5.2 Foster the continued growth of renewable power generation

The power sector in Jordan has seen rapid uptake of renewable energy facilitated by enabling policies and regulations. Utility-scale projects have advanced through subsequent rounds of direct proposals, and substantial capacity is being deployed under the wheeling and net metering scheme, which is focused on the self-consumption of various end-consumers such as industries, commercial enterprises, public buildings and households. The impressive growth since the enactment of Renewable Energy and Energy Efficiency Law No. 13 of 2012 has highlighted the scale of opportunity in Jordan, with access to low-cost electricity from renewable energy as well as challenges related to integration.

Advancing further renewables growth in the power sector will require wide-ranging actions that focus on expanding the pipeline of projects under the various schemes with a focus on effective integration, as well as on addressing project development challenges and linkages to energy efficiency.

Action 2: expand the project pipeline through direct proposal, net metering and wheeling schemes

The current pipeline of utility-scale projects under the direct proposal scheme provides an outlook to 2021. The latest (third) round of the direct proposal auction took place in 2018, achieving record-low prices for solar PV (USD 0.0255/kWh); however, these are not reflected in the electricity mix yet. The realised prices for new solar are substantially lower than the average cost of electricity procured by NEPCO. Since the third round, there have been no further rounds. This is a result of several factors, including reduced power demand growth and excess capacity in Jordan's power sector. Under the right conditions, subsequent rounds of direct proposals could establish a pipeline of low-cost electricity from renewable resources, which could contribute to decreasing bulk supply costs in the long-term and positively impact electricity tariffs while also shoring up power demand.

Given the apparent limitations on the grid for integrating renewables and the oversupply in the power sector, a holistic approach may be needed to accommodate further renewables covering integration measures (e.g., storage, network upgradation), demand generation (e.g., electrification of end-uses) and energy efficiency. For instance, combining storage with on-site generation can help address variability and grid management issues for projects developed to cater to specific demands (e.g., industrial parks). Existing (e.g., in Qastal, Madaba and Sahab) and future industrial zones (e.g., between Jordan and Iraq) could pursue dedicated wheeling projects coupled with storage, building on the model followed for the Ma'an Development Area. For industry-specific wheeling projects, a key challenge is to ensure that the available grid capacity is equally accessible for all, including SMEs, non-energy entities (e.g., water utilities) and those most vulnerable due to the high cost of energy supply.

With significant annual electricity subsidies for agriculture, low-income households and SMEs, cost-effective distributed renewable energy solutions could represent a win-win solution for consumers and governments. Rooftop solar has substantial untapped potential in public buildings, including government offices, mosques, hospitals, commercial entities and residences. Government programmes have also been launched to deploy rooftop solar PV systems for small residential consumers currently under national welfare schemes. Such programmes should be scaled up to increase social impact, reduce consumer energy expenditure and limit government subsidy costs. The electricity tariff design and charges (e.g., wheeling rates) for renewable energy projects should accurately reflect the true cost of the services delivered by the network.

Recommended actions:

- Implement subsequent rounds of direct proposals to develop a long-term renewable energy project pipeline, and reduce bulk power costs and tariffs for end-consumers. Subsequent rounds will be conditional upon an increase in electricity demand and the availability of grid capacity for large-scale projects.

- Support the development of dedicated areas for new wheeling projects for large consumers, building on the model of the 100 MW community solar PV for the industrial sector. Ensure available capacity on the grid is equally accessible, including for SMEs and those most vulnerable to the high cost of energy.

16 Annual electricity tariff subsidies for the agriculture sector amount to JOD 40 million, while those for small-scale industries are JOD 29 million and medium-sized industries are around JOD 50 million (Jordan Times, 2020b).

- Support the development of small-scale renewable energy projects to maximise social impact and reduce energy expenditure.

- Design renewable energy projects with a focus on effective grid integration through hybrid solutions (e.g., solar-storage, solar-wind) building on lessons from existing storage projects in Jordan. IRENA finds that renewable energy hybrid projects have higher capacity utilisation factors and make more use of the grid, thereby reducing grid integration costs. In 2018, India's Ministry of New and Renewable Energy issued a National Wind-Solar Hybrid Policy that sought to optimise the utilisation of infrastructure and better match the generation of renewable energy with the demand profile. Not only was the project able to meet a capacity factor of 30%, the bids received for the nationwide auction were as low as USD 38.7/MWh (IRENA, 2019a).[17]

- Activate existing bylaws and instructions for the adoption of rooftop solar PV and energy efficiency solutions in government buildings through a combination of incentives and enforcement. In this regard, address the challenge of outstanding bills to distribution companies that inhibits government buildings from connecting rooftop solar PV to the grid through tailored repayment schemes or public financing outlay.

- Assess and support renewable energy other than solar PV and wind, including geothermal and waste-to-energy for municipalities, as well as applications across sectors (e.g., replacement of diesel pumps for irrigation, water supply pumping systems).

Action 3: Address project development challenges

Lengthy approval processes and project development timelines increase developers' transaction costs and risks. These affect utility-scale and small-scale projects differently. The time between an expression of interest and project commissioning can be several years, and efforts are needed to establish a fixed milestone-based timeframe. For renewable energy projects where interaction with distribution companies is required, it is important that EMRC ensures the processes are streamlined across the companies and simplified for small and zero feed-in systems.

For utility-scale projects, land acquisition can be a challenge for developers. Standardising land acquisition processes by pre-developing sites – such as the Ma'an Development Area and Mafraq Development Area for utility-scale solar PV projects – including the development of grid interconnection infrastructure, conduct of sector-specific environmental and social impact assessment (e.g., bird migration studies in the case of wind) and completion of land acquisition, can level the playing field for the private sector participating in future tender processes. At present, the private sector integrates perceived land acquisition costs into their bids, which may affect fair competition.

A key challenge for the development of net metering projects is the waiting period for applications and subsequent smart-meter installations. Applications for the development of projects are submitted to the distribution companies, which then undertake a review and conduct the requisite technical and grid impact studies. Waiting periods for applications, GIS and smart metering installations can be time-intensive (up to three months) even for smaller projects (e.g., 10 kW). Distribution companies are faced with high loads of applications, having approved over 15 300 applications by the end of 2019. Developers could potentially bring in third-party studies; however, there are several challenges to this such as lack of data and software availability with third parties and a trust issue wherein studies conducted by the distribution companies are preferred.

Recommended actions:

- Consider the use of online platforms for project developers of net metering and wheeling projects to complete all necessary processes. Simplified processes and a separate grid code may be designed for small and zero feed-in systems.

- Introduce a clear plan to reduce the waiting period for applications and smart metering installation. Consider augmenting in-house capacity within distribution companies to undertake GIS and reduce time for processing.

- Improve access to outcomes from grid impact studies and consider conditional approvals for projects based on certain pre-requisites (e.g., integration of storage, control systems).

17 In May 2020, a record-low bid of INR (Indian rupee) 2.9 per kWh (USD 0.038 per kWh) for the first year (with 3% escalation each year) was received for 400 MW of "round-the-clock" supply through wind, solar or hybrid solutions with storage: www.rechargenews.com/transition/india-hails-renewable-milestone-after-first-deal-for-24-7-green-power/2-1-806047.

- Separate city planning requirements from the process of securing a connection to the distribution grid for small-scale renewable energy projects.

- Engage local communities around project sites to maximise social impact. In this context, IRENA's Renewable energy auctions: Status and trends beyond price (IRENA, 2019a) finds that community involvement can increase social acceptance and minimise land acquisition processes. In South Africa, project developers are required to submit evidence to support community engagement and benefit sharing guideline that includes a social risk analysis, a community engagement strategy, a benefit sharing program, and letters of support as well as reporting, monitoring and evaluation plans (IRENA, 2019a).

- Develop and issue instructions for land use for renewable energy projects. For utility-scale and wheeling projects, pre-developing sites and allowing entities like the Ma'an Development Authority to provide infrastructure management can level the playing field for the private sector participating in the auction process.

Action 4: Strengthen linkages to energy efficiency

Renewable energy and energy efficiency should be pursued in tandem. The Energy Efficiency Bylaw No. (73) for the year 2012 and the NEEAPs have provided the foundations for advancing energy efficiency measures in the Kingdom. Some linkages between renewable energy and energy efficiency were made by design, with the Energy Efficiency Bylaw No. (73) making compulsory the instalment of solar water heaters from April 2013 on pre-specified buildings. Enforcement, however, has been a key challenge, as discussed further in Chapter 5, Section 3.

Bylaw No. (73) also mandates energy audits for all large consumers. The JREEEF and JCI have targeted financing programmes for energy audits; however, the penetration has been limited. A key challenge has been that the bylaw outlines that MEMR bear responsibility for reviewing the audits, but MEMR has limited capacity to review thousands of energy audits annually. Shifting this responsibility to entities with sufficient capacity, such as JISM, may be considered.

For buildings, the building codes issued by the National Building Council need to be enforced. The JGBG was issued in 2013, with an incentive programme for the adoption of green buildings being approved in 2015. Meeting Level D of the JGBG is equivalent to abiding by all the codes. Despite Jordan's comprehensive energy efficiency framework, challenges of enforcement remain to be addressed.

Large-scale improvements in efficiency across the energy sector and the wider economy directly impact primary energy needs, thereby directly reducing the need for fuel imports. In power generation, for instance, combined heat and power applications can drastically improve efficiencies and offer cost-effective energy alternatives, especially in industries where both electric and thermal energy is consumed. Pilot projects already exist, such as in Wadi Shalala in Irbid. However, dedicated regulations are missing to scale up the adoption of such solutions.

On the consumption side, progress has been made on energy efficiency through dedicated programmes to deploy LED street lighting in municipalities and replacement of inefficient lighting in households. The Ministry of Public Works and Housing, which is responsible for all government buildings, has also rolled out an energy audit and energy efficiency programme. Benefiting from the experience, energy efficiency programmes can be substantially scaled up with substantial cost-saving opportunities for end-users, especially government buildings.

Recommended actions:

- Improve compliance of industry, commercial and public buildings, as well as households, with existing codes and the Energy Efficiency Bylaw. This can be achieved through a combination of well-designed strict penalties and incentives devised by MEMR.

- Ensure effective implementation of the NEEAP 2018-2020 and reporting on periodic basis while also working towards issuing the update to the NEEAP beyond 2020.

- Incentivise compliance with JGBG in Jordan's building sector. Support thermal insulation inspection for new construction in co ordination with the UNDP's ongoing programme in Jordan.

- Improve compliance with energy audit requirements for large industry consumers. MEMR should ensure that multiple licensed and specialised entities are available to specific industries to undertake the audits.

- Develop capacity within the industrial sector to implement energy efficiency (and renewable energy) measures. Based on findings from energy audits, consider development of industry-specific benchmarks and best practices.

- Encourage the adoption of energy-efficient equipment in industries with due consideration for their market competitiveness.
- Scale up the adoption of energy-efficient streetlights and replacement of inefficient residential lighting, building on the programmes being undertaken by municipalities and MEMR.
- Introduce dedicated regulations and codes for combined heat and power applications that can substantially increase energy efficiency by building on existing pilot projects. A dedicated heat law would enable NEPCO to sell heat as a commodity as with electricity, thus equipping itself with the ability to supply industrial areas with electricity and heat through combined heat and power.

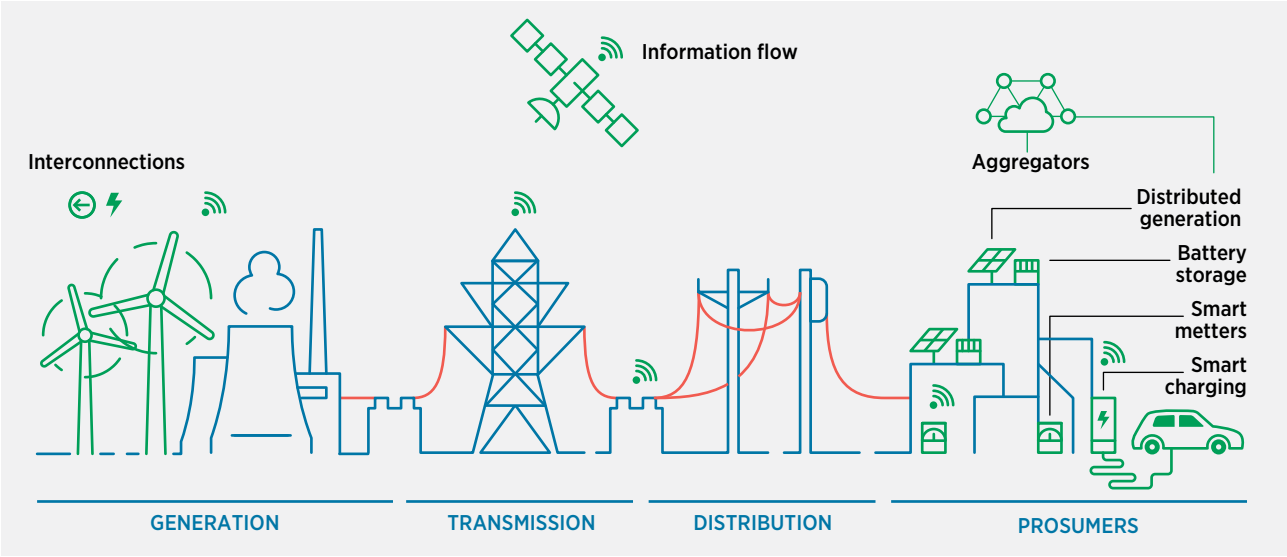
5.3 Plan for the integration of higher shares of renewable power

The share of electricity from renewables in Jordan's power mix has grown rapidly over the past decade. Concerns have emerged over the ability of the power system to integrate renewable shares well beyond 25%, resulting in the suspension of new projects over 1 MW and no additional direct proposal rounds since 2018. The integration challenge is further exacerbated by slow electricity demand growth and the nature of "take or pay" PPAs with conventional IPPs, resulting in capacity charges and adding to integration costs.

Addressing the integration challenge will require a wide range of actions to improve overall system flexibility in the short-, medium- and long-term. In Jordan's context, these include building and upgrading transmission and distribution infrastructure, deploying battery and pumped-hydro storage, promoting demand-side management, and incentivising electrification of end-uses. These measures cannot be pursed in silos and must form part of a holistic strategy to improve the flexibility of the power system to integrate higher shares of renewables. Several tools are now available to analyse the flexibility needs of a power system (e.g., IRENA's FlexTool) and identify the least-cost flexibility solutions and integrate within the strategy.

The integration challenge requires a wide range of actions to improve system flexibility. These include building and upgrading transmission and distribution infrastructure, battery and pumped-hydro storage, promoting demand-side management, and incentivising electrification of end-uses.

Figure 18. **Innovative solutions in power system**



Source: IRENA (2019c)

Action 5: Strengthen national transmission and distribution infrastructure

The lack of transmission and distribution infrastructure capacity to handle higher shares of renewables is a key hurdle to further growth. Strengthening networks involves the development of dedicated transmission corridors between areas with high concentrations of renewable energy projects and load centres, upgrades to existing distribution infrastructure to accommodate higher shares, as well as improvements in grid management to reduce losses and enable active load management.

As seen in the case of the yet-to-be-commissioned Green Corridor project for transmission of renewable power from the south of the Kingdom, the development timeframe for such infrastructure is long (usually five to six years). Therefore, long-term planning is needed to align the timelines of infrastructure development with those of new utility-scale projects and load centres (e.g., industrial zones) to ensure power is evacuated in a timely way. With the Kingdom faced with sluggish demand growth and high capacity factors, measures for demand creation and enhancement of regional electricity trade – building on existing agreements with Egypt, State of Palestine and Saudi Arabia – will also be crucial. The majority of the net metering and wheeling projects connect to the distribution grid, large parts of which are congested. Strengthening distribution networks, coupling generation with storage and adopting digital technologies (e.g., smart meters, supervisory control and data acquisition [SCADA] systems) can support integration of higher shares of renewables. These measures can also allow effective load management, which is necessary with large-scale electrification of end-use sectors such as transport.

Recommended actions:

- Upgrade the transmission network and system management to manage future increases in the share of renewable energy and electrification of end-uses. Other ministries related to industry, agriculture, transport and water are crucial for identifying regions with existing and upcoming power demand potential.

- Expedite the commissioning of the Green Corridor for transmission of renewable power generation from the south of the Kingdom. Greater focus is needed on transmission infrastructure requirements in the east for future renewable energy projects.

- Continue to focus on regional infrastructure development to facilitate electricity trade, building on recently signed agreements with Egypt, State of Palestine, Saudi Arabia and Lebanon.

- Identify priority areas within the distribution network – especially in industrial zones – with high congestion, in the short-term. Mobilise investments to strengthen infrastructure and unlock further network capacity to integrate renewables and other loads such as from electric vehicle charging stations.

- Increase the rate of penetration of smart meters to improve grid management, building on the successes of distribution companies such as IDECO.

- Upgrade NEPCO control centre and, building on rollout of smart meters, issue regulations and bylaws for smart grid implementation. These measure should be led by EMRC, in consultation with NEPCO and the distribution companies, to improve grid monitoring and maintenance and thereby to reduce losses and downtime.

- Develop a strategy for data and knowledge management to leverage data emerging from smart meter rollout and better understand consumption. Such data form the bedrock for the implementation of smart grids and facilitates reaping the full benefits of grid digitisation.

Action 6: Introduce storage code for grid management at the transmission and distribution level

Storage brings substantial value for grid management as a stand-alone asset as well as when integrated with a renewable power supply. Battery and pumped-hydro storage can reduce the variability of renewables, increase self-consumption (even enabling "zero-to-grid" installations in some cases), reduce peak-load demand and allow load-shifting. When deployed as part of a holistic strategy, storage also has the potential for reducing the investment needs in transmission and distribution infrastructure to integrate higher shares of electricity from renewable energy.

While Jordan has had a 23 MW/12.6 MWh Li-ion solar-battery project operating since February 2019, the main shortcoming for the future growth of storage in the Kingdom is the lack of a regulatory framework to support large-scale deployment at the

generation, transmission, distribution and end-user levels. The current scope of energy storage projects is largely utility-scale, with high untapped potential for combining storage with distributed renewables in buildings (public, private and commercial), and small and medium-sized industry. The regulation is important to guide investments in storage with private sector participation, as well as to create market mechanisms for storage solutions to provide additional grid services related to demand response, ramp controls, ancillary services and power quality.

Recommended actions:

- Conduct a comprehensive flexibility needs assessment to identify least-cost storage solutions, including battery storage, pumped-hydro needed at the transmission, distribution and end-user levels, and supply-side flexibility (e.g., CSP with molten salt storage).

- Formulate a dedicated storage code to provide the regulatory guidance for the development of battery storage infrastructure at the generation, transmission, distribution and end-user-levels and instructions to connect to the grid. The actions have to be taken by MEMR and EMRC in consultation with the system operator (NEPCO), distribution companies and other stakeholders with relevant experience.

- Integrate utility-scale and distributed energy storage into the overall Energy Sector Master Strategy, including targets, which clarifies the services storage can provide within the power sector (e.g., spinning reserve, arbitrage, load-shifting, peak shaving) and the remuneration models.

- Prioritise the development and financing of combined renewable energy and storage projects in regions where grid congestion is high and low-cost energy supply is a priority (e.g., industrial zones, SMEs, public buildings).

- Take steps towards the implementation of a project in collaboration with the Ministry of Water and Irrigation Building on outcomes of the assessment of reservoirs for developing pumped-hydro storage conducted under the EU-funded Renewable Energy and Energy Efficiency II Programme.

Action 7: Improve load management through demand side solutions

The increasing share of variable renewable power in Jordan's electricity mix will require active measures to match (existing and new) demand and supply in an optimum manner that reduces overall system costs (e.g., need for peaking plants) and incremental integration infrastructure investment. At present, there is no peak-load strategy, which leads to expensive, flexible generation (e.g., diesel, oil-fired generators) being procured during high-load times to balance demand and supply. This increases the overall cost of electricity supply and, if passed on to consumers, would be reflected in rising consumer tariffs.

Further demand-side management measures could shift parts of the load to non-peak times of the day with use of incentives such as time-of-use tariffs. With the growth in demand for electric vehicles, for instance, offering lower charging tariffs during high solar generation/low-load times (11 a.m. to 2 p.m.) can facilitate load shifting and reduce peak load demand. At the same time, the cost of charging can be substantially higher during off-peak solar periods, leading to increased revenues for the electricity companies.

Recommended actions:

- Develop and implement a renewable energy peak-load strategy to address peak demand in buildings and industry through solar PV and storage, when competitive with expensive peaking plants.

- Set targets for renewable energy and storage to meet a certain share of peak-load demand.

- Assess the feasibility of time-of-use tariffs to facilitate demand shifting towards low-load periods. Incentivising electric vehicle charging and high industrial loads during low-load/high-renewable generation periods with low tariffs, and correspondingly higher tariffs during high-load periods, can support integration efforts.

- Create new demand streams from electric water heaters. In Oregon, a smart grid enables water heaters to be fitted with a two-way communication response system such that a "fleet" of water heaters can be used as a virtual battery (Routefifty, 2020).

5.4 Incentivise the use of renewables for heating and cooling

As discussed in earlier chapters, the power sector accounts for less than a quarter of Jordan's final energy consumption. Increasing the share of domestic resources in the Kingdom's energy mix and reducing the cost of energy requires a stronger focus on the use of renewables for meeting energy needs for heat across different end-use sectors. The use of renewables to meet heating energy needs has largely involved solar water heating systems for domestic applications and, to a lesser extent, concentrated solar heating solutions to provide process heat in industry. Despite successful programmes, there is still large untapped potential for renewables use for heating/cooling.

Action 8: Support greater adoption of renewable solutions in industry and buildings

Solar water heating applications remain the most mature form of renewable use for heating/cooling, mainly in the domestic sector. The solar water heater programmes in Jordan have successfully installed over 26 000 systems (as of 2018), and these should be supported to continue deployment in the domestic sector. Some of the challenges faced include the lack of targets for deployment, lack of enforcement of mandates and codes, and absence of long-term financial incentive programmes for end-users.

There is also substantial untapped potential across other end-use segments such as commercial and public infrastructure (e.g., hotels, swimming pools). This is also the case in industry, with CSP and CSH solutions meeting process heat needs. Several installations are already in place in pharmaceutical and tobacco plants, among others. In industry, such solutions have the potential to substantially reduce the need for traditional fuels such as LPG, electricity and coal. On the one hand, awareness of the economics and applications of renewable heat in industry and commercial sectors is limited on the part of both end-users and local vendors.

On the other hand, there is a lack of a dedicated heat bylaw to provide long-term targets for various renewable heat applications across domestic, industry and commercial sectors and to lay out the mechanisms for deployment. The enforcement of the Bylaw for Energy Efficiency and the Jordanian Code for Thermal Insulation, among others, plays a complementary role by reducing loads and sizing of systems, as well as by facilitating energy audits and raising awareness.

Given Jordan's climatic conditions, meeting heating and cooling requirements in areas faced with energy poverty is a key challenge.

The Royal Initiative for Heating in Schools represented an important step to tackle this challenge, utilising distributed renewable energy solutions for delivering heating and cooling services, while also improving insulation of school buildings, among other infrastructure upgrades. The programme has the potential to be scaled up to include other public buildings and households faced with energy poverty.

Recommended actions:

- Develop a clear, long-term solar water heater penetration strategy for the domestic, commercial and industry sectors backed by targets building on lessons learned from the programmes implemented in 2018 and 2019. The data collected from the sales of such systems should be collected and reported regularly as part of the Annual Report of the MEMR.

- Develop a programme for incentivising and enforcing existing and new facilities that are using conventional boilers for heat (e.g., in swimming pools and industrial processes) to shift towards renewable energy.

- Address enforcement challenges by developing a mechanism to improve compliance with existing mandates through a combination of penalties, incentives and creating sufficient capacity within institutions (e.g., training of staff/inspectors on the use of Monitoring, Reporting and Verification (MRV) protocols).

- Implement the JGBG (Level D), which includes compliance with all mandatory building codes.

- Support capacity building of architects for the development of solar roofs.

- Gather data from industries using renewable energy solutions, including CSH and water heaters, to conduct industry-specific techno-economic feasibility studies to increase awareness and inform target setting.

- Improve awareness among local suppliers and manufacturers on renewable energy-based heating/cooling technology applications, specifically in industry.

- Make accessible and affordable infrastructure for testing and certification of technology through specialised entities such as the RSS. Quality marks and logos, such as the SHAMCI developed for solar water heaters jointly by MEMR, NERC, JSMO and RCREEE, need to be devised for various technological applications.

- Build on the success of the Royal Initiative for Heating in Schools by expanding the coverage of renewable energy solutions among buildings and households where energy poverty is prevalent.

5.5 Support renewable options for transport and mobility

The transport sector is the largest energy consumer in Jordan and is reliant mainly on crude oil derivatives such as diesel and gasoline. Government efforts to decrease energy use in the sector have primarily relied on incentivising high efficiency vehicles, including non-plug-in hybrids and fully electric vehicles. While the adoption of hybrid and electric vehicles has grown rapidly over the past few years, they still represent a small share of the overall transport fleet. Rapidly scaling up the use of hybrid and electric vehicles will require a holistic approach that focuses on different vehicle segments, concurrent charging infrastructure development and smooth integration with the grid. Additionally, other domestic energy sources also need to be tapped, including gaseous and liquid biofuels, as well as green hydrogen in the long-term.

Action 9: Start to diversify energy use in the transport sector

To reduce reliance on imported fuels and tackle environmental pollution, the government has since 2008 offered varying levels of incentives to support the adoption of hybrid and electric vehicles. This resulted in the purchase of over 30 000 such private vehicles by the end of 2019. However, this represents a small fraction of the overall fleet of road transport in the Kingdom. The adoption of electric vehicles remains highly sensitive to fiscal incentive schemes introduced by the government, and sales have fluctuated with changes in policy.

The economic and environmental case for electrifying fleet vehicles, in particular public buses and fleets, is stronger than the case for private vehicles. It offers the opportunity to benefit from economies of scale, higher utilisation of vehicles and displacement of polluting vehicle stock (e.g., public buses). Aside from initiatives taken by various municipalities, there is presently no incentive or regulation that encourages the shift. Furthermore, awareness of the techno-economic and environmental opportunity presented by the electrification of fleets is limited. This lack of awareness potentially impacts key decisions related to upcoming public transport procurements, including the Amman Bus Rapid Transit.

The development of charging infrastructure – a critical feature of the electric vehicle ecosystem – has lagged. EMRC was the first in the region to introduce instructions for licensing electric vehicle charging stations in 2014, but their rollout has not kept pace with the requirements necessary to meet a rapidly growing market segment. There is an urgent need to improve the business case for private sector participation in charging infrastructure development in partnership with distribution companies and municipalities.

The rapid growth of electric vehicle adoption offers both challenges and opportunities. Incentivising electrification of the transport sector provides the benefit of coupling with cost-effective renewable power and addressing slow electricity demand growth. However, increasing charging load during non-solar peak hours will place additional burdens on the grid. Through measures such as time-of-use pricing, charging can be incentivised to take place during low-load hours and peak solar PV generation. With smart metering and digitisation, electric vehicles also have the potential to participate actively in providing grid services, including storage.

To harness these opportunities, however, a long-term energy diversification strategy for the transport sector is necessary that also considers other alternatives such as biogas for large municipality vehicles and green hydrogen. The Ministry of Transport will be the nodal agency at the national level responsible for integrating alternate mobility solutions within the national transportation strategy. Experience from emerging economies is now available on designing holistic electric vehicle policies that include long-term targets (by segment), incentives for vehicles, models for private and public charging infrastructure development, vocational training, and research and development. Furthermore, end-of-life management of batteries also needs to be considered for sustainable recycling and disposal. The absence of such a strategy and the lack of a clear roadmap with targets and siloed policies are substantially slowing down the energy transition in the transport sector.

Recommended actions:

- Devise a long-term energy diversification action plan for the transport sector in line with Jordan's Master Strategy for the Energy Sector and the Long-Term National Transport Strategy.[18] The plan should include targets for an appropriate mix of alternative fuels such as renewable electricity, liquid and gaseous biofuels, as well as green hydrogen. Such a strategy should be backed by stable policies and incentives.

- Develop a holistic electric vehicle policy to facilitate adoption and reduce air pollution. The policy should include targets and stable incentives for the electrification of public transport, fleets and private vehicles and address charging infrastructure development and capacity building for O&M.

- Introduce mandates for large fleet owners to transition to electric vehicles and put in place adequate measures to facilitate the transition, building on the experience of GAM.

- Conduct a comprehensive techno-economic and environmental assessment of electric public buses and undertake pilot projects to inform decision-making regarding upcoming public transport procurements.

- Identify the most appropriate business models for rapidly scaling up public and private charging infrastructure development led by the private sector, distribution companies (as non-core business) and municipalities.

- Integrate electric mobility within the Jordan National Building Code, incentivising existing and new buildings to develop necessary infrastructure for distributed charging.

- Adapt the licensing instructions issued by EMRC in 2014, as well as the electricity tariff structures for charging stations to improve the business case for private sector investments.

- Adopt a holistic strategy to effectively integrate electric vehicles into the power system by offering low-cost tariffs for charging during peak solar PV between 11 a.m. and 2 p.m. Furthermore, devise an electric vehicle-to-grid strategy that integrates electric vehicles into providing grid services, including storage and demand-shifting, enabled by smart metering and digitisation.

- Plan for end-of-life management of lithium-ion batteries with increasing electric vehicles and associated capacity building, including re-use for stationary electricity storage applications (stand-alone or grid-connected applications).

- Support the development of alternative fuels such as liquid and gaseous biofuels (e.g., for large municipality vehicles) and green hydrogen for segments of the transport sector, such as large freight, for which electrification is not feasible.

5.6 Catalyse Renewable Energy investment

With the expansion of the renewable energy sector since 2012, investment flows have grown rapidly, reaching a cumulative USD 5 billion by the end of 2019 (MEO, 2020). The bulk of investments have been from international sources, involving both commercial and development finance. Several factors have limited the mobilisation of domestic financing for the sector. These factors include a lack of capacity and skills within local banks to project-finance utility-scale renewable energy projects, the scale of investments required, and the ability of international project developers to secure more attractive capital from external sources. However, with strong support from donors and development finance institutions, local commercial banks and co-operatives have played a catalytic role in the implementation of public financing schemes for small-scale renewable energy applications, such as rooftop solar PV and solar water heaters, through the CBJ and the JREEEF programme. Financing has also been made available to conduct energy audits in large energy consumers.

To scale up renewable energy adoption, much greater levels of domestic capital will need to be mobilised in both the utility-scale and distributed power sectors, as well as in transport and heating/cooling sectors. Substantial investments will also be needed in energy efficiency and complementary infrastructure development, such as electric vehicle charging infrastructure, transmission and distribution grids, and storage. With a strong track record of international financing institutions participating in Jordan's renewable energy sector, focused attention is needed to increase the capacity of local financing institutions to mobilise greater capital for the sector.

18 http://www.trt.it/en/PROGETTI/development-of-long-term-national-transport-strategy-for-jordan/

Action 10: Build the capacity of local financing insitutions and project developers

While some local banks are co-financing large projects with multilateral development banks, local financial institutions are still not very actively involved with utility-scale renewable energy financing. This is especially true of financing related to projects that require larger volumes of investment, longer tenor and unique documentation. Over time, capacity is being developed as understanding of the sector improves. On-lending and risk mitigation facilities by international financing institutions, including multilateral development banks and national development banks, can play a key role in increasing the experience of local banks and mobilising larger shares of domestic capital for renewable energy development.

Beyond financing renewable energy projects, large investment needs exist for energy efficiency (e.g., LED lighting, industrial equipment replacements) and complementary infrastructure development (e.g., distributed storage, electric vehicles, charging infrastructure). The distributed nature of these investments means that local financing institutions will have to play a fundamental role in designing financing products to meet these investment needs. For instance, vehicle financing departments within banks must consider dedicated lending lines for electric vehicles, home loan financing to be linked with rooftop solar and enterprise financing with energy efficiency investments. The lack of capacity within local banks to understand emerging financing opportunities strongly inhibits their ability to design tailored products and services for various consumers.

Capacity gaps also exist among developers and proponents of renewable energy projects. The limited skills to prepare project documents, develop business plans, undertake accurate project costing and seek financing are leading to low-quality proposals reaching financing institutions.

Recommended actions:

- Develop the capacity of green lending units in local commercial banks with regard to renewable energy and energy efficiency as well as new technologies (e.g., storage, electric charging infrastructure, energy efficiency in industries). The increased capacity should improve the implementation of programmes from JREEEF and CBJ, as well as access to additional international financing (e.g., climate finance). This can be undertaken in collaboration with the Association of Banks.
- Increase awareness among financing institutions (including branches of banks) on the scope of technologies covered under various financing programmes.
- Encourage international financing institutions, including multilateral development banks and national development banks, to establish co-lending and risk mitigation facilities to increase the experience and exposure of local banks to the renewable energy sector.
- Design capacity-building initiatives for developers on the preparation of bankable project proposals and business plans covering renewables, energy efficiency and emerging technologies (e.g., storage).
- Consider lending requirements for local banks to meet in certain priority sectors, including renewable energy.

Action 11: Improve access to public financing programmes

To support the implementation of Law No. 13 of 2012 concerning the Renewable Energy and Energy Efficiency Law and subsequent revisions, several public financing schemes have been established with the involvement of the CBJ, JREEEF, co-operatives, commercial banks and donors.

The CBJ's concessional financing facility is delivered through commercial banks for an amount up to JOD 4 million. A challenge faced in accessing the financing is that the loans can be accessed only by end-consumers and not by the project developers themselves. Some end-consumers are unwilling to take on debt leading to less uptake, while the programme also does not benefit from portfolio lending to project developers. Other challenges faced by project proponents are the varying levels of awareness among local bank branches on the terms of the programme and their capacity to evaluate proposals in a timely manner. Finally, the due diligence standard applied while assessing project applications is the same, irrespective of the magnitude of financing sought, leading to long lead times and higher transaction costs for smaller projects.

Regardless, the CBJ concessional lending facility has received a strong response and has played a catalytic role in developing projects not large enough for project financing and yet not small enough for alternative financing programmes by JREEEF and donors.