## Power sector: Direct proposal submissions

Under the direct proposal submission route, investors can identify and develop grid-connected renewable energy projects and propose these to MEMR. The direct proposal submission by the private sector takes place in rounds defined by the MEMR considering the capacity to be contracted. The Direct Proposal Committee was established by the provisions of the Direct Proposal Bylaw 50/2015 to identify the appropriate opportunity to conduct a new round. Each round comprises a two-stage tender process: the pre-qualification stage to confirm developer experience and ability, and the tender stage for short-listed developers to prepare proposals and submit tariff bids. For the first round, the submitted tariffs must be lower than the ceiling reference price, which is calculated based on a methodology issued by the EMRC.

The first expression of interest in 2012 offered a feed-in tariff. Twelve solar PV projects with a cumulative capacity of about 200 MW were approved (Infrastructure Journal, 2013). Further, the PPA for the first wind direct proposal submission for 117 MW at Tafila was signed in 2013. The 20-year PPAs were signed for USD 0.12/kWh for wind and USD 0.169/kWh for solar PV (barring the 52.5 MW Ma'an project, which was awarded at USD 0.148/kWh). In the first round, MEMR focused on the southern region of Ma'an, which was attractive from a resource standpoint as well as the applicable regulatory and administrative regime in the Ma'an Development Area.

The second round was launched in August 2013 and switched from a feed-in tariff to competitive bidding. It awarded four projects of 50 MW each at record-low prices of USD 0.0613-0.0767/kWh (New Energy Update, 2015). The projects focused on the northern and eastern parts of the Kingdom to ease pressure on the grid. MEMR required interested parties to identify the project location and ascertain from the relevant transmission or distribution company whether the site was deemed suitable for grid interconnection (Infrastructure Journal, 2013). At the end of 2016, the third round of tender was launched, planning to develop 200 MW of solar PV in the Ma'an area and 100 MW of wind projects in the south of the country. In September 2018, the results of the Round 3 auction were announced and a record-low bid of USD 248.9/kWh was submitted (RES4Med, 2019).

The rounds of direct proposal submissions have been a strong driver of renewables growth in the power sector. Regular updates of the bylaw (e.g., the Direct Proposal Bylaw (50) year 2015 and Bylaw (66) year 2016) were undertaken based on the lessons learned since 2012. To attract the private sector to participate in the tenders, the government took additional steps to address key investment risks. First, a government guarantee backed the PPAs to address off-taker risks. Second, template contractual documents were made part of the tender package, including the PPA, Land Lease Agreement, Grid Connection Agreement and the Government Guarantee Agreement.

Third, a slew of preferential taxation schemes have been introduced. These include, for instance, 75% relief from income tax normally levied on the project company (from resource assessment to construction) for ten years; exemption from all customs and other duties, taxes, fees, returns and levies; exemption from stamp duties; exemption from general sales tax and withholding tax on income relating to local or imported goods, material and services; exemption for non-Jordanian investors and financiers from income tax and general sales tax that may arise on interest payments, fees and any instalments resulting from financing activities.

The Direct Proposals Bylaw prioritises the use of private land for renewable energy, and developers often have to negotiate directly with local communities rather than through formal institutions, which poses risks of project delay and disruption. Further, developers are required to pay a fee for change in the "type of use" for the land which ranges from JOD 5-8 per square metre. Public lands are managed by the Department of Land and Survey (DLS) in Jordan and where such land is required under the Direct Proposal Scheme, developers should approach MEMR which will in turn liaise with DLS. The exact leasing price is determined by a special committee in the DLS and has to be approved by the minister of finance.

The current pipeline of utility-scale projects provides an outlook to 2021, beyond which subsequent rounds of direct proposal submissions need to be issued to benefit from electricity from renewable energy that is substantially cheaper than the NEPCO's current average cost of electricity procurement. Indeed, several factors are contributing to a slowdown in the issuance of subsequent rounds, including uncertainty related to the overall electricity demand growth, available grid infrastructure capacity and existing take or pay contracts with IPPs. Without demand growth measures, such as incentivising electricity consumption, reducing energy poverty and electrification of end-uses, future rounds of direct proposal submissions are unlikely to take place.

However, important steps have already been taken to ensure the benefits of low-cost electricity from renewable energy can be passed on to sectors presently most vulnerable to high energy costs. Industries, for instance, can already benefit through earmarked renewable energy projects. The 100 MW solar project in East Amman is an example in this regard where land has been allocated for lease to generate low-cost solar power to improve the competitiveness of industries (Jordan Times, 2020c). It is, however, important to ensure equitable access to low-cost renewable power for small and medium enterprises, including those most at risk due to high energy costs.

Existing and future industrial zones should pursue dedicated renewable power supply coupled with energy efficiency and storage. The expedited development of renewable and storage projects as well as strategically positioned development of new projects such as these can facilitate deployment with limited stress on the grids for integration.

### Power sector: Government-owned projects

Renewable energy projects developed under this route include those that are government-owned and publicly financed through grants and loans provided by governments and development agencies. For such projects, MEMR issues a tender to select an EPC contractor. The EPC contractor is responsible for all activities from design to engineering, procurement, construction, commissioning and transferring the renewable energy plant over to MEMR. However, renewable energy developers licensed by EMRC must apply for government tenders in partnership with an accredited contractor listed by the MEMR.

The total installed (or under construction) capacity of government-owned commercial power plants has reached 149 MW from PV and 169 MW from wind. Besides solar PV and wind, either government-owned or through public-private partnerships, projects focused on biogas and hydro have also been developed in the past. The Jordan Biogas Company has a landfill project in Rusaifa, with further plans by the Greater Amman Municipality to implement a biogas project using the methane gas captured in the Ghabawi landfill.

### Power sector: Wheeling and net metering projects

The development of renewable energy projects for self-consumption is guided by the wheeling and net metering programmes depending on the location of the generation facility with respect to the consumption site. The capacity of projects under the programmes grew from around 250 MW at the end of 2018 to 573 MW in January 2020.[11] At over 35%, Jordan has among the highest percentages of wheeling and net metering projects relative to total renewable installed capacity.

The Electric Power **Wheeling Scheme** has been devised to encourage large consumers to develop renewable energy for self-consumption with a view to reducing energy costs and increasing competitiveness. The scheme allows the user to install the renewable energy system in a different location of the consumption facility and connect it to the transmission or distribution grid. The directive for the scheme was issued in 2013 and later amended in 2015 (EMRC, 2015). As of January 2020, wheeling projects totalled a capacity of over 222 MW,[12] with strong interest from large consumers. The Jordanian telecom operator Orange Jordan, for instance, has announced a 37 MW solar project to help meet part of its electricity needs. The capacity is spread across three sites in the King Hussein Bin Talal Development Area, the Mafraq and the Amman governorate (Willuhn, 2019).

Beyond commercial entities and industry, refugee camps have also been able to benefit from the wheeling scheme, with the Azraq and Zaatari camps meeting a large share of total electricity needs through solar projects (UNHCR, 2020). The solar plant in Azraq refugee camp was inaugurated in May 2017 while the one in Zaatari camp opened in November 2017. The Azraq refugee camp is now powered by a 5 MW solar PV project which covers 70% of the total electricity required. In the case of the Zaatari refugee camp, the solar project connects all shelters in the camp and provides 12 hours electricity per day. The projects help UNHCR save an average of USD 6 million annually in electricity costs while bringing an improved electricity supply to those living in these camps (UNHCR, 2019b).

**11** Based on MEMR presentation (January 2020).

**12** Based on MEMR presentation (4 January 2020).

The **Net Metering** scheme is focused on the development of renewable energy, mainly solar PV, for all metered consumers to cover up to 100% of their own consumption and connect the system mostly to the distribution grid. The scheme is based on the Directive Governing the Sale of Electrical Energy Generated from Renewable Energy Systems, which provides guidance on the conditions for existing and new users, as well as specifies the mechanism for billing and remuneration for users under this scheme. Net metering is most attractive for high-consuming residential consumers and public buildings (Box 3) that are paying high electricity tariffs (reaching JOD 0.30 [USD 0.42] per KWh).

For net metered users, the distribution company undertakes monthly billing and annual settlement between the electricity consumed from the grid and exported to the grid. For the total installed capacity to be connected to the grid, the expected generation must not exceed the average monthly consumption (IEA, 2020). For the monthly billing, if the electricity consumed from the grid is higher than renewable electricity exported, then the consumer pays for the extra consumed electricity to the distribution company according to the prevailing tariff structure. In case export is higher than consumption, then the excess electricity is rotated to the next month, also known as "banking of power". The annual settlement can be either on a financial basis (capped to 10% of the electricity imported from the grid) or on an energy basis, where the surplus is rotated to the next year. The tariff for purchasing surplus renewable electricity by the distribution company is set at 0.12 JOD per kWh (USD 0.17 per kWh) for solar PV systems. It is important to note that the exodus of high-paying commercial and industrial electricity consumers from the electricity grid risks undermining the cross-subsidisation mechanism (Vinter and Norman, 2019).

Substantial interest in self-consumption (wheeling and net metering) programmes has resulted in rapid capacity deployment, as well as several implementation-related challenges. Applications are generally submitted to distribution companies, which then undertake a review and conduct the requisite technical and grid impact studies (GISs). Distribution companies are faced with high loads of applications and are unable to increase capacity to address this. The potential for a one-stop shop for project proponents is being explored to complete all necessary processes, as is the use of online platforms where possible (EDAMA, 2019b). Simplified processes may also be designed for small and zero feed-in systems.

**Box 3. Facilitating development of distributed solar on public buildings**

The implementation of renewable energy and energy efficiency measures for public buildings holds immense potential for reducing electricity costs. While several mandates and programmes have been launched, enforcement has remained a key challenge. The lack of transparency in available budget in existing areas on electricity bills inhibits public buildings from conducting energy audits and implementing renewable energy and energy efficiency measures. The Ministry of Public Works and Housing, which is responsible for all government buildings, has a methodology for energy efficiency. It has implemented the same with the Ministry of Education and Health covering over 500 buildings.

Incentives can be introduced for managers of public buildings to adopt renewable energy and energy efficiency measures through dedicated financing schemes. Energy service companies (ESCOs), which carry out energy performance contracting, allow savings from annual electricity bills to be utilised for other budget lines, as well as ensure that buildings are able to connect to the grid without paying dues.

Under both the wheeling and net metering schemes, projects mostly connect to the distribution network. However, owing to uncertainties in grid capacity to absorb further generation, new projects over 1 MW on the distribution network have been suspended until the completion of technical studies to assess the capacity of the electrical grid to integrate further capacities. Even those under 1 MW are reportedly often not approved, or approval is granted for only part of the capacity applied for, by the distribution companies owing to limitations on the grid. The private sector has strongly noted the importance of communicating information regarding where capacity is available on the grid and for distribution companies to consider providing conditional approvals for projects. This includes, for example, conditions regarding integration of storage or limits on electricity exports to reduce stress on the grid.

Wheeling and net metering projects will play a fundamental role in the growth of Jordan's renewable energy sector. Such projects allow end-consumers to benefit directly from the low cost of electricity from renewable energy and, in the case of large private sector entities, improve the competitiveness of products and services. The freeze on projects over 1 MW due to grid limitations highlights the need to identify pathways through which wheeling and net metering projects can continue to expand, while integration challenges are addressed (discussed in greater detail in Chapter 4, Section 1, "Policies and regulations for integration"). The transition also brings challenges for incumbent distribution companies and bulk power suppliers as high-paying commercial and industrial end-users essentially utilise only the carriage (network) and reduce power consumption from traditional suppliers. In this context, it is important to ensure that the allocation of costs is fairly distributed across the end-consumers.

Since 2012, even as electricity generated from renewable energy has grown substantially, the electricity tariff structure has remained unchanged. Tariffs need to appropriately reflect the grid usage of self-consumption renewable energy projects (net metering and wheeling) to ensure proper allocation of network costs with other consumers and the distribution companies. As renewables continue to grow, the distribution companies will face greater challenges. EMRC will need to adapt regulated tariff design structures to ensure viability for the distribution companies in the long-term, even as distribution companies also evolve business models with the changing structure of the energy system.

### Power sector: Off-grid and cross-sector projects

With rapidly decreasing technology costs and scalability of solutions, diverse renewable energy applications are also emerging in off-grid and cross-sectoral contexts. The first zero feed-in project of 9 MW was recently given approval. From a regulatory perspective, zero feed-in systems are permissible with the approval of the distribution company, with EMRC developing a relevant bylaw. As battery storage costs continue to fall, it will become increasingly competitive for certain categories of consumers (e.g., commercial establishments with majority day-time loads) to transition towards zero feed-in distributed solar. To facilitate this, instructions will need to be issued by distribution companies and design codes.

In addition, several cross-sector projects have also been developed. In June 2017, the Jordanian Ministry of Agriculture signed an agreement with the National Energy Centre of the Royal Scientific Society to develop over 320 solar water pumping systems on farms in the Jordan Valley and valleys of the south and 100 on the high plateaux (Azraq, Mafraq, Madaba). While the majority operate in an off-grid configuration, some are connected to the grid under the net metering programme (MEDENER, 2019).

As discussed in Chapter 2, water pumping accounts for 15% of all electricity consumed in Jordan. Electricity is a major cost for water utilities, and the Ministry of Water and Irrigation has pursued the development of solar projects to cover its electricity costs. However, a 50 MW proposed solar project was cancelled in light of the technical challenges related to the grid and the prevalent oversupply situation in the power sector. A joint committee between the Ministry of Water and Irrigation and MEMR has been constituted to discuss several issues related to the management of water and energy, (pumped) storage and desalination.

### Heating/cooling

Chapter 3, Section 3 discussed the diversity of renewable energy applications in the heating/cooling sector. These included solar water heating for domestic, commercial and industrial applications, as well as geothermal and solar for space heating. Several projects already exist, with a strong presence of local system manufacturers and installers, and demonstrated benefits in terms of reduced energy consumption, decreased expenditures, improved reliability of supply and emissions reduction.

Despite the potential, the policy and regulatory landscape for renewable energy in heating/cooling is not as developed as that of the power sector. The adoption of solar water heaters has grown gradually over the past decades with a number of local enterprises deploying systems for residential, commercial and industrial applications. Partnerships with financing institutions were developed to deliver end-user financing for such systems. With the NEEAP and JREEEF programme, the sector received a strong impetus with end-user financing available through a network of community based organisations (CBOs). The JREEEF programme deploying 22 000 systems concluded in 2019, with the next phase in partnership with the commercial banks in the early stages of implementation.

In follow-up to the Renewable Energy and Energy Efficiency Law No. 13 of 2012, mandates were also issued to deploy solar water heaters on all new buildings exceeding a pre-defined area. Solar water heaters became compulsory for apartments with an area greater than 150 $m^2$. Commercial offices with less than 100 $m^2$ and private dwellings with less than 250 $m^2$ were exempted.

In addition, in 2013, the Ministry of Public Works and Housing Council issued the first Jordan Green Building Guide (JGBG), providing the basis for a local green building rating system. The incentive programme gives extra floor area ratio for buildings that achieve high levels of energy and water savings (Zawaydeh, 2018). Renewable energy integration in buildings is mentioned in the guide, and users can acquire eight points for integrating more than 20% renewable energy.

At the municipality level, the Greater Amman Municipality issued a special regulation in 2015 regarding solar system installation requirements on building rooftops, vacant lands and parking lots. This regulation ensures that installed systems to satisfy zoning requirements. An updated version of the requirements will be issued and released by the end of 2020.

A key challenge for solar water heater penetration in Jordan has been the enforcement of existing mandates, the lack of stringent penalties and the lack of capacity to ensure compliance. Furthermore, the focus of the next phase of the JREEEF programme on partnerships with commercial banks to provide end-user financing, as opposed to CBOs in the first phase, has led to a substantial slowdown in the adoption of solar water heaters, especially in the domestic segment. Each market segment requires a tailored financing approach to support solar water heaters. While the delivery of end-user financing through CBOs for domestic consumers was effective, commercial and industrial consumers may benefit from dedicated financing lines through commercial banks.

In industry, several projects using heat from renewable energy sources already exist. CSH applications have been deployed in pharmaceutical and cigarette production as process heat. In addition to the financing needs discussed earlier, capacity building initiatives focusing on local suppliers and manufacturers is needed to improve awareness of renewable energy-based heating/cooling technology applications.

Renewable heat use, including solar water heaters, currently lacks a clear long-term target that provides local suppliers visibility into the future market, especially given the dependence on public programmes (and accompanying subsidies) for deployment. To improve reporting on the progress, the data collected from the sales of such systems should be collected and reported regularly as part of the Annual Report of the MEMR.

**Box 4. Addressing energy poverty through renewable energy: The case of the Schools Heating Program and refugee camps**

In February 2015, the Schools Heating Program (King Abdullah II Initiative) was launched to provide heating in public schools. The project was envisaged to roll out in two phases. In the first phase, central heating would be installed in 50 schools located in extreme cold conditions. The second phase would expand the scope of the project to over 3 700 of Jordan's public schools. The programme has been implemented through the JREEEF, and has now covered over 134 public schools.

The schools have been equipped with solar-PV based space heating and cooling units along with solar water heating solutions. In addition, energy efficiency improvements have been made to school buildings by improving insulation, changing windows, installing energy efficient lights and upgrading electrical wiring. Awareness campaigns for students, teachers and the community on energy conservation and renewable energy applications is also being conducted.

Renewable energy solutions have also been applied to address energy poverty in refugee camps and associated public service infrastructure (e.g., education, healthcare). The Norwegian Refugee Council, for instance, initiated a Renewable Energy and Energy Efficiency Program in 2015. It installed grid-connected solar PV systems in 34 public schools, thus reducing the cost of additional shifts for refugee students, as well as improved energy efficiency. Additionally, 710 solar water heaters were installed in refugee households, reducing the cost of living and improving tenure security.

**Source:** MEMR (2019c), MESIA (2018), Royal Hashemite Court (2015), NRC (2020)

## Transport

The transport sector accounts for the largest share of energy consumption in Jordan. Efforts to diversify the energy mix in the sector have focused mostly on incentivising the purchase of hybrid and electric vehicles through sales tax and customs exemptions. Fiscal incentives have been used extensively as a tool to facilitate adoption. Electric vehicles were exempted from clearance taxes on import for five years until the end of 2018, which improved their attractiveness substantially and has driven adoption. However, the clearance tax of 25% was reinstated in April 2019, which reduced sales sharply. In November 2019, the government reintroduced the incentives based on the battery capacity of the electric vehicles. Those with a capacity of 250 kilowatts (kW) and lower (which represent 95% of the electric vehicles in Jordan) saw clearance taxes reduce from 25% to 10%. Meanwhile, taxes on vehicles with a capacity above 251 kW were reduced to 15% (Xinhua, 2019b; Zeidan, 2019). The impact of this tax reduction on electric vehicle sales remains to be seen; however, stability in policy support is seen to be crucial for the sustained growth of the sector.

To support the adoption of electric vehicles, simultaneous efforts are needed to expand the charging infrastructure. The EMRC currently provides licenses to public and private electric vehicle charging stations. So far, the commission has issued licenses to 16 charging stations and announced intentions for all new gas stations to have electric charging facilities. To achieve large-scale and rapid electrification of the vehicle fleet in the Kingdom, the rollout of charging infrastructure has to be substantially accelerated.

The economics of electric mobility are fast evolving with rapidly decreasing costs of storage technologies and improving maturity of applications across the different transport segments. In the specific case of electric buses, for instance, these have been found to be a technically and financially feasible option with substantial co-benefits in terms of reduced air pollution and GHG emissions, as well as dependence on imported diesel fuel (GGGI, 2018). Pilot projects across specific routes will improve the understanding of operational viability of electric buses for intra- and inter-city transport.

Coupling the electrification of transport with renewable power will be important to diversifying energy use in the sector. This will require strong co ordination between the Ministry of Transport and MEMR, as well as a holistic strategy or long-term roadmap which sets targets for the electrification of private vehicles, fleets and public transportation. It should further guide the development of complementary infrastructure and skill sets. Municipalities, such as GAM, have taken steps to set targets for taxi fleets.

## Policies and regulations for integration

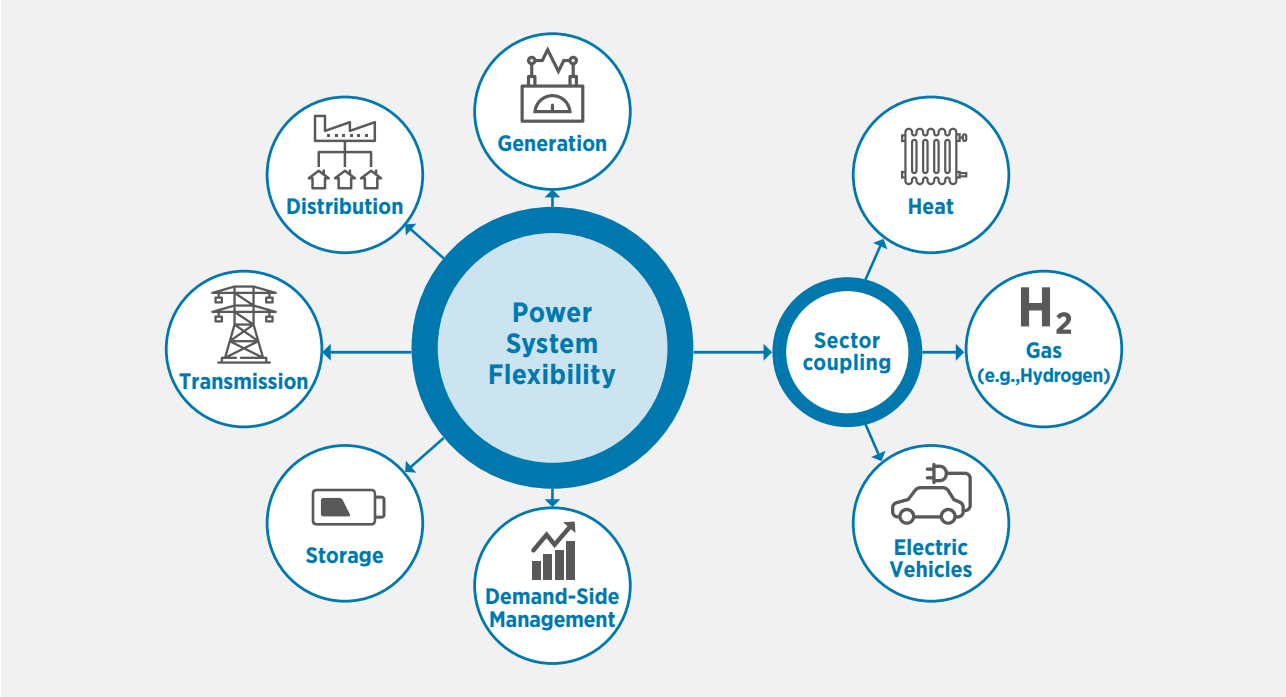
The integration of higher shares of variable renewables has emerged as a primary concern holding back continued growth of the sector. By 2021, it is anticipated that renewable energy will account for 30% of total installed power capacity and 20% of electricity generated in Jordan (Marar, 2019). Concerns over the ability of the grid to integrate renewables beyond the existing pipeline have led to the suspension of new projects above 1 MW since January 2019. This has contributed to uncertainty in the sector and, importantly, not allowing large consumers to benefit from a low-cost energy supply from renewable energy.

Some steps have been taken towards integration in Jordan, which has enabled the integration of a rapidly growing share of electricity generated from renewables over the past few years. These have largely focused on developing and strengthening the transmission and distribution infrastructure, as well as introducing dedicated regulations for injecting renewable power into the grid.

However, further growth in the share of renewables in the electricity generation mix requires a wider range of actions to improve overall system flexibility in the short-, medium- and long-term. As illustrated in Figure 15, the measures range from reinforcing transmission and distribution infrastructure to increasing storage, managing the demand side, and incentivising flexible generation, as well as introducing sector coupling (IRENA, 2018; IRENA, OECD/IEA and REN21, 2018). The optimum mix of measures varies from context to context and should form part of a holistic strategy to improve system flexibility in a least-cost manner and be backed by dedicated regulations to guide deployment and operation.[13]

**13** The IRENA FlexTool is a detailed tool that analyses the flexibility needs of a power system covering traditional options (e.g., flexible thermal and hydro generation with high ramping capability and very low start-up time), as well as other innovative technologies (e.g., flexible demand, energy storage and sector coupling). The FlexTool is capable of analysing current system operations and performing future analysis with high penetration of variable renewables, thereby proposing the optimum possible flexibility solutions. Country-level analysis has so far been conducted for Colombia, Panama, Thailand and Uruguay (IRENA, 2018).

Figure 15. **Measures to integrate high shares of variable renewables in the power mix**




**Source:** IRENA (2018a)

## Transmission and distribution infrastructure

The expansion and strengthening of grid infrastructure have to keep pace with renewable energy development. The scope of infrastructure work needed for effective integration varies from constructing dedicated transmission corridors between renewable resource-rich regions to load centres (e.g., the Green Corridor) to strengthening the distribution infrastructure through upgradation of equipment (e.g., transformers) and improved system management.

While the National Energy Strategy provides an outlook to 2030, grid infrastructure needs to plan for the longer term. A much higher share of renewables also needs to be assessed and planned for. NEPCO's network expansion and development strategy should offer a blueprint for stakeholders, including the private sector and other ministries, to develop the necessary infrastructure, raise capital and devise a time-bound plan. A similar exercise will need to be conducted by the distribution companies to identify network bottlenecks that require investments for upgradation and modernisation. This is particularly crucial given the growth of electric vehicle sales and the associated charging infrastructure. Investments in smart grid systems, including metering, across the distribution network can help implement a tailored approach to managing renewables integration at the transformer level.

Effective co-ordination between MEMR, NEPCO and the distribution companies can ensure optimum network management during the transition towards higher shares of variable renewables in the electricity mix. Integration measures can also be mainstreamed into deployment policy design by setting up renewable energy projects in areas of close proximity to loads (e.g., industrial zones) or regions with available grid capacity. Hybrid projects (e.g., solar-wind, solar-on site storage) can further support integration by smoothening generation, increasing network utilisation and enabling load shifting.

The scope of infrastructure work needed for effective integration varies from constructing dedicated transmission corridors between renewable resource-rich regions to load centres to strengthening the distribution infrastructure through upgradation of equipment and improved system management.

## Storage

Managing the increasing share of renewable energy 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 of infrastructure investment. Energy storage costs are expected to decrease by 2030. With rapid construction times and lower social and environmental impacts, energy storage could be a solution to some of the challenges of integrating renewable energy (IRENA, 2020b). In Italy, for instance, Terna installed 38.4 MW/240 MWh sodium sulphur batteries for transmission investment deferral. Over 330 MW of such projects had been deployed by 2017 and are expected to reach around 14.3 GW by 2026 (IRENA, 2020b).

The level of flexibility storage can offer for Jordan's power system needs to be studied closely. Broadly, two storage options are available – battery storage and pumped hydro – each offering its unique set of characteristics and flexibility services.

Developing battery storage at the transmission and distribution levels and on the demand side can increase self-consumption and reduce variability for the grid. When combined with renewable power and energy efficiency, storage can reduce peak-load demand and help achieve "zero-to-grid" configuration for buildings, commercial sites and industries. In the specific case of the residential sector, which accounted for 46% of total electricity consumption in 2018, the daytime peak-demand load can be reduced through energy efficiency measures, coupled with growing solar PV generation and storage, thus reducing the need for expensive peaking plants. Having a renewable energy peak strategy with targets is critical to cover part of the peak requirements.

Grid-scale energy storage infrastructure can provide a wide range of grid services, including renewables smoothing, arbitrage and ancillary services. The benefits are already demonstrated by the solar PV Li-ion battery storage project in the Al-Mafraq region. While bids for a larger solar-storage project are in the evaluation stage by MEMR, there is presently no long-term strategy or target for storage deployment in the Kingdom. There is also no regulatory framework to facilitate and guide storage deployment at the transmission, distribution and end-user-level. With storage costs falling, the business case for storage adoption will become strong, both at the utility scale and behind the meter, and enabling regulations will be needed for rapid adoption. The distribution company, JEPCO, began receiving applications for storage in January 2020.

Pumped hydropower storage is being closely considered, with several sites being studied for development (Box 5). Key issues remain to be resolved between MEMR and the Ministry of Water and Irrigation in terms of ownership of water resources and regulations to govern the operation and remuneration of services provided by the pumped hydro facility.

Grid-scale energy storage infrastructure can provide a wide range of grid services. The benefits are already demonstrated by the solar PV Li-ion battery storage project in the Al-Mafraq region.

**Box 5. Assessment of pumped water storage**

Under the EU-funded Renewable Energy and Energy Efficiency II programme, an assessment of pumped-hydro storage was conducted for five reservoir/dam sites in Jordan. Among the sites assessed, Wadi Mujib, Wadi Arab and King Talal reservoirs were found to have the highest potential for pumped-hydro development. The turbine capacity at each site is 215 MW, 95 MW and 225 MW, respectively, and the assessment was conducted based on the energy storage capacity, fulfilment of grid service re equipments (NEPCO) and potential transmission line losses. Wadi Mujib was found to have the highest potential among all dams in Jordan.

Given that Jordan is a water-stressed country, the development of pumped-hydro infrastructure has to equally consider other uses of the dam such as supply of water for irrigation, industry and domestic purposes. Mujib Dam, for instance, is a multipurpose water source and serves as an important water supply source in central western Jordan. Co ordination between MEMR and the Ministry of Water and Irrigation will be needed to address issues related to water resources and minimise conflict between different end-uses. Further, EMRC will need to issue adequate codes for the operation and remuneration of services provided by pumped-hydro storage.

## Sector coupling and load-shaping

In an environment of slow demand growth, deploying new renewables capacity to lower energy costs will still pose challenges for NEPCO and the distribution companies given existing tariff structures and nature of "take or pay" contracts in the sector. The government took measures in 2019 to stimulate demand through reduced tariffs for the industry. As noted, steps towards incentivising the adoption of electric vehicles have been taken; however, the scale of adoption has been limited in the absence of stricter mandates and complementary infrastructure. Other opportunities such as utilising excess low-cost electricity for the production of energy carriers, such as hydrogen, for use in transport and industry are yet to mature and be fully explored (IRENA, 2018b).

The electrification of end-use sectors can potentially drive demand growth. However, its management needs to be accompanied by strategies for demand-side management and load shaping. The growth in new electricity demand, for example from growing electric vehicles in the transport fleet, may not necessarily coincide with peak renewable generation. Load shaping includes measures to match electricity demand to variable supply with demand-side management (IRENA, IEA and REN21, 2018). Time-of-use tariffs are important market signals to shift certain loads during times of low loads, thus also reducing peak-load demand. Jordan's tariff structure is currently fixed-consumption based for various consumer groups. Increased digitisation of systems will be also be crucial to enable load shaping.

## Policies and regulations to maximise benefits

The share of domestic energy sources in primary energy is targeted to grow from 8% in 2017 to 15% by 2020 and 40% by 2025. Import substitution of energy fuels with domestic energy resources offers the opportunity to localise segments of the energy value chain, develop new industries and create employment opportunities – key political priorities in the Kingdom and the region (EIB and IRENA, 2015). Beyond manufacturing of renewable energy technologies, new opportunities for value creation also exist in operation and maintenance, design, engineering and financial services, and development of new solutions such as smart grids and metering.

Presently, hundreds of companies are working in the renewable energy and associated sectors in Jordan. More than 5 000 people are estimated to be working in the supply chain, ranging from design, procurement, electrical, mechanical and civil Installation to quality control, safety, commissioning and operation and maintenance (EDAMA, 2019c). Many existing companies have established new business lines to respond to the growing domestic market for renewable energy, in particular for distributed solar PV systems and solar water heaters.

Jordan's existing domestic manufacturing base for renewables is strong in many areas – modules, cables, mounting structures and solar water heaters – although the limited size of the local market is a significant constraint. Instability in the policy environment – such as the suspension of new projects over 1 MW connected to the distribution network that has been in place since January 2019 and the changes in the design of financing support programme for the solar water heaters – strongly impact the sustainability of businesses and investments in capacity augmentation and product/service diversification in Jordan's renewable energy sector.

There is substantial potential for leveraging the strength of the existing domestic manufacturing base to meet the sector's requirements domestically as well as internationally. Domestic module manufacturers – such as Philadelphia Solar, which has a combined module manufacturing capacity of 800 MW – are already exporting products and delivering EPC in markets such as the United States. To support the local industry, a comprehensive industrial policy is needed that provides an actionable vision for the development of a robust, local industry around a changing energy sector through dedicated incentives, creation of industrial clusters and facilitation of joint ventures and technology transfer. Such a policy should build on the rounds of incentive packages introduced by the government in 2019 to stimulate the economy. Recent packages encompass programmes to support industry and introduce incentives for exports which benefit all industries, including renewable energy.

The competitiveness of existing industries (e.g., cables) can be strengthened through incentives, such as exemptions and concessional loans, that level the playing field for competition in domestic and international markets. By leveraging regional agreements, such as the Joint Arab Market, Jordan could become an important exporter of the various products and services demanded to drive the energy transition.

Domestically, the scale and structure of utility-scale projects can often crowd out local suppliers, developers and financiers. While a local content requirement is in place – and the share has gradually been increased to 35% with each subsequent round – its definition

and effectiveness needs to be closely assessed. It was reported that the 35% requirement can be fulfilled by procuring the necessary value of the project through local contractors even if the products and services are being imported. The design of tenders, both public and private, are also known to introduce challenges for local enterprises to actively participate in due to barriers such as the inclusion of material origin requirements. When possible, these should be reviewed to ensure a level playing field for local technology and service providers to participate in the sector's development.

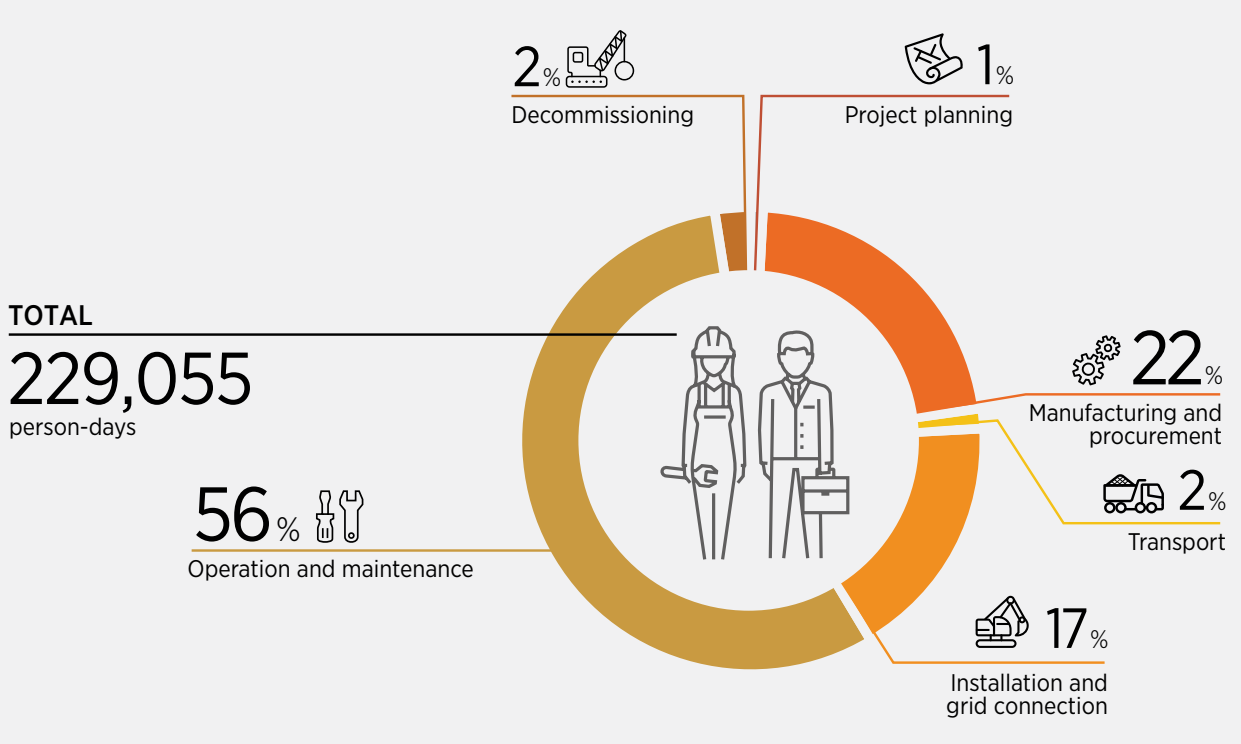
Standards and quality assurance frameworks are crucial for a sustainable and renewable energy market. New regulations issued in July 2019 mandate the testing of all modules at the Jordan Institute for Standards and Metrology and the Royal Scientific Society. Affordable, third-party testing and certification centres need to be accessible for renewables equipment, as well as for raising awareness among consumers on product standards available in the market (e.g., through labelling of solar water heaters).

Building adequate skills for the growing renewable energy sector is crucial to ensuring quality installations and long-term permanence. Identifying the current and future skills needs and partnering with training institutes, universities and industry are important for the development of curricula and delivering quality training for the workforce (Box 6). With the expansion of the renewables sector in the recent past, skills availability in the sector is projected to be satisfactory with several universities having integrated energy-related programmes.

**Box 6. Assessing skills needs across value chain: The case of solar PV**

IRENA's Leveraging Local Capacities studies assess skills and occupational requirements along the renewables value chain. For solar PV, IRENA analysis shows that 56% of the total jobs are in O&M, 22% are created in manufacturing and 17% are in installation and grid connection. Notably, while jobs in manufacturing and installation are temporary, those created in O&M last throughout the lifetime of the project.

**Distribution of human resources required along the value chain for the development of a 50 MW solar PV plant by activity**




**Source:** IRENA (2017)