specific equipment that may often be beyond the means of individual smallholder farmers. A financial solution to this barrier may include offering such equipment through lease to local farmers' group or cooperatives supported by government subsidies. Private sector participation in providing the opportunity to lease these equipment and machineries to farmers may also present as a derisking solution. Techniques can be shared through the establishment of demonstration plot financed by government to support initial uptake of the technology application. Therefore, it is important to explore options in providing these tools, such as through subsidies for inputs such as fertilizers, farm equipment and machineries.

##### **Private derisking**

Similar to climate smart agriculture technologies, conservation agricultural practice require change in behavior in which the agricultural practice is executed. This moves farmers away from traditional practice which may result in hesitation from farmers. In order to eliminate this barrier, this issue needs to be addressed through capacity building with continuous information dissemination and training activities delivered to individual farmers and farmer groups. Such activities include field visits to researcher and farmer-managed demonstration sites, documentation and awareness campaign (through posters, brochures, video, among others), and regular exchange of information between farmers and research groups about crop implementation and monitoring<sup>20</sup>. Capacity-building activities are also critical in determining which conservation agricultural management practices are effective in a particular local

<sup>18</sup> Food and Agriculture Organization (FAO). Conservation Agriculture. Accessed from <http://www.fao.org/3/a-i6169e.pdf>

<sup>19</sup> Food and Agriculture Organization (FAO). Conservation Agriculture. Accessed from <http://www.fao.org/3/a-i6169e.pdf>

<sup>20</sup> Kong, R., Sar, V., Leng, V., Trang, S. Boulakia, S., Tivet, F. and Seguy L. (2016). "Conservation Agriculture for Climate-Resilient Rain-Fed Uplands in the Western Regions of Cambodia: Challenges, Opportunities, and Lessons from a 10-Year R&D Program.

context. Additionally, converting to a sustainable farming and food system involve different phases which involve field-level approach, participatory research with farmers, community associate approaches, and community network approach<sup>21</sup>. Capacity-building activities should be provided in each phase tailored to the focus of each transition phase.

Similar to CSA technologies, an external support is required for financial derisking in providing the necessary tools, input and equipment accessible. However, private derisking can be led by the Palestinian government, without external support. The technology also allows for application within the current jurisdiction of Palestine, which makes this feasible in the short term.

#### 4.5 Water harvesting

Water harvesting is a technique of developing surface water resources that can be used to provide water for livestock, for domestic use, and for agriculture. Rainwater conservation and harvesting for agriculture use provides opportunities to reduce the high risk of yield losses associated with low rainfall and uneven distribution throughout the season. Water harvesting, specifically rainwater harvesting, for agricultural use is highly relevant to the Palestinian context. Climate change provides additional stress to already limited rainfalls in the region. Additionally, drought and growing population will be challenging in meeting the agricultural need for the country. Use of alternative water resources, such as rainwater, has been identified as an important adaptation solution in Palestine’s NDC. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Financial risk	Financial	Significant initial investment required	Incentives and financial schemes to support investments
Private risk	Cultural	Resistance towards implementation of technology and changing traditional agricultural practices	Capacity building
Public risk	Geographical	Limited area available that meets site specific requirement	Negotiation

Concrete potential measures to derisk the introduction of the technology are detailed below.

##### **Financial derisking**

In scaling up water harvesting technologies for agricultural purposes, a financial source to cover the initial technology investment in infrastructure, personnel training, and ongoing maintenance costs is required. As such, in order to drive demand by farmers for water harvesting technologies, government subsidies should be provided to farmers for adopting water harvesting technology. A lack of formal financial mechanism, such as subsidies, will encourage farmers to favor existing production practices and discourage formation of a market for water harvesting<sup>22</sup>. Business models will also need to be developed to provide loans and credit to farmers for purchasing water harvesting technologies which will further form a market interested in production using water harvesting technologies. This can be achieved through engagement with local financial institutions.

<sup>21</sup> Komatsuzaki, M. (2011). “Agro-ecological Approach for Developing a Sustainable Farming and Food System.” *Journal of Developments in Sustainable Agriculture* 6, 54-63.

<sup>22</sup> Sixt, G.N., Klerkx, L. and Griffin, T.S. (2017). “Transitions in water harvesting practices in Jordan’s rainfed agricultural systems: Systemic problems and blocking mechanisms in an emerging technological innovation system”. *Environmental Science and Policy*

### **Private derisking**

Water harvesting technologies require regular maintenance for operation. Lack of capabilities and knowledge on the water harvesting technologies will lead to insufficient maintenance of water harvesting systems. Thus, this will negatively impact the physical infrastructure of water harvesting technologies. Capacity building activities should be developed that focus on campaigns to build water scarcity awareness in agricultural communities and on potential end use of water harvesting technologies. Without the awareness of water scarcity, the application of this technology will not be feasible. This is most effective when carried out through in-farm demonstration and teaching model farms.

### **Public derisking**

Water harvesting technologies provide positive impacts to farmers with respect to enhanced crop yields and increased income. However, in order to operate, applicable technologies will need to be installed in areas favorable to meeting site specificities. In addition, there may be cases in which significant alterations are needed on the existing buildings and infrastructure or putting up new structures. In such cases, this will need to be assessed, discussed and negotiated with applicable participating groups as it might require securing of additional space and land. It is important to emphasize that most of the agricultural land is located in Area C. Farmers introducing the technology in area C are expected to face more challenges with Israeli occupation.

Palestine will need external assistance in financial derisking while the application of the technology in areas favorable to the site specificity will require communications with Israeli occupation over Area C. However, by focusing on the area under current jurisdiction of Palestine, this technology is feasible in the short-term.

## 5. Water and wastewater sector

The following technologies for the water and wastewater sector have been prioritized.

- Rainwater harvesting
- Water resources monitoring technologies
- Wastewater collection and treatment plants and advanced wastewater treatment technologies

### 5.1 Rainwater harvesting

Rapidly growing population and Israeli occupation and control over water and land resources have worsened Palestinian water supply and management issues. A large number of Palestinians suffer from shortages of drinking and agricultural water, especially during the summer when the water shortage is at its worst, and most of the households live isolated from the water network. The implementation of rainwater harvesting systems can allow these isolated households to have an independent access to water resources. The following risks and barriers have been identified for this technology.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Political	Need to apply for construction and rehabilitation permit with Israel	Negotiations
Financial risk	Financial	High construction cost expected in remote areas	Financial schemes
Public risk	Geographical	Limitation in terms of land-use	Negotiations
Private risk	Awareness	Lack of awareness about water contamination risks	Capacity building

Concrete potential measures to derisk the introduction of these technologies are detailed below.

#### **Public derisking**

Israel strengthened land restrictions in the West Bank in 2002, making it illegal to build or rehabilitate any structure without the permission of the Israeli Civil Administration (ICA) in Area C. Structures built without permits face the risk to be demolished by Israeli occupation. It is thus primordial to seek international support and solidarity in addition to communication with Israeli Authorities for the construction of rainwater harvesting systems, but it implies a long process with a high probability of refusal.

This can only be mitigated through negotiation with Israel. To this end, Palestine has to request for international support and to keep meetings with Israel and develop a partner platform to support the dialogue. In an independence scenario, where Palestine would not have to apply for construction and rehabilitation permit for the construction of rainwater harvesting systems in the West Bank anymore, the construction and rehabilitation process for rainwater harvesting systems would be smoother and more efficient for Palestinians.

Public derisking can be achieved at low costs.

#### **Financial derisking**

Although the cost of rainwater harvesting technology is usually relatively low (except for large scale water harvesting structures like dams of different scales and large collection ponds), construction cost can significantly increase depending on the location. As the technology is suited for not densely

populated remote areas, construction costs are expected to be higher than the market average, and this will require financial investment costs for interested potential users. A potential useful and tested financial scheme that can be implanted could be the one used by the Biogas Sector Partnership program (BSP program) in Nepal for the implementation of domestic biogas plant. The Government of Nepal, through the BSP program, installed domestic biogas plants that use cattle manure to provide biogas for cooking and lighting, in order to address the issue of fuelwood, cattle-dung cakes and agricultural residues for cooking and kerosene for lighting.

Although the technology is different, scale and implementation location are very similar to the one for rainwater harvesting technology. Through the BSP program, the household pays one third of the total cost in kind by providing labor and materials. The remaining two thirds of the cost are paid by the household on a cash payment basis or by contracting a loan, as it is seen as a useful and beneficial long term investment. Moreover, as the cost of the plant varies depending on the location, with additional costs for an installation in remote and hilly areas mainly due to transportation costs, BSP established a subsidy programme by providing higher subsidies to remote areas households. This allowed all households to acquire domestic biogas plants at the same cost no matter where they are located. In order to implement the same scheme for rainwater harvesting technology in Palestine, the government could finance one part of the scheme and call for international financial support for the remaining part. The government also has to implement a favorable environment for local banks to provide loans for such project.

### **Private derisking**

Rainwater harvesting faces barriers related to the risk of water contamination that can lead to severe health issues. Thus, frequent cleaning and maintenance are required. In this context, capacity building, which would explain the importance of conducting frequent maintenance and the merits of using rainwater harvesting system could constitute a mitigation option. The development of capacity building campaigns conducting trainings about the health risks due to water contamination and how to efficiently conduct cisterns maintenance could be a solution.

Palestine will need external assistance in capacity building, while the application of the technology in areas favorable will require negotiation with Israel in Area C. However, by focusing on the area under Palestine's current jurisdiction, the implementation of this technology seems feasible in the short-term.

## **5.2 Water resources monitoring technologies**

Water is one the key components in both the Palestinian economy and the regional geopolitical setting. Moreover, West Bank and Gaza are facing significant and growing shortfalls in the water supply available for domestic use, in principle, as a result of Israeli occupation full control of water resources. It is thus primordial to assure water security in Palestine. This can be done partly by implementing water resources monitoring systems to manage freshwater resources, collect essential information in characterizing the physical, chemical and biological status of water resources, and determine trends and challenges over time. The following risks and barriers have been identified for these technologies.

<b>Type of risk</b>	<b>Type of barrier</b>	<b>Summary</b>	<b>Derisking approach</b>
<b>Public risk</b>	Political	Need to apply for construction and rehabilitation permit	Negotiations
<b>Public risk</b>	Institutional	Lack of clarity on entity with responsibility to implement this technology (governance gap)	Development of detailed regulations
<b>Financial risk</b>	Financial	High construction cost expected in remote areas	Financial schemes
<b>Public risk</b>	Geographical	Limitation in terms of land-use	Negotiations
<b>Private risk</b>	Awareness	Lack of awareness about water contamination risks	Awareness campaigns

Concrete potential measures to derisk the introduction of these technologies are detailed below.

### **Public derisking**

One of the barriers faced by water resources monitoring technologies in Palestine is the absence of control over its own groundwater supply. Water supply falls under the agreements with Israel for groundwater abstraction (internal resources) and imports from Israel for the remaining supply. Thus, Palestine's groundwater supply is fully controlled by Israel. The implementation of water resources monitoring technologies (mainly monitoring for water quality) in Palestinian ground water resources, in particular, for wells located in area C, requires to coordinate and obtain cooperation from Israel, and this can only be mitigated through negotiations with Israel.

The other barrier faced by water resources monitoring technologies in Palestine is the governance gap in the water sector. Each stakeholder's responsibilities remain unclear. Even though the 2014 Water Law establishes the Water Sector Regulatory Council (WSRC) as the entity responsible for water service providers' monitoring and regulation, while local government units are the ones responsible of the water services. However, neither the Palestinian Water Authority (PWA) nor the WSRC has technical or administrative control over the local government units, creating a significant governance gap in the sector. Thus, it is important that the Government implements a more detailed regulation defining each stakeholder's responsibilities concerning the water sector. In addition, and as it is also important that every stakeholders work in collaboration with each other, the government has to create a dialogue enabling environment and framework.

Public derisking can be achieved at low costs.

### **Financial derisking**

The implementation of water resources monitoring technologies requires significant financial resources, for both the technologies themselves and human resources required to analyze collected data, and Palestine has limited financial resources. Although external international support will be required to implement these technologies in Palestine, the Government may also tighten the current monitoring and commercial licensing regime, and make the private sector accountable for the safety of water provided to citizens through the implementation of quality standards and strong regulations. This measure would encourage private sector investment in these technologies as well as securing human resources needed to monitor and analyze collected data.

### **Private derisking**

Although some water resources monitoring technologies are already being implemented in Palestine, they do not work efficiently. Collecting data is only the first step of the monitoring process, and data analysis is also a very important component of the process, primordial to identify policies and measures to enhance water quality. Palestine requires external support for the capacity building of local engineers that are in charge of analyzing collected data, through the organization of trainings for instance.

While financial derisking can mainly be implemented by the Palestinian Government without or with almost no external support, capacity building will require significant external support from donors. Overall, the development of the technology will require lengthy negotiations with Israel for cooperation, which will come in addition to the implementation of detailed regulations and policies. This suggest that water resources monitoring technologies for some areas may be implemented on the long term, while those for areas under full Palestinian control may be implemented on the short term.

## **5.3 Wastewater collection and treatment plants and advanced wastewater treatment technologies**

The Government adopted the Palestinian National Water Strategy from 2013 to 2032, in which the

importance of wastewater management and treatment is emphasized in the national policy, especially access to water and wastewater services, and sustainable wastewater management. The following risks and barriers have been identified for this technology.

Type of risk	Type of barrier	Summary	Derisking approach
<b>Financial risk</b>	Financial	Lack of financial resources	Financial schemes
<b>Public risk</b>	Geographical	Lack of land space	Negotiations
<b>Public risk</b>	Institutional	Governance gap in the water sector making it unclear which entities is responsible for what	Development of detailed regulations
<b>Private risk</b>	Access to energy	Lack of electricity and fuel for the proper working of the technology	Develop internal energy sources
<b>Private risk</b>	Technical	Lack of adequately trained human resources	Capacity building

Concrete potential measures to derisk the introduction of these technologies are detailed below.

### **Financial derisking**

The Palestinian Government adopted the Palestinian National Water Strategy, which suggests that the Government would be willing to invest in wastewater collection and treatment plants. However, the technology itself remains relatively expensive. In most of the countries, wastewater collection and treatment plants are funded by urban utilities or municipalities using tariff revenues and supplemented by local taxation. But as stakeholders lack financial means in Palestine, the Government could consider to finance it partly or fully from pollution charges according to the Polluter Pays Principle. This financial schemes for wastewater treatment plant is common in some Central and Eastern European countries, where revenues from pollution charges are earmarked for spending on anti-pollution purposes.

### **Public derisking**

Although the Palestinian Government was able to obtain written consent from Israeli occupation authorities to allow Palestinian Government to import all related equipment needed for the implementation of wastewater treatment plants, and confirmation that Israeli Military Forces would not threaten this type of project, the issue related to land availability still remains. Further regional dialogue and collaboration with Israel through frequent meetings and negotiations is the option available.

There is a multitude of governmental and non-governmental institutions that are involved in the Palestinian water sector, which leads to significant institutional fragmentation and a lack of coordination between the different stakeholders in the wastewater collection sector. The roles and responsibilities of each institution regarding the treatment and reuse of wastewater is unclear. The implementation of a clear regulation on wastewater treatment defining each stakeholder's roles and responsibilities is extremely important.

### **Private derisking**

Since 2008 Gaza conflict and the embargo on Gaza by Israel, the four existing wastewater treatment plants in Gaza are operating discontinuously, mainly due to the lack of electricity and fuel. One option to allow the proper working of this technology could be to partly, or fully if possible, power the wastewater treatment plant with independent renewable energy sources such as solar power (the solar power plant would power the wastewater plant directly without being grid-connected). As the Palestinian Government was able to obtain written consent from Israeli Authorities to allow the Palestinian Government to import all related equipment needed for the implementation of wastewater treatment plants, this seems feasible for the implementation of future wastewater treatment plants. Another option for Palestine would be to continue the negotiations with Israel in order to have access to enough electricity to power the wastewater treatment plants.

Moreover, for both wastewater collection and wastewater treatment plants, Palestine is facing a lack of adequately trained human resources. Very often, when implementing this kind of project, only investment and implementation costs are considered, excluding technical staff training. Wastewater plants require technical knowledge related to maintenance, which if not conducted appropriately results on unsustainable and not properly working systems for both wastewater collection and treatment plants.

Capacity building to related stakeholders is thus crucial for this. Technical assistance may include maintenance, as well as modules related to quality control.

In the case Palestine chooses the polluter pays principle, financial derisking can mainly be implemented by the Palestinian Government without or with almost no external support. While capacity building may require external support from donors, this can be done at relatively low-costs.

Additionally, the Palestinian Government was able to obtain written consent from Israeli Authorities to allow the Palestinian Government to import all related equipment needed for the implementation of wastewater treatment plants, and confirmation that Israeli Military Forces would not threaten this type of projects. Therefore, the implementation of this technology seems feasible on the short-term.

## 6. Transport sector

The following technologies for the transport sector have been prioritized.

- Upgrade of the existing vehicle fleet
- Public transport (modal shift)
- Flood prevention

### 6.1 Upgrade of the existing vehicle fleet

Upgrading a large number of the existing vehicle fleet to newer and environment friendly models and introducing hybrid/electric cars appears to be one of the potential solutions to tackle the pollution issue and a way for Palestine to keep up with the world's eco-friendly approach regarding transport. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
<b>Public risk / Private risk</b>	Infrastructure	Introduction of EVs at a large scale requires the implementation of infrastructure specific to hybrid/electric cars	Development of new power infrastructure, negotiations with Israel for more electricity supply
<b>Financial risk</b>	Financial	Meeting infrastructure requirements will require significant investments	External resources
<b>Public risk</b>	Geographical	Limitations in terms of land-use	Negotiations
<b>Private risk</b>	Informational	Insufficient information related to the technology and general issue on climate change	Awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

The upgrade of the existing vehicle fleet through the diffusion of new efficient vehicles and EVs will require significant public derisking in order to overcome the barriers identified. The first barrier identified requiring public intervention is the lack of infrastructure directly to EVs and the degradation of roads. The introduction of EVs at a large scale requires the implementation of infrastructure specific to hybrid/electric cars, including EV charging stations and power networks. Although pilot charging stations have been installed recently by some private companies, there is currently no charging stations effectively covering the whole country.

Charging stations will also have to be connected to power sources. For EVs to make sense, in terms of GHG emission reduction, these power sources have to mainly be clean, renewable energies. However, the majority of electricity is still being imported from Israel and relies on fossil fuels. The installation of renewable energy connected to the grid is not a foreseeable option in the near future, as IEC still holds its ownership and has high requirements for its stability.

One solution to provide the required infrastructure would be to install mini-grids or off-grid generation for EVs in Palestine. However, this option is also constrained by land limitations, which have to be negotiated with Israel, and significant investment costs. These constraints considerably impact the feasibility of these measures on the short term.

In an independence scenario, where Palestine would own the transmission grid and would be able to integrate renewable energy unconditionally, building new infrastructure for EVs would allow to pave the way to upgrade the fleet with EVs. In the meantime, the number and scale of charging stations may have to remain limited.

**Financial derisking**

As mentioned above, the development of the infrastructure required for EVs, such as charging stations, will require significant investments mainly from the private sector. Given the scope of these investments, Palestine may have to rely on external support and explore the possibility of public private partnerships for the management of charging stations.

**Private derisking**

Awareness is insufficient in relation to the technology and its benefits. There is a lack of information on the impact of conventional transportation on GHG emissions and climate change as well. Providing access to these information to end users will significantly support the shift in behavior and adoption of this technology. This may be done through the development of awareness campaigns.

Palestine will require external support for the development of infrastructure and financing. One major barrier, which may only be overcome by negotiating or obtaining independence on grid management / upgrading, is the integration of renewable energy to the grid and its connection to charging stations. This suggests that this technology may be more adapted for a long-term perspective.

**6.2 Public transportation (modal shift)**

Palestine needs to shift from its current private vehicle heavy modality of transportation to more efficient public transportation system. This will result in significant benefits including the reduction of amounts of vehicles plying the roads and hence reducing traffic congestion, better connectivity between cities contributing to economic development, and reduction in greenhouse gas emissions and other harmful air pollutants. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Financial risk	Financial	Facilities and infrastructure requirements will require significant investments	External resources
Private risk	Informational	Insufficient information related to the technology and general issue on climate change	Awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

**Financial derisking**

The development of the necessary facilities and infrastructure required to implement public transportation services will require significant investments. This will also include the development of relevant policies and strategies to promote the development of public transportation in Palestine. Given the scope of these investments, Palestine may have to rely on external support to develop its public transportation system.

**Private derisking**

Information pertaining to the benefits in patronizing public means of transportation, its economic and social benefits, as well as information on the impact of the existing modality of transportation on GHG emissions and climate change, needs to be effectively disseminated to the general public. This may be done through the development of awareness campaigns.

Palestine will require external support to develop its transport infrastructure and facilities to enhance its public transportation services and encourage shift in behavior to utilize public transport instead of using private vehicles.

### 6.3 Flood prevention

Palestinians, especially those who live in the Gaza Strip, live with the threat of temporary displacement, property losses and health risks due to the flooding risk in winter. Nowadays, several technologies exist to prevent flooding. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Political	Restrictions on the import of materials in Gaza, upgrade or renovation work in areas B and C in the West Bank	Negotiations
Financial risk	Financial	Meeting infrastructure requirements will require significant investments	External resources

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

The development of flood prevention measures will require significant public derisking in order to overcome barriers identified. Gaza experiences more floods and is in need of flood prevention infrastructure. However, there are significant restrictions on the import of materials in Gaza by Israel, which undermine the development of these projects. Overcoming this barrier will require negotiations between Palestine and Israel to allow the introduction of materials in Gaza. In the West Bank, approval is required to perform any renovation or upgrade in Area C. This will also require negotiations between Palestine and Israel.

#### **Financial derisking**

Sustainable flood prevention technologies are relatively expensive as they involve significant infrastructure construction works. Given the scope of these investments, in addition to minimal opportunities for the private sector involvement, Palestine may have to rely on external support for these projects.

Palestine will require external support for the financing of infrastructure. One major barrier, which may only be overcome by negotiation, is to obtain less strict importation rules for materials in Gaza. This suggests that implementing this technology in Palestine in areas where it is most needed may be conditional to a number of long term factors.

## 7. Solid waste sector

The following technologies for the solid waste sector have been prioritized.

- Waste sorting
- Composting
- Recycling

### 7.1 Waste sorting

Palestine would greatly benefit from improving its solid waste sorting practices as about 50 to 55 percent are comprised of organic waste while the rest can be recycled. Having an effective and environmentally safe management of solid waste will allow for other waste handling alternative options such as recycling and composting technologies become financially viable. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Regulatory	No regulations and policies which promote and enforce sorting of solid waste either from the household level or central/communal level.	Development of regulations and policies
Public risk	Institutional	Ambiguity in roles and responsibilities resulting in overlap in efforts due to variations in interpretations of responsibilities of relevant institutions	Clarification of roles and responsibilities
Public risk	Technical	The effective separation of useful materials from unsorted waste is perceived as difficult	Technology transfer and awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

Improving waste sorting practices will require a number of public derisking strategies. As there are no regulations requiring the sorting of solid waste either at the household level or central/communal level, it will be crucial for Palestine to develop a regulation detailing waste sorting responsibilities. Regulations can often kick-habits, especially if they are matched with other measures, such as incentives for waste sorting or penalties for not sorting the waste.

It will also be important to clarify roles and responsibilities for waste sorting, as roles and responsibilities of each organization may overlap in efforts in the current environment. Clear roles and responsibilities will enable relevant organizations, such as Joint Service Councils and Local Government Units, among others, to take ownership in solid waste management.

Finally, the main barrier to effectively separate useful materials from unsorted waste is the lack of an efficient waste sorting methodologies and technologies in the country, and its associated financial capacities. In order to achieve this, the Government can aim to transfer methodologies adopted in other countries for waste-sorting such as those promoted by the Nationally Appropriate Mitigation Actions (NAMA) on circular economy solid waste management approach for urban areas in Kenya. Technology

transfers can be encouraged by the development of pilots or demonstration projects in the country.

However, technology and methodologies can only be transferred when roles and responsibilities are clarified and when regulations concerning waste sorting are drafted, as these will influence which organization should take ownership of the technology.

Palestine may require support from international partners for technology transfer and the development of pilots. This technology does not require negotiations with Israel, which suggests that it is relatively easy to implement.

## 7.2 Composting

Composting effectively reduces the overall waste volume that ends up in landfills. As waste material required for the production of compost is organic, this consequently reduces the decomposition of organic waste in landfills thereby reducing greenhouse gas emissions. At the same time, the final product, compost, are valuable inputs to the soil and serves as soil conditioner and/or fertilizer providing nutrients for agricultural products. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Regulatory	Lack of regulations to enforce standards established for composting	Development of regulations
Public risk	Technical	Technical expertise and know-how specific to composting is required to ensure its quality	Capacity building

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

Similar to the derisking strategies required for recycling and waste sorting, composting requires regulations which will support its implementation. Composting requires adequate separation of compostable materials from the non-compostable fraction in the municipal solid waste stream. The first set of regulations should target waste sorting, which will allow to effectively target organic waste to process it into compost. Specific to composting, regulations need to be developed to enforce the standards set by the Palestine Standards Institution on composting in Palestine.

As the technology for composting already exists in Palestine, it is more important to focus on capacity building, as controlling the quality of compost is complex and as marketability of the compost is directly influenced by its quality. Focusing on improving compost quality through capacity building will enable improved market share and prices for compost in the country.

Palestine may require support from international partners for capacity building on the quality of compost. This technology does not require negotiations with Israel, which suggests that it is relatively easy to implement, if land can be secured.

## 7.3 Recycling

There are existing recycling facilities in Palestine. However, these are mainly small in scale, have limited capacities and caters to specific waste categories such as paper and plastic. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Regulatory	Current legislations governing the solid waste management sector lack comprehensiveness in addressing solid waste management issues from a modern perspective, including its efficient enforcement	Development of regulations and enforcement
Public risk	Technical	Lack of technical expertise and know-how on recycling technologies	Capacity building
Private risk	Social	Lack of acceptance of recycled material by end-users	Awareness campaigns and capacity building

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

The strategy of solid waste management 2017-2022 covers elements which are required for an efficient legal framework. However, there is a lack of regulations detailing how the legal framework will be implemented. Developing detailed regulations related to solid waste management will enable to clarify roles and responsibilities as well as income streams for the organizations responsible for solid waste management. This includes recycling of waste. There is also a need to develop standards for the various stages of solid waste management such as those for recycling operations.

Detailed regulations will clarify which organization should be in charge of recycling, and could also set the enabling environment for the development of recycling plants by the private sector. The pre-enabling condition for recycling is to make sure that the sorting of solid waste is implemented. As there are no regulations which require the sorting of solid waste either at the household level or at the central/communal level, it will be extremely important to develop these regulations.

Regulations will also need to take into account requirements of external markets for recyclable material. Although some material, such as paper or plastic, might be recycled in Palestine, others may need to be sent to external markets, such as in Jordan, where standards for recyclable material exists. It will be crucial to align with those existing international regulations in order to be able to sell waste to these markets.

Finally, there is a need to enhance the technical know-how for recycling technologies to be mainstreamed and for the country's recycling industry to develop. This will enable the industry to develop in the country.

### **Private derisking**

End-users are usually not familiar with recycled material and use of recycled material. In addition, companies often do not have value chains that integrate or is able to integrate recycled material. This leads to a lack of local market availability for recycled material in Palestine. Awareness campaigns and capacity building will be required to ensure stakeholders understand the benefit and the need of this technology, as well as to develop value chains that integrate recycled material.

Palestine has already received support from JICA on solid waste management. The development of regulations and capacity building will require additional support from other international partners. If land can be secured, the technology could be implemented quickly. Private derisking may be implemented by Palestine with almost no external support. However, Palestine may need support to develop value chains

integrating recycled material.

## 8. Other technologies

Other technologies not belonging to certain specific sector has also been identified for prioritization. The following technologies have been prioritized.

- Provision of beach nourishment, reclamation and beach drift rehabilitation
- Development of water, food and sanitation monitoring and safety systems using high technology related to health
- Low-carbon cold chain

### 8.1 Provision of beach nourishment, reclamation and beach drift rehabilitation

The provision of beach nourishment, reclamation and beach drift rehabilitation has been identified as a national priority due to the high vulnerability of Palestine’s coastlines to the impacts of climate change. The following risks and barriers have been identified for this sector.

Type of risk	Type of barrier	Summary	Derisking approach
Public risk	Institutional	Need to have coordinated efforts among the responsible institutions, as well as identify which government institution would take the lead	Designation of roles and responsibilities
Private risk	Access to materials	Restrictions on importing materials	External support and negotiations
Financial risk	Financial	Requires significant investments	External support
Private risk	Informational	Insufficient information related to the technology and general issue on climate change	Awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

#### **Public derisking**

The introduction of beach nourishment, reclamation and beach drift rehabilitation technologies require the coordinated efforts among all government stakeholders from the local level to the national level. This public risk may be overcome through the clarification and designation of roles and responsibilities among all concerned government institutions, as well as designating the appropriate government institution to take the lead on handling matters concerning coastal erosion management in Palestine.

#### **Private derisking**

The import of materials related to beach nourishment, reclamation and beach drift rehabilitation such as sand, rocks, cement and steel are restricted by Israel. This may be overcome through the support of the international community as there were previous instances wherein international organizations involved in implementing and managing projects requiring importing such materials, were given exceptions. In general, international solidarity and agreement with Israel will be required.

Coastal erosion management also face a barrier with the lack of awareness of the general public,

especially stakeholders of coastal areas in Gaza on the condition of beaches. Awareness campaigns will be crucial in disseminating this information to the public.

### **Financial derisking**

The implementation of beach nourishment, reclamation and beach drift rehabilitation technologies require significant investments, both in terms of construction costs, as well as costs associated with the provision of technical assistance. External resources will most likely be the main source of financing for the deployment of this technology.

Overall, the development of beach nourishment, reclamation and beach drift rehabilitation technologies will require significant external support from donors. This applies not only in terms of providing financial resources, but also direct involvement in implementation and management, to potentially alleviate the barrier on access to materials.

## **8.2 Development of water, food and sanitation monitoring and safety systems using high technology related to health**

The development of water, food and sanitation monitoring and safety systems using advanced, high-end technology is essential in ensuring the health and well-being of the Palestinian population. Such monitoring and safety systems will help reduce the country's vulnerability to major diseases related to water, food and sanitation. The following risks and barriers have been identified for this sector.

<b>Type of risk</b>	<b>Type of barrier</b>	<b>Summary</b>	<b>Derisking approach</b>
<b>Public risk</b>	Technical	Monitoring and safety systems relevant to the Palestinian context need to be identified	Technology transfers
<b>Public risk</b>	Capacity	Capacities of stakeholders need to be strengthened for the identification and use of systems	Capacity building
<b>Private risk</b>	Awareness	Lack of adequate information about disease prevention in resource scarcity situations	Awareness campaigns
<b>Financial risk</b>	Financial	Introducing the technology requires significant investments	External support

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

The introduction of water, food and sanitation monitoring and safety systems using advanced technology related to health faces a number of barriers which can be identified as public risks. The most important is to identify a system which is relevant to the Palestinian context.

The use of these systems, including the identification of relevant information, correct input and data credibility and analysis, among others, is also another major barrier. This barrier may be overcome by proposing capacity building interventions to the organizations which will manage the system.

### **Private derisking**

Monitoring and safety systems also faces a number of barriers related to the lack of information provided

to end-users, who are not aware of the measures they should take at their level in case there is scarcity of food and water, for example. Awareness campaigns, coupled with the development of such systems, will be crucial in order to ensure their efficiency.

### **Financial derisking**

Monitoring and safety systems bear significant costs. At this stage, this is not a technology which can be monetized by the private sector in Palestine, for example by providing information bulletin and others. To introduce the technology, Palestine will therefore have to rely on external support.

Palestine may require support from international partners for technology transfer and capacity building related to the management of such systems, as well as for financing. It is important to emphasize that technologies require significant capacity building and system requirements, which are prerequisites in implementing the technology.

## **8.2 Low-carbon cold chain**

The impacts of climate change such as rising temperatures and more extreme weather events may increase post-harvest losses due to increased likelihood of spoilage and increased risk of pathogen or pest infestation. Conventional measures have been taken to address such losses such as increasing cooling and improving storage capacities. However, these measures translate into higher costs. There is a need to introduce lower-cost, low-carbon solution through cold chain technologies to improve food security and reduce GHG emissions. The following risks and barriers have been identified for this sector.

<b>Type of risk</b>	<b>Type of barrier</b>	<b>Summary</b>	<b>Derisking approach</b>
<b>Public risk</b>	Political	Importing restrictions may entail additional challenges in introducing the technology into Palestine	Negotiations
<b>Public risk</b>	Regulatory	Patents need to be protected in Palestine	Development of regulations
<b>Private risk</b>	Awareness	Lack of adequate information about potential cold chain technologies	Awareness campaigns

Concrete potential measures to derisk the introduction of the technology are detailed below.

### **Public derisking**

The introduction of low-carbon cold chain technologies are driven by private sector technology providers, both on the supply and demand side. The private sector will require clear guarantees that the technology can be imported.

Additionally, low-carbon cold chain technologies involve patented high-end technologies. Providers of such technologies usually make sure that the technology will be protected from theft in recipient countries. This involves legal protections for their patents. The development of such regulations in Palestine would constitute a guarantee for technology providers and could de-risk the technology.

### **Private derisking**

Low-carbon cold chain technologies also faces a number of barriers related to the lack of information provided to end-users, who are not aware of new developments in cold chain technologies. Awareness campaigns, which would explain the merits of low-carbon cold chain technologies, especially in terms

of cost savings could constitute a mitigation option.

The technology requires significant derisking for the private sector to get involved. It is not clear whether Palestine can ensure that patents are protected under its current legal system, which might discourage technology providers, until this becomes possible.

## **9. Common measures identified**

Although a number of derisking measures are specific to their technologies, there are several common measures which have been identified in this report and could therefore be implemented for several technologies.

For example, a main derisking measure is securing land and building permits. Some of the measures proposed involve negotiations with Israel occupation authorities in order to secure those. This would enable Palestine to implement a number of projects requiring land, such as in the transportation, water, energy and waste sectors.

Another significant common derisking measure is the provision of financial schemes to derisk a technology. This type of derisking can be divided between securing financing for public projects and projects aiming at private sector engagement. For public projects, measures mainly involve seeking external support, for example from climate finance sources mostly through grants.

For private sector led projects, financial derisking measures mainly involves the provision of subsidies, but also financial schemes which aim at facilitating the acquisition of new technologies. For example, some measures include the leasing of equipment to reduce initial investment costs or blended finance, in order to decrease interest rates at final user level.

Finally, other major common derisking measures include the development of regulations. Although Palestine has developed policies for all sectors, there are often few detailed regulations. It is important to develop those in order to operationalize policies as well as clarify roles and responsibilities.

## **10. Conclusion and recommendations**

This report identified potential measures for derisking the technologies in the long list. The set of measures will be more or less complex to implement depending on the technologies. Additionally, some technologies may require the full set of proposed measures to be attractive, while others may be able to take-up with partial derisking measures. Technologies with less complex sets of derisking measures may be implemented faster.

The complexity of the set of derisking measures has been assessed within this report and will guide the prioritization as well as the development of the technology roadmap.

## Annex 1 – list of prioritized technologies

Sector	Technology
Energy	1. National grid assessment and electricity grid upgrade
	2. Various applications of solar PV technologies
	3. Energy efficiency
	4. Solar water heating
Agriculture	1. Climate smart agriculture (precision agriculture)
	2. Efficient irrigation
	3. Resilient animal fodder
	4. Conservation agriculture
	5. Water harvesting
Water and wastewater	1. Rainwater harvesting
	2. Water resources monitoring technologies
	3. Wastewater collection and treatment plants and advanced wastewater treatment technologies
Transportation	1. Upgrade of the existing vehicle fleet
	2. Public transportation (modal shift)
Solid waste	1. Waste sorting
	2. Composting
	3. Recycling
Others	1. Provision of beach nourishment, reclamation and beach drift rehabilitation
	2. Development of water, food and sanitation monitoring and safety systems using high technology related to health

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