E-mobility Development in the Context of the Egyptian-German Technical Cooperation

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The future of E-mobility and Urban Planning in Egypt
20th November, 2019
Overview of the German cooperation
Implementing Organizations (GIZ and KfW)

- GIZ operates in more than 120 countries worldwide
- Proud of our long-lasting partnership in Egypt dating back to 1956
- The priority areas agreed with the Egyptian government are
  - Renewable energy (RE) and energy efficiency (EnEff)
  - Water supply and sanitation, irrigation and waste management
  - Sustainable economic development for employment
The Egyptian-German Joint Committee for Renewable Energy, Energy Efficiency, and Environmental Protection (JCEE)

- On-going cooperation since 2008 with the Ministry of Electricity and Renewable Energy (MoERE)
- The 4th phase of the project started in June 2019 until 2023 with a total budget of an additional EUR 7.5 million for TC/TA

The operational framework for the reduction of CO₂ intensity in electricity supply is reduced and at a consumer level improved

<table>
<thead>
<tr>
<th>Renewable Energy (RE) for utility-scale projects</th>
<th>Coordination of the energy efficiency (EnEFF) national strategy</th>
<th>Dissemination of EnEFF technologies</th>
<th>RE and EnEFF on the distribution level</th>
<th>Sustainable energy and climate protection using RE and EnEFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoERE Renewable Energy Authority (NREA)</td>
<td>MoERE EnEff Units (EEUs)</td>
<td>NREA Distribution companies (DSOs)</td>
<td>DSOs NREA</td>
<td>Environmental Agency (EEAA) MoERE</td>
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<tr>
<td>Transmission Company (EETC)</td>
<td>Electricity Regulator (EgyptERA)</td>
<td>ECO-FEI</td>
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Cross-cutting topics including capacity development, policy mechanisms, awareness rising and application of innovative technologies, e.g. smart grids
### The current situation since October 2018

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Electric Vehicles (EVs)</td>
<td>• More used EVs in the market according to منشور استيراد رقم 37 لسنة 2018</td>
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<td></td>
<td>• New EVs from US, European and Korean markets</td>
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<td></td>
<td>• Locally manufactured through Ministry of Military production (MoMP)</td>
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<td>Charging stations</td>
<td>• Charging stations by two (2) charging point operators (CPOs) scattered across Egypt, covering</td>
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<tr>
<td></td>
<td>shopping malls, highways and condensed residential areas in greater Cairo.</td>
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<td></td>
<td>• The chargers are primarily AC and located at filling stations owned by the National Petroleum</td>
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<td>Company (NPCO)</td>
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<td>Electric buses</td>
<td>• E-buses manufacturing line through Arab Organization for Industrialization (AOI)</td>
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<td>• Beyond the pilot and testing phase stage</td>
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<td></td>
<td>• The market is dominated through Chinese products</td>
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<td>Policy</td>
<td>• The governance structure is still in its early phase</td>
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<td>• International IEC technical standards on the national scope are still missing</td>
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<td></td>
<td>• Licensing initiated through EgyptERA</td>
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Agenda

- Process landscape using the GIZ management tool Capacity WORKS
- Development of Scenarios of EVs ramp-up in Egypt (up to 2040)
- Impact of the EV fleet on the Egyptian power system
- Way forward
How was the study structured

**Status quo:** energy supply of mobility sector is performed by fuel oil sector

- **Petroleum oil sector**
  - Decoupling between electricity and petroleum sectors. Mobility has no impact on demand

- **Electricity sector (Generation, transmission, distribution)**
  - Assets for power generation, transmission and distribution were designed to meet only the demand of traditional electricity consumers

- **Mobility sector**
  - Residential, commercial and industrial customers powered via the distribution network

Icons provided from flaticon
How was the study structured (cont.)

Future: energy supply of mobility sector is performed by electricity sector

1. Anticipate ramp-up demand (EVs is the most unpredictable)
2. Analyze impact on the sector
3. Empower role of the market regulator

Petroleum oil sector

Mobility sector

Electricity sector (Generation, transmission, distribution)

E-mobility sector (New consumers)

Electricity consumers

Residential, commercial and industrial customers powered via the distribution network

Icons provided from flaticon
Technical cooperation through Capacity WORKS
Process landscape of E-mobility in Egypt (exemplary landscape)

Steering processes

- Manage policy and regulatory framework
- Manage grid planning and operation
- Manage generation capacity
- ...

Core processes

- Anticipate the potential impact of EVs on the power system
- Anticipate the future electricity demands of EVs
- Integrate solar and energy storage systems
- ...

Support processes

- Empower the roles of stakeholders
- Tariff design and structure
- Subsidies in infrastructure
- ...

To integrate more environment-friendly and efficient vehicles meeting new regulatory requirements set by governments and other law-setting bodys.

The GIZ employs a total of 42 tools clustered through its 5 success factors.
Strategic orientation of the stakeholders

- International best practice and policy recommendations primarily for EgyptERA
- Guidelines on tariff design structure
- Impact on various policies (incl. climate and transport)

Scenarios development of EVs ramp-up in Egypt (Topic of discussion today)

- Major criteria influencing the electricity demand of EVs
- EV fleet for different segments
- Market Penetration

Grid impact

- Anticipated electricity demand and grid loads by EVs
- Forecast of market share of EVs and its impact on the grid
Modelling the future number of EVs in Egypt
Assumptions discussed in next few slides

**Input parameter**

**Calculation parameter**

**Status quo figures:**
- **2005-2017:** population (World Bank reports)
- **2005-2015:** All vehicles in use (UN/OICA)

**Forecasts: (discussed in next slides)**
- **2018-2040:** population (UN projections)
- **2016-2040:** motorization rate decommissioning rate
- **2020-2040:** EVs share of new vehicle sales
Population development according to UN forecast figures

Base Scenario:

- Population growth forecast for Egypt published by United Nations (UN)
- Population growth rates ranged in between 1.3% and 1.7% per year

High Scenario:

- Population growth rate according to base scenario (UN) + 0.5% (calibration)

or Low Scenario:

- Population growth rate according to base scenario (UN) - 0.5%

Population 2017 standing at 97 million
Low: 123, basic: 137, and high: 151 Million by 2040
Motorization rate in Egypt (2005 – 2015)

Definition:
The motorization rate (MR) represents the number of vehicle in use per 1000 inhabitants

- In the period 2005-2015 the motorization rate in Egypt increased by 60% from 38 to 61 vehicles per 1000 inhabitants
- As the population was also growing considerably during this period, the increase of motorization rate was achieved by an enormous increase of total numbers of vehicles in use from 2.9 to 5.7 million
- The growth rates are between 3% and 11% per year

Q. How to forecast the futuristic MR up to 2040?

Source: International Organization of Motor Vehicle Manufacturers (OICA)
Estimation of the motorization rate by 2040
Approach considering population density

**EU, Japan**
- Population spread across whole country over long distances
- Motor vehicles used to cover larger distance
- High MR level of 543 - 591

**Hong Kong, Singapore**
- High population density, population lives in a “small” area
- Smaller distance to be covered during daily routines
- Rather low MR level of 92 and 147

**Egypt (Comparable to Hong Kong or Singapore)**
- Selected motorisation rate levels for Egypt for 2040 to be applied in the model:
  - 100 (basis), 140 (high), or 70 (low)
Forecasting the number of vehicles in use in Egypt by 2040

Development of population in Egypt

Development of Motorisation Rate in Egypt

Development of number of vehicles in use in Egypt

Note: There are various secondary factors (which were not taken into account) incl. the macro- and micro-economics aspects.
Decommissioning and sales of vehicles in Egypt by 2040

Factors and assumptions

Assumption for internal combustion engines (ICEs)
- **Lifetime**: 15-20 years (decommissioning of 5% per year), based on an average driving distance of 15,000 km per year in Egypt
- A detailed lifetime will depend on a variety of factors incl. regular maintenance, brand ... etc.

Assumption for (first generation) of electric vehicles
- **Lifetime**: 10-15 years. Lower than ICEs since there is no international experience (yet) regarding battery lifetime.
- Figures may be increased in future, and affected by customs regulations منشور استيراد رقم 37 لسنة 2018
- Driven by **EV market attractiveness**

**Political factors**
- Charging infrastructure
- Government monetary subsidies (one-time or post-purchase)
- Non-monetary regulations (parking)

**Econmical factors**
- Purchasing price
- Fuel price
- Maintenance cost
- Battery

**Technology factors**
- Driving range
- Charging time
- Charging capacity

One of the biggest and strongest catalysts for EV market attractiveness is the presence of monetary and non-monetary government subsidies.

EV Market Attractiveness is defined as the degree to which from a customer perspective the purchase of an EV instead of a conventional vehicle is a more attractive option, in both monetary and non-monetary terms.
E-mobility expansion intentions / targets of selected countries
Selection of EV-share of new vehicles sales in Egypt in 2040 (Strategic target)

Countries worldwide have set targets for an absolute number or overall share of electric vehicles by a certain year.
(Still missing in Egypt in SDS2030 or ISES2035).

In the developed model (exponential growth expected)
- **Starting year (2019):** 0%
- **End-year (2040):**
  - basis scenario 45%
  - high scenario 75%
  - low scenario 25%

The figures are rather conservative.

Data Source: [http://slocat.net/sites/default/files/e-mobility_overview.pdf](http://slocat.net/sites/default/files/e-mobility_overview.pdf)
Share of EVs by 2040

*Putting all the pieces together*

The total number of EVs in Egypt is expected to be in the range of **1.2 to 3.6 million** vehicles in 2040.

- **Low:** 9%, **Basic:** 15%, and **High:** 26% of total vehicles

The model provides rather indicative figures and cannot be considered as a complete model

- Secondary factors are still missing
  - **Macro-economics**, incl. consumer price index, inflation rates, interest rates …etc.
  - **Micro-economics**, incl. product pricing, product related promotion
  - EV market attractiveness (slide 16)

While the figure seem conservative, they make sense put in perspective with other countries, e.g. China 20% EV share of new sales by 2025 (previous slide)
What else was covered in the GIZ study
Design of the tariff structure by the Egyptian electricity regulator (EgyptERA)

Tariffs used to promote the ramp-up of e-mobility, e.g.:

- Free charging & parking or “Pay for the service and not for the energy” (previous model). Covers public parking space with charging infrastructure
- Reduced tariff for EV users with dedicated meter (residential)
- Time-of-use tariff (residential/public)

A time-of-use tariff system could be applied in Egypt
- to avoid charging in super-peak-hours and
- encourage charging in off-peak-hours
What else was covered in the GIZ study (cont.)
Licensing and standardization by EgyptERA

The allocation of licenses can be applied to control the EV market. There are different types of licensing:

- License to limit access of CPOs on the grid
- License as quality control (e.g. traders on stock exchange)

- (Technical) requirements,
  - construction (by building authority)
  - electrical connection, safety …etc.
  - Terms and conditions for end customers
  - Charging standards

Source: German National Platform for E-Mobility, 2010)
What else was covered in the GIZ study (cont.)

Grid Impact analysis for regions owned by North Cairo DSO

- Stress test (geographic heat map) with different penetration levels
- The models were developed with DigSILENT PowerFactory
- The stress tests considered 5% penetration and 25% penetrations (possible in 15-20 years)
What else was covered in the GIZ study (cont.)
Determination of future electricity demand of EVs for power system planning

Annual driving distance per EV
Km/year [~10,000-15,000]

Specific electricity consumption per EV
kWh/100km [~17kWh]

Annual Electricity consumption
kWh/year

Number of EVs
In previous model

Electricity consumption of EVs
TWh/year or GWh/day

Charging hours per day for EV
h/day

Overall charging load
[GW]

<table>
<thead>
<tr>
<th>Scenario</th>
<th>EVs in 2040</th>
<th>TWh/year</th>
<th>GWh/day</th>
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</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.2 Mio</td>
<td>2.04</td>
<td>5.6</td>
</tr>
<tr>
<td>Basic</td>
<td>2.1 Mio</td>
<td>3.57</td>
<td>9.8</td>
</tr>
<tr>
<td>High</td>
<td>3.6 Mio</td>
<td>6.12</td>
<td>16.8 (energy needed 2040)</td>
</tr>
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</table>
Closing remarks and way forward (same as 2018)

1. Creation of business models
   - Owning the value chain and understanding requirements of the Egyptian market

2. Cooperation to define the stakeholders map (actors' ecosystem)
   - Collaboration between the private and the public sector and international cooperating agencies

3. Education, awareness and capacity building
   - Consumers and stakeholders

4. Define drivers and strategy
   - EV Market Attractiveness with regards to political factors
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