

## Ex-post evaluation

# “Energy efficiency/low-energy lamp programme”, Morocco

|                                             |                                                                 |                              |      |
|---------------------------------------------|-----------------------------------------------------------------|------------------------------|------|
| <b>Title</b>                                | FC module “Energy efficiency/energy-saving lamp programme”      |                              |      |
| <b>Sector and CRS code</b>                  | Energy, CRS code: 23110                                         |                              |      |
| <b>Project number</b>                       | BMZ no. 2009 66 754                                             |                              |      |
| <b>Commissioned by</b>                      | Federal Ministry for Economic Cooperation and Development (BMZ) |                              |      |
| <b>Recipient / Project-executing agency</b> | Office Nationale de l'Electricité et de l'Eau (ONEE)            |                              |      |
| <b>Project volume/ Financing instrument</b> | EUR 10.54 million / low interest loan                           |                              |      |
| <b>Project duration</b>                     | 2012–2020                                                       |                              |      |
| <b>Reporting year</b>                       | 2023                                                            | <b>Year of random sample</b> | 2022 |

## Objectives and project outline

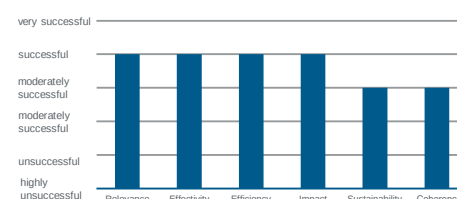
The FC measure was part of a Moroccan government programme in which light bulbs were replaced nationwide by energy-saving lamps (ESL). The target at outcome level is a cumulative saving of 5, 250GWh by 2030 and 360MW peak load. At impact level, the goal is to contribute to more efficient use of scarce energy resources and climate action by avoiding a cumulative 3.675 million tCO<sub>2</sub> by 2030. The goals were to be achieved through the installation of 10 million ESLs, a communication campaign, training and equipping of the distribution network as well as the implementation of a disposal study.

## Key findings

The project made a relevant contribution to the more efficient use of scarce energy resources and to climate action. The project has been rated “successful” for the following reasons:

- Replacing conventional light bulbs with energy-saving lamps is one of the most cost-effective measures for energy efficiency and climate action. The project was completely aligned with Morocco’s energy policy priorities.
- A contribution was made to improving the living conditions of particularly disadvantaged or vulnerable target groups by increasing their disposable income; this could unfortunately not be quantified due to a lack of suitable monitoring.
- The planned results and overarching developmental impact have been almost fully achieved, but over a longer period than originally planned.
- The project has a certain risk with regard to its sustainability. There was no support for the introduction of legal and economic framework conditions to ensure the sustainability of the national transformation to efficient lamps. This could also have been done, for example, by means of a complementary measure.

## Overall rating: successful



## Conclusions

- A theoretically high microeconomic and macroeconomic benefit of energy efficiency measures does not automatically lead to rapid market penetration due to high transaction and investment costs (and subsidies for conventional products). As a result, loan programmes and accompanying training, information and quality control measures as well as legal provisions are generally necessary.
- In energy efficiency projects, theoretical savings are often assumed based on a simulation. For this reason, the actual energy savings of a representative sample of the target group should be monitored during the project.
- The impact of energy efficiency projects on the available income of disadvantaged target groups should be included and monitored in the target and indicator system.

## Ex-post evaluation – rating according to OECD-DAC criteria

### List of abbreviations

|        |                                                                                                        |
|--------|--------------------------------------------------------------------------------------------------------|
| ADEREE | Agence de Développement des Energies Renouvelables et de l'Efficacité Energétique                      |
| PCR    | Project Completion Report                                                                              |
| AMEE   | Agence Marocaine pour l'Efficacité Energétique                                                         |
| CDER   | Centre de Développement des Energies Renouvelables                                                     |
| CDN    | Contribution Déterminée au niveau national (corresponds to NDC)                                        |
| CDM    | Clean Development Mechanism                                                                            |
| CFL    | Compact fluorescent lamp/light                                                                         |
| DC     | Development Cooperation                                                                                |
| EPE    | Ex-post evaluation                                                                                     |
| ESL    | energy-saving bulbs (LBC in French)                                                                    |
| FC     | Financial Cooperation                                                                                  |
| GEF    | Global Environment Facility                                                                            |
| GIZ    | German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit) |
| GWh    | gigawatt hours (1 GWh = 1,000 megawatt hours MWh = 1 million kilowatt hours KWh)                       |
| LBC    | Lampes à basse consommation (ESL in English)                                                           |
| LED    | Diode électroluminescente (English: light-emitting diodes)                                             |
| LI     | Lamps à incandescence (conventional bulbs)                                                             |
| LFC    | Lampes fluocompactes (CFL in English)                                                                  |
| MAD    | Moroccan Dirham (national abbreviation also Dh)<br>exchange rate January 2023: 1 EUR = 11.06 MAD       |
| MDG    | Millennium Development Goals (MDG)                                                                     |
| MEMEE  | Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement (MEMEE)                              |
| MW     | Megawatt (1 MW = 1,000 kilowatts KW = 1 million watts)                                                 |
| NDC    | Nationally determined contribution                                                                     |
| ONE    | Office National de l'Electricité                                                                       |
| ONEE   | Office National de l'Electricité et de l'Eau                                                           |
| PP     | Programme proposal                                                                                     |
| SDG    | Sustainable Development Goals (SDGs)                                                                   |
| SIE    | Société d'Ingénierie Energétique                                                                       |
| UNDP   | United Nations Development Programme                                                                   |
| UNFCCC | United Nations Framework Convention on Climate Change                                                  |

### General conditions and classification of the project

As an Financial Cooperation (FC)-module, the project was part of the “Environment and Climate Change” Development Cooperation (DC)-programme in Morocco, with the programme objective of “Introducing a development model that minimises negative impacts on the environment and the climate, and which takes precautions against climate change”<sup>1</sup>. The LogFrame logic of the DC programme was updated in April 2019, and the programme objective and time horizon were changed as follows: “Moroccan households, public institutions and companies are supplied with energy safely and in a climate-friendly manner. Time horizon 2015–2020”. The FC module was to be linked to other modules in the areas of energy efficiency, capacity building and network expansion as well as flanking TC measures that support Morocco's energy transition (achievement of synergy effects).

<sup>1</sup> See results matrix dated 11 February 2014 in the programme-specific KfW report dated 8 April 2014

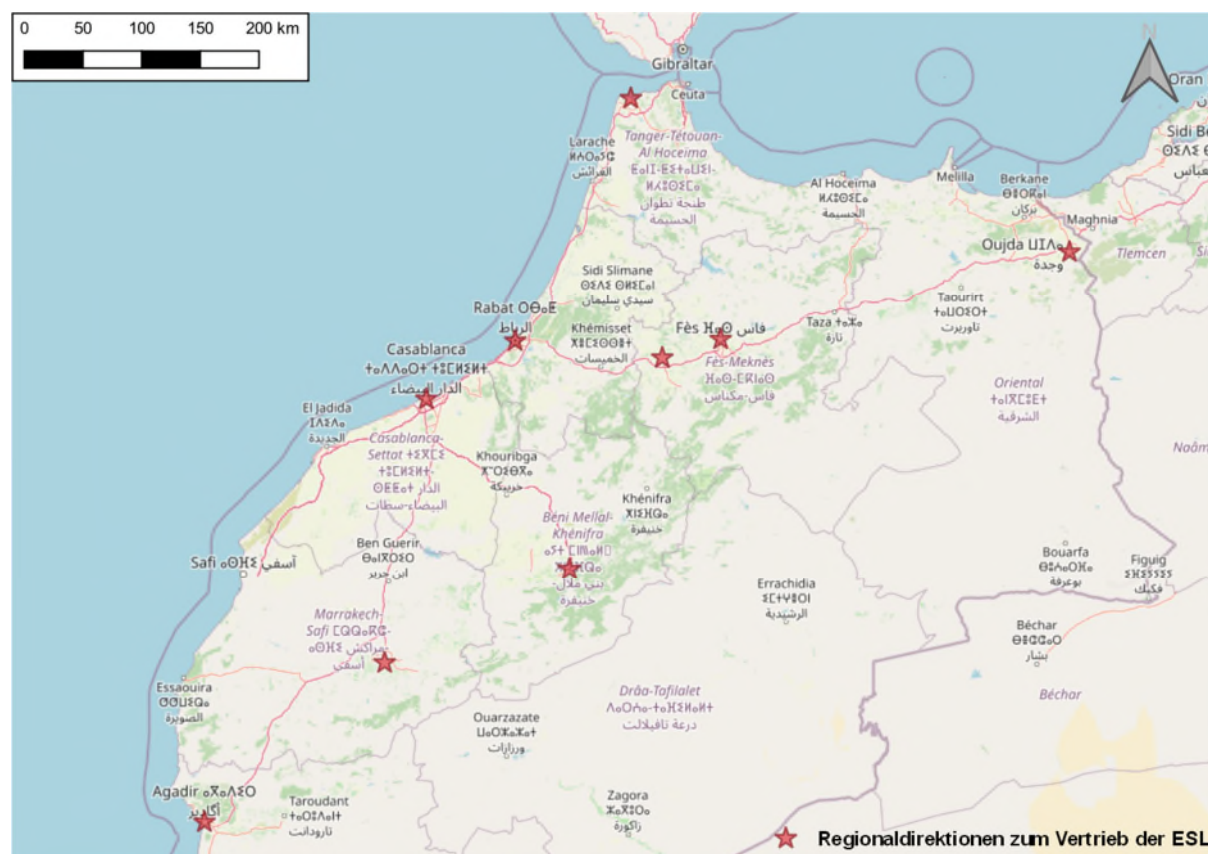
## Brief description of the project

The “Energy Efficiency/Low Energy Lamp Programme” project was part of a Moroccan government programme in which light bulbs (lampes à incandescence – LI) were replaced by energy-saving lamps<sup>2</sup> (ESL) nationwide. As a result, the enormously increased demand for electricity – and especially the peak load in the evenings, was set to be brought back down. As part of this INARA programme,<sup>3</sup> the executing agency “Office National de l'Electricité et de l'Eau (ONEE)” planned the installation of a total of 15 million compact fluorescent lamps (CFL). Since 2008, 5 million CFLs have been installed in a first phase financed by the World Bank. The second phase, financed by the German FC, primarily envisaged the installation of 10 million CFLs.

The objective of this project at outcome level was to save electrical energy. In purely mathematical terms, the project was to save 360 MW peak load, which would not have to be provided by ONEE. The overarching developmental objective of the FC measure at impact level was to contribute to more efficient use of scarce energy resources and to climate action. The target group was the private and public customers of the state-owned electricity provider ONEE, which mainly supplied rural and outlying areas.

In addition to the installation of the 10 million CFLs, a communication campaign, training and equipping of the distribution network as well as an environmentally oriented disposal study were planned as part of this FC project.

**Figure 1: Map of module regions** (data source: OpenStreetMap Standard, own presentation)



<sup>2</sup> At the time of project design, only compact fluorescent lamps (CFL) were regarded as energy-saving lamps (ESL). At the time, ESL was a marketing name for the CFLs. However, this term now also includes other energy-saving light sources such as LEDs. Since the end of 2018, the export, import and manufacture of compact fluorescent lamps within the EU has been prohibited under the EU Mercury Regulation. An EU ban on conventional light bulbs had already been imposed in 2012.

<sup>3</sup> INARA is Arabic for “lighting”

## Breakdown of total costs

The total investment costs have almost halved due to the delays in project implementation and the simultaneous reduction in procurement costs for CFLs. The executing agency ONEE's own contribution increased from approximately 17% to approximately 21% of the total costs. The FC contribution in the form of a subsidised interest loan was primarily used to finance the significantly higher initial investment needed for CFL procurement compared to that needed for conventional light bulbs.

|                                    |                    | Inv.<br>(planned) | Inv.<br>(actual) |
|------------------------------------|--------------------|-------------------|------------------|
| <b>Investment costs (total)</b>    | <b>EUR million</b> | <b>24.00</b>      | <b>13.40</b>     |
| Counterpart contribution           | EUR million        | 4.00              | 2.86             |
| External financing                 | EUR million        | 20.00             | 10.54            |
| <i>Of which budget funds (BMZ)</i> | <i>EUR million</i> | <i>20.00</i>      | <i>10.54</i>     |

## Evaluation according to OECD-DAC criteria

### Relevance

#### *Policy and priority focus*

Given the country's significant population and economic growth, the energy sector was faced with the challenge of an increasing demand for energy and, in particular, electricity at the time of the 2012 project appraisal (by approx. 6% per year in the period from 2005 to 2015). This ultimately led to capacity bottlenecks in power plant output and sharply increasing peak loads (1999 to 2010 from 2.4GW to 4.8GW), extremely high import dependency (97.5% for primary energy in 2009) with corresponding burden on the national budget and negative effects on Morocco's balance on current account. It also led to an increasing environmental impact due to the increased share of fossil energy in the energy mix (more than three times excessive concentration of particulate matter compared to the WHO reference value) and a 70% increase in CO<sub>2</sub> emissions between 1997 and 2007.<sup>4</sup>

To address these challenges, the Moroccan government pursued an ambitious policy of renewable energy and energy efficiency promotion:

- **Energy efficiency** was described in 2008 as an important lever of national energy policy in the "Programme National des Actions Prioritaires (PNAP)" of the National Energy Strategy (Stratégie Énergétique Nationale) of the MEMEE (Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement). Among other things, the programme indicated the potential to reduce energy consumption by 12% by 2020 and by 15% by 2030. In addition, the "distribution of ESLs" in the construction sector was defined as the "expected result" of the programme. The "short- to medium-term ban" on conventional light bulbs (Lamps à Incandescence – LI) was listed as a measure of the medium- and long-term energy efficiency strategy.
- The Energy Efficiency Act of 2011 (Loi n° 47–09 relative à l'efficacité énergétique promulguée par le Dahir n° 1-11-161 du 1er kaada 1432, 29 September 2011) points to the core problems of Morocco's dependence on energy imports as well as the strongly growing energy demand, and explicitly mentions the goal of widespread distribution of ESLs.
- The "Stratégie Nationale de l'Efficacité Énergétique à l'horizon 2030" was presented in March 2014. It envisaged a total reduction of 25% in final energy consumption in all sectors by 2030. Between 2014 and 2020, a total of 320 million tCO<sub>2</sub> were to be saved across all sectors. Here too, the ban on the sale of light bulbs (LI) was listed as a concrete measure for the years 2014/2015. This strategy was updated by MEMEE in August 2020.

<sup>4</sup> Appropriate sources are listed in Annex 5.1 in the annexes.

- In order to embed the importance of energy efficiency in the Moroccan government's energy strategy, the AMEE (Agence Marocaine pour l'Efficacité Energétique) was founded in 2016, which exclusively pursues the promotion of energy efficiency.
- Morocco's nationally determined contributions (NDC), updated in June 2021, formulated Morocco's global target of reducing greenhouse gases by 45.5% compared to the reference scenario by 2030 as part of the Paris Agreement. Of this, 18.3% is to be achieved through 34 measures financed nationally. One of these measures mentioned in the NDC (no. 25) is a programme to promote energy-saving lamps in Moroccan households by installing 40 million LEDs and 40 million CFLs between 2010 and 2030.
- The project also aimed to contribute to the achievement of the 2030 Agenda with the Sustainable Development Goals (SDGs) SDG 7 "Affordable and Clean Energy" and, in particular, to sub-goal 7.3 "By 2030, double the global rate of improvement in energy efficiency".

The relevant quality characteristics of the Federal Ministry for Economic Cooperation and Development (BMZ) were taken into account in the project concept as far as possible. The target group was not explicitly limited to poorer households in order to ensure a wide impact and transformation across the entire lighting sector. Since ONEE's customers focus on the outskirts of cities and rural areas, while the often more prosperous urban households are supplied by other municipal and private electricity providers, disadvantaged households are disproportionately the main beneficiaries of this FC project. Since these poorer households also consume a larger proportion of their electricity for lighting (34.4% compared to 19.5% for the national average budget<sup>5</sup>), it can even be assumed that an indirect contribution to alleviating poverty and reducing inequality is being made. However, no corresponding indicators were identified in the appraisal report, and there was no follow-up on the development of the target group's disposable income.

#### *Focus on needs and capacities of participants and stakeholders*

The project was intended to contribute to the safe, efficient and climate-friendly electricity supply of the target group (ONEE's private and public customers). Therefore, all ONEE customers were included in the target group; there were no specific other selection criteria.

Significant gender impact potentials due to a different design were not analysed during the planning and design of this project at the time and could not be identified in the household survey that took place as part of the EPE. The non-representative target group survey revealed that approximately 85% of those who pay household electricity bills are male. Therefore, male household members benefit first and foremost from the savings achieved by the project. The extent to which this benefit has been passed on to other household members is not clear from the target group survey (see Annex 5.2, p. 17 on the target group survey in the annexes).

The project was also geared towards the interests of executing agency ONEE, which included the avoidance of voltage fluctuations and power outages through the reduction of power consumption and, in particular, peak load.

#### *Appropriateness of design*

The project's design was technically, organisationally and financially appropriate, and was very well suited to contributing to solving the core problem (strongly increasing energy demand, capacity bottlenecks, import dependency, environmental impact). The target system and the underlying impact assumptions were plausible and also fundamentally verifiable. However, follow-up parallel to the project's implementation on its impact on selected and representative ONEE customers (beneficiaries and comparison group) would have been helpful in order to corroborate the validity of the assumptions and the savings actually achieved.

The results chain is generally plausible; a reduced-interest loan for the procurement of energy-saving lamps (**input**) was intended to enable the **output** of "installation of 10 million CFLs", supplemented by a communication campaign, training and equipping of the distribution network as well as implementation of a disposal study. The implementation of these measures under defined framework conditions (average service life of the CFLs in exchange for LI, useful life, etc.) leads to the desired **outcome** of "saving of electrical energy" (as well as at the same time to the reduction of the peak load not mentioned in the project appraisal's LogFrame but important for the project-executing agency). The achievement of the outcomes also makes a relevant contribution to the

<sup>5</sup> Source: PNUE/UNEP 2017, p. 19. Urban households consume almost twice as much electricity as rural households (1,576kWh per year compared to 818kWh).

development policy objective at **impact** level, i.e. to the efficient use of scarce energy resources and to climate action. The reduction in greenhouse gas emissions associated with increased energy efficiency benefits the entire population of Morocco as well as humanity globally.

The project was a DC module as part of a DC programme entitled “Environment and Climate Change”. The project’s contribution to the DC programme objective in the formulation from 11 February 2014 (“Introduction of a development model that minimises the negative effects on the environment and climate, and which takes precautions against climate change”) can only be partially and indirectly tracked and checked (environmental impact, e.g. on air quality through reduction of fossil energy production and climate impact through reduction of greenhouse gas emissions). In the version of the programme objective dated 25 April 2019 (“Moroccan households, public institutions and companies are supplied with energy in a safe and climate-friendly manner. Time horizon 2015–2020”), the contributions of the project are easier to track (“secure supply” through reduction of consumption and peak load and “climate-friendly” through reduction of greenhouse gas emissions) and can also generally be better assessed by the selected indicators.

The evaluation of the first phase of the INARA programme (World Bank financing) showed that the distribution of 4.6 million CFLs saved approximately 345 GWh annually and reduced peak load by approximately 200 MW (in each case in the last year of the project term). Household electricity bills fell by 20%, while electricity consumption fell by 22% (World Bank 2016). On this basis, the objectives at outcome level of the project considered here appear realistic and rather conservative: based on the distribution of 10 million CFLs (doubled quantity), annual savings of 660GWh and 360MW peak load (less than twice as much) can be assumed.

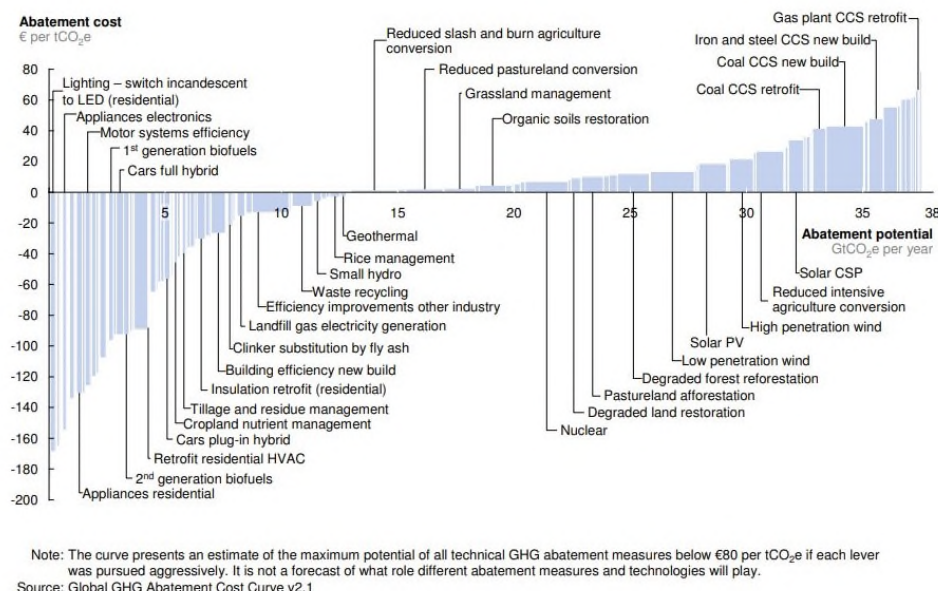
However, the choice of indicators in the project’s design proved to be unsuitable, as their achievement depends on all 10 million CFLs being distributed and installed within the first two years of the project and the savings for all 10 million CFLs being achieved in the following eight years. In fact, the number of CFLs distributed in the first two years (2014 and 2015) amounted to only around 1.7 million of the 10 million CFLs, with this figure gradually increasing to about 9.5 million by 2023. Although this is expected to achieve the desired **cumulative** savings over a total period of approximately 16 years with a service life of approximately eight years for the CFLs up to around 2030, the originally intended average values per year are not expected to be achieved for ten years. Since it is not uncommon for the implementation of energy efficiency projects to be delayed (the World Bank project INARA 1 was also delayed by 21 months), the designation of cumulative indicators would have made more sense than the choice of annual average values. We have therefore adjusted this in this evaluation at outcome and impact level.

In principle, the replacement of conventional light bulbs (LI) by ESLs is one of the most cost-effective measures for generating energy savings and for climate action. The McKinsey chart below shows the costs per avoided tonne of CO<sub>2</sub> as well as the quantitative annual reduction potential for various energy-saving technology measures as global averages using the “Global GHG Abatement Cost Curve” (version 2.1 from 2010).

Figure 2: McKinsey Global Greenhouse Gas Abatement Cost Curve (2010 version 2.1)

Exhibit 6

V2.1 Global GHG abatement cost curve beyond BAU – 2030



Source: [McKinsey 2010](#) : "Version 2.1 of the global greenhouse gas abatement cost curve", p. 8

The measures that cause negative costs, i.e. the CO<sub>2</sub> emissions saved per tonne even facilitate a financial profit, are listed on the left on the X axis. On the far left of the X-axis, the replacement of bulbs by ESLs (here LEDs) is listed with over EUR 160 negative costs (profit), i.e. it is the most cost-effective measure for CO<sub>2</sub> reduction (and energy saving). Since other studies with more realistic assumptions (e.g. the 2009 [cost-potential curves of the Wuppertal Institute](#) for ADEREE and GIZ with data for Morocco) also come to the conclusion that the replacement of light bulbs by CFLs is one of the "low-hanging fruits", i.e. one of the most cost-efficient climate action measures, the approach of this project can be assessed as particularly relevant for climate action.

The project's design is based on a holistic approach to sustainable development in that the target group, and in particular the poorer households, benefit financially (lower electricity bills), the overall population experiences a lower environmental impact (due to reduced air pollution from fossil power plants and the mitigated effects of greenhouse gas emissions, e.g. with regard to extreme weather, drought, etc.) and the executing agency ONEE or the government has to make fewer investments in new power plants by reducing peak loads and at the same time can ensure security of supply in the face of strongly growing demand for electricity.

In addition to the choice of indicators, one weakness in the project's design was the lack of consideration of the question of how the effects can be sustainably ensured over the project term. In view of the large difference between current prices<sup>6</sup> and a high proportion of counterfeit and illegally imported ESLs of poor quality,<sup>7</sup> there is a risk that the target group will use conventional bulbs (LI) again at the end of the ESLs' service life, as they cost just a quarter of the price of an ESL. It would therefore have been necessary to provide for a quality assurance component (minimum energy standards, label programmes where applicable) as well as regulatory (step-by-step prohibition – out-phasing of LI) and financial mechanisms in addition to tax mechanisms in the project's design in order to align the prices of LI and ESLs. This shortcoming would not have been as serious if coordination had taken place with the UN Environment and GEFs' parallel project "Market Transformation for Energy Efficient Lighting in Morocco" (2012–2019), which contained precisely these components. However, as described in the Coherence section, there was no coordination between the two projects documented in the reporting.

<sup>6</sup> As of February 2023: approx. EUR 0.50 per unit for LI and approx. EUR 2 per unit for an LED

<sup>7</sup> See Missaoui (2019), p. 6–10

## *Response to changes/adaptability*

Originally, only the procurement of CFLs was planned. KfW proposed an LED component later, but the executing agency ONEE did not wish to implement it.

## *Summary of the rating*

The project's objectives and activities were largely in line with the national climate plans, energy sector strategies and policies as well as the Sustainable Development Goals (SDGs), and were well aligned with the needs and capacities of those involved and affected. The project's design is satisfactory, with clear and comprehensible formulation of the core problems as well as a suitable target system and results chain – with the exception of the choice of indicators.

## **Relevance: 2**

## **Coherence**

### *Internal coherence*

Saving energy and reducing environmental impact are among the Moroccan government's priority goals. Environmental protection, renewables and energy efficiency are core areas of the development cooperation (DC), with Morocco being a key focus area.

As an FC module, the project was part of the "Environment and Climate Change" DC programme in Morocco. It was linked to other modules in the areas of energy efficiency, capacity building and network expansion as well as accompanying TC measures, which supported Morocco's energy transition in a complementary manner<sup>8</sup>. With the exception of the reference to "regular coordination meetings between TC and FC" (e.g. KfW Reporting 2018, p. 6), there is no concrete evidence of direct synergies and accompanying measures. However, it can be assumed that, for example, the TC module "Consulting AMEE" was at least indirectly effective in a complementary manner in that it identified the energy efficiency potential in Morocco and built up corresponding capacities. In addition, the other modules of the DC programme for the expansion of renewable energies (e.g. through hydroelectric and solar power plants) had synergistic effects for the reduction of greenhouse gas pollution as a result of the improvement of the emission factor (CO<sub>2</sub> emissions per kilowatt hour generated).

Since the project requires less energy to be generated in thermal power plants, it contributes to SDG 7 ("Affordable and Clean Energy").

### *External coherence*

The project was designed as the second part of the programme implemented by the Moroccan government and co-financed by the World Bank to replace traditional light bulbs with energy-saving lamps nationwide. From 2008 to 2011, the World Bank financed the first phase of the programme with ONE (later ONEE), which consisted of the distribution of 5 million ESLs with CFL (compact fluorescent lamp) technology. The World Bank's programme generated learning experiences for the implementation of this project as well as synergies at impact level.

In parallel to this project, the UN Environment and GEF implemented the "Market Transformation for Energy Efficient Lighting in Morocco" project with GEF ID 4139<sup>9</sup> with a total volume of approximately USD 6.8 million from March 2012 to September 2019. The planned outputs of this programme were:

- Distribution of 10 million CFLs to Moroccan households to replace inefficient bulbs<sup>10</sup>
- Proposal of Minimum Energy Performance Standards to promote energy efficient lamps including quality control and test procedures for CFL and LED lamps
- A detailed plan and recommendations for recycling and safe disposal of used CFL and LED lamps
- Design of a financial mechanism to reduce the purchase price of CFLs for Moroccan consumers

<sup>8</sup> Project completion report dated 11 December 2019

<sup>9</sup> See UN Environment GEF Project Implementation Report (PIR), Fiscal Year 2019

<sup>10</sup> These appear to be the same 10 million CFLs from the KfW ONEE CFL project, as the PIR mentions that ONEE invested USD 13.24 million to buy the 10 million CFLs and received a loan from KfW for it.

- National communication campaign in radio and TV as well as demonstration objects and LED screens in 2019.

Although there were obviously both overlaps and complementary measures of the GEF programme with the KfW-ONEE project, neither KfW nor ONEE can identify any coordination of the measures with GEF/UN Environment in their reporting. In the report by GEF/UN Environment, the KfW ONEE project is mentioned in a footnote, but it appears that there was no mutual alignment or coordination.

The project supplemented the partner's own efforts appropriately and to a reasonable extent. ONEE'S own contributions involved the purchase and acceptance of the CFL deliveries, training of the sales network partners and the conception of a contract with these partners (installers, direct marketing agents and sales outlets) as well as project management for the implementation of the project, including on-site progress checks. At approximately EUR 2.86 million, ONEE's own contribution amounted to around 21% of the total investment costs.

### Summary of the rating

Internal coherence can be described as quite successful, as regular consultations have taken place as part of the DC programme "Environment and Climate Change". There are no indications of overlaps or friction losses with other German DC projects, nor is there any information about direct synergy effects or accompanying measures. External coherence was moderately unsuccessful, as no coordination with the UN Environment and GEF projects, which were largely carried out simultaneously and in a complementary manner, is discernible, so that overlaps and duplicate financing in sub-areas (e.g. for information campaigns) cannot be ruled out.

**Coherence: 3**

## Effectiveness

### Achievement of (intended) targets

The achievement of the objectives at outcome level (saving of electrical energy) can be summarised as follows (see the ex-post calculations in Annexes 5.7 and 5.8 in the annexes):

| Indicator                                                            | Status during PA | Target according to EPE     | Actual value at PCR (optional)                                            | Actual value at EPE                                                                                                     |
|----------------------------------------------------------------------|------------------|-----------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| (1) <b>New:</b> Cumulative savings of 5,250GWh <sup>11</sup> by 2030 | 0                | 5,250GWh cumulative by 2030 |                                                                           | Value approx. 83% achieved: 4,359GWh cumulative (Annex 5.7), target value 5,250GWh at least 95% expected by around 2030 |
| (2) Saving 360 MW peak load                                          | 0                | 360MW                       | Value approx. 70% achieved (according to ONEE for 2015–2020: 253 MW/year) | Value approx. 70% achieved (according to ONEE for 2015–2020: 253 MW/year, see Annex 5.7)                                |

### Contribution to achieving targets

The objectives at output level were almost completely achieved. More than 95% of the CFLs were distributed at the time of the ex-post evaluation, the communication campaign was carried out, the disposal study was presented and the training as well as equipping of the sales network was implemented as an own contribution by ONEE.

<sup>11</sup> Value from Annex 6 of the PP

According to the project completion report dated 11 December 2019, just over 9 million CFLs had been sold to the target group by this date (especially in outlying districts and rural regions). The remaining approximately 1 million CFLs were to be sold to end customers in the course of 2020. According to ONEE, close to 760.000 households were supplied with a total of approximately 5.9 million CFLs between 2014 and 2023. Around 3.6 million more CFLs were distributed to the other part of the target group (administration / small businesses / direct sales) in the same period. Therefore, in total, around 9.54 million of the originally planned 10 million CFLs were distributed by May 2023. The remaining CFLs were still in the inventory of ONEE and its sales partners at the time of the EPE and are still to be distributed.

In the disposal study, a follow-up plan was proposed that was largely implemented in the area of communication (benefits of the CFLs, safety instructions for broken lamps, awareness-raising and information campaigns, etc.). On the other hand, measures were only implemented to a non-representative extent in the area of reviewing actual household energy savings. The proposed measures for the disposal and recycling of the CFLs as well as for health and environmental protection at the landfill sites were also not implemented.

Since the contract with the supplier of the CFLs was only concluded in July 2014, an adjustment of the catalogue of measures (outputs) and the objectives at outcome level by an additional LED component in favour of the then available better technology (LEDs instead of CFLs) could possibly have led to even better results. In the UNDP and GEF's parallel energy efficiency project "Improving the energy efficiency of lighting and other building appliances" in Egypt (2010–2018, approx. USD 19.5 million), a decision was made at short notice at the end of 2013 as part of the "adaptive management" concept to not promote the originally planned CFLs, instead only promoting LEDs. In the final evaluation of this project, it is assumed that, without this decision, the results of the corresponding outcome would have been 50% worse<sup>12</sup>. However, as the price differences between CFLs and LEDs were still considerable at this time (approx. USD 5 vs USD 15, see Figure 10 in the "Sustainability" section), ONEE's decision to use CFLs was still expedient. However, the available residual funds could have been used for the procurement of additional LEDs. Although this very expedient component was planned, it was ultimately not implemented due to a strategic and business policy decision by ONEE.<sup>13</sup>

The indicators for the objectives at outcome level are values calculated ex ante within the framework of a methodology specified<sup>14</sup> by the UNFCCC (United Nations Framework Convention on Climate Change; in the PP in Annex 6, p. 5). These values are achieved under specified defined conditions (e.g. duration of CFL use per day, useful life, light efficiency of the lamps, technical losses in the network, etc.). An explanation of how the calculations of the ex ante and ex post values are understood (Excel tables in Annexes 5.6 and 5.7) is given in Annex 5.9 in the annexes.

In the first phase of the INARA programme financed by the World Bank, an average daily useful life of the CFLs of two hours and a service life of five years (= 3.650 hours) was assumed. The difference between the power consumption of a bulb and a CFL is stated as an average of 60W (World Bank 2016, p. 41). On the other hand, according to the PP, the project considered here assumes an average useful life of 3.5 hours, a service life of 7.8 years (=10,000 hours) and a consumption difference of 67W per lamp. Regarding the duration of use per day, the standard values of the CDM methodology were adopted in the project reviewed here, with these values assuming a distribution of six CFLs per household.

In the updated ex-post savings calculation at the time of the EPE, realistic/validated values were expected (see Annex 5.7). Based on the information provided by ONEE and the Philips contract, the following changes compared to the ex ante calculation have been added: CFL output 20W instead of 18W, CFL useful life 12,000 hours instead of 10,000 hours (9.4 instead of 7.8 years), number of distributed CFLs 9,543,000 instead of 10 million. In addition, the values for the technical and non-technical grid losses were increased to 15% in accordance with ONEE (see Annex 5.8). The values for the output of the replaced LI and for the CFLs' daily usage time were left constant, although the target group survey suggests lower values (75W for the LI and approx. 2.5 hours of usage time).

A systematic and representative follow-up/validation to accompany the project (both the values for the actual energy savings and the assumptions for the framework conditions) was not carried out for the affected ONEE customers. Also, no ex-post calculation of the avoided CO<sub>2</sub> emissions was carried out before the EPE (similar to the

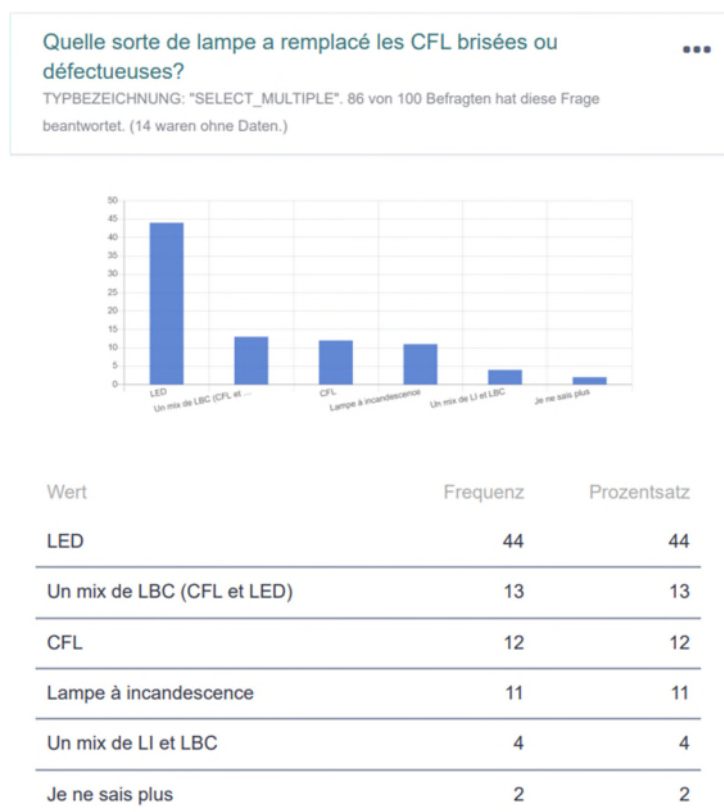
<sup>12</sup> GEF/UNDP 2018, p. 16

<sup>13</sup> Source: Email from KfW dated 25 January 2019 to the German Federal Ministry for Economic Cooperation and Development (BMZ)

<sup>14</sup> CDM Methodology Efficient Lighting V4: [DRAFT \(unfccc.int\)](https://unfccc.int/documents/1366262/1366262/CDM-Methodology-Efficient-Lighting-V4.pdf)

ex ante calculation in Annex 6 of the PP). This would also have been expedient because the 10 million CFLs actually procured had a respective output of 20W instead of the 18W specified in the PP<sup>15</sup>. As part of the EPE, it was only possible to attempt to review the validity of the hypotheses in practice by means of a random but not representative customer survey (100 households). In the survey results, for example, the CFLs' average use duration per day was indicated as approximately 2.5 hours (see Annex 5.2, p. 7). However, since many of the households surveyed had already received their CFLs more than five years ago, these estimates are only rough indications. ONEE assumes a CFL usage duration of 3.5 hours per day. Above all, it must be taken into account that by May 2023, approximately 95% of the lamps had been distributed, and this had taken place over a significantly longer period than planned (ten years instead of two).

**Figure 3: Transformation of lamp demand** (from Annex 5.2, page 12)



In the survey of 100 households from the target group using the KoBo toolbox<sup>16</sup>, it became clear that around two thirds of the respondents exclusively purchased ESLs (LBC in French – mainly LEDs, but also CFLs) as a replacement for the CFLs sold by ONEE, as they are aware of the financial advantages of this type of lamp. The question in Figure 3 was: "Which type of bulb replaced a broken or defective CFL?" The result of this survey is further evidence of the effectiveness of the project, even after the end of the CFLs' useful life.

In the analysis, at the time of the EPE (2023), the indicator for the originally intended cumulative energy savings within ten years (ex ante calculation in the PP Annex 6) of 5,250GWh is achieved at approximately 83% (4,359GWh). For 2030, it is expected that 95% of the indicator will then be achieved in accordance with the CFLs distributed up until 2023, i.e. a total of approximately 4,988GWh is expected to have been saved by then (see Annex 5.7).

For the indicator for the reduction of peak load, a cumulative analysis does not make sense, as it concerns actual or potentially saved power plant capacities annually. At the time of the EPE, approximately 70% of the indicator was achieved according to ONEE (see Annex 5.8); however, the CFLs distributed over a longer period also continue to have an effect here, so that the peak load will also be reduced by 2030 instead of by 2020, but less per year overall than originally planned<sup>17</sup>.

It is worth mentioning that the evaluation report (PIR – Project Implementation Report)<sup>18</sup> by UN Environment/GEF for Component 3 (distribution of 10 million CFLs to ONEE customers) of the "Market Transformation for Energy Efficient Lighting in Morocco" project reports that 700 GWh/year of electricity savings, a 6.5% reduction in peak load corresponding to 330MW and 650.000 tCO<sub>2</sub> greenhouse gas reductions were achieved annually. Unfortunately, it is not clear in the report how these values were calculated or verified. There are considerable doubts about the validity of the above-mentioned values, especially since at the reporting date (30 June 2019) not all 10

<sup>15</sup> According to the ONEE- Philips Electronique Maroc contract dated July 2014

<sup>16</sup> The KoBo Toolbox (<https://www.kobotoolbox.org/>) is open source software that can be used to collect, analyse, visualise and evaluate data and surveys.

<sup>17</sup> The calculation basis is described in the PP on page 6 of Annex 6. ONEE has updated the underlying assumptions (see Annex 5.8). As a result, the average load reduction achieved per year is 70% (253MW), albeit with significant deviations per year (68–352MW). Ultimately, instead of 100% (360 MW/year) over ten years, the saving is a reduction of 70%=253 MW/year over approximately 16 years.

<sup>18</sup> UN Environment/GEF 2019, p. 4

million CFLs had been distributed, as claimed, but only approximately 9 million. At the same time, the PIR reports that the other components of the project (minimum efficiency standards, test procedures, certification and recommendations for safe disposal and recycling of the CFLs) had not been implemented at the time that the PIR was compiled.

### *Quality of implementation*

Founded in 1963, ONE (known as ONEE from 2012) has proven itself as a reliable and qualified executing agency in long-term cooperation with German and international DC, and has therefore already successfully implemented the first phase of the energy-saving lamp programme financed by the World Bank (INARA I). However, energy suppliers are generally not interested in measures for the promotion of energy efficiency, as they gain their revenue as well as their political and economic importance from the sale of electricity. However, since ONEE is also a grid operator, it can be assumed that there is interest in the project's goal of reducing peak load (360 MW) and therefore in grid stability.

In principle, the report emphasised the high quality of management by the executing agency ONEE. However, the originally planned distribution of the 10 million CFLs for the first two years (for 2012 and 2013) actually took place over a total period of ten years (2014–2023). The significant delays in project implementation have already been reported above. According to the PCR, the main reasons were the delays in signing the loan agreement between ONEE and KfW, the coordination of the tender documents, the contract negotiations with Philips and in the implementation of the newly added LED component, which was subsequently removed. In practice, this affected the otherwise high quality of implementation.

### *Unintended effects (positive or negative)*

No positive or negative unintended effects are known.

### *Summary of the rating:*

The project will almost completely achieve its objectives at outcome and impact level, but in a cumulative view over a longer period up to around 2030. This is due to the fact that the distribution of the CFLs in Morocco took place over a significantly longer period of time; over more than ten years instead of two years as planned.

## **Effectiveness: 2**

## **Efficiency**

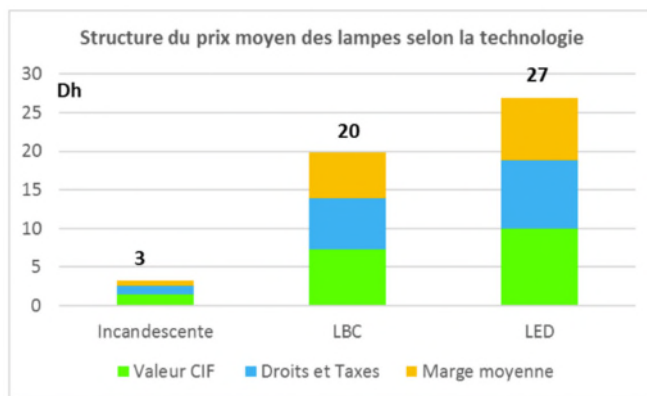
### *Production efficiency*

The replacement of conventional light bulbs with CFLs is generally one of the most cost-effective measures for energy saving and therefore for climate action. In the specific case of Morocco, this statement can be justified by the following example calculation: replacing an 85W LI with a 20W CFL saves 65W per CFL and 83kWh per year at an average daily operating time of 3.5 hours. This results in a saving of EUR 9.13 per CFL per year at an electricity price of EUR 0.11/kWh. The project distributed an average of 7.7 CFLs per household (information provided by ONEE, see Annex 5.5), which results in savings of EUR 70.30 per household per year. The CFLs were sold by ONEE's sales partners for MAD 18 (cash payment) or MAD 20 (payment in instalments over 20 months), which is approximately EUR 2/CFL. With an investment of EUR 15.40 (7.7 CFLs times EUR 2), households can therefore achieve a profit of EUR 70.30 per year (EUR 5.86/month), which corresponds to a payback time of around 2.6 months and is therefore generally highly profitable.

**Figure 4: Price structure for lamps in Morocco, 2016–2018**

LBC equals CFLs, green=import value, blue=fees and taxes, orange=average profit margin

Source: [Rafik Missaoui, 2019](#)



Due to the high profitability of investing in energy-saving lamps, the question of whether the transformation would not have taken place without the project will be discussed below. It must be taken into account that the purchase price for CFLs was significantly higher than the price for conventional light bulbs during the project period. For example, between 2016 and 2018, a conventional light bulb cost only 3 Moroccan dirhams (Dh or MAD) - around EUR 0.30 – while a CFL cost more than six times this amount, and an LED cost nine times this amount (Missaoui 2019, p. 9). These significantly higher initial investments for the ESLs (CFLs or LEDs) meant that, if there were no suitable financing options or subsidies for this new technology and the target group was not informed or convinced of the advantages of the ESLs, many households refrained from buying them. Since ONEE also offered the CFLs with a loan over 20 months, customers were able

to make the repayment using the savings in their electricity bills. In addition, when launching innovative products, high transaction costs must always be assumed for potential customers, e.g. the neutral procurement of information about the advantages and disadvantages or the search for shops that sell the products. These costs can significantly reduce the savings potential of ESLs and are a justification for corresponding funding programmes such as the project considered here.

Finally, it should be noted that, while total costs of EUR 13.4 million were incurred, EUR 10.5 million of these were loans and only EUR 835,766.52 of budget funds were allocated as grants, i.e. less than EUR 0.10 per CFL. The executing agency ONEE was largely able to refinance itself for the repayment of the loan to KfW through the sale price of the CFLs and has now also repaid the loan in full. In addition, the above-mentioned savings made from foregoing investment in new power plants must be taken into account, so that a positive cost-benefit calculation also results for the executing agency.

There were no costs for implementation consultants, as the executing agency ONEE assumed the project management for the implementation of the project as its own share.

The project was delayed by over four years compared to the design in the PP (86 months instead of 33 months total duration). The loan agreement with ONEE was only signed at the beginning of November 2012, i.e. approximately seven months later than planned. Furthermore, there were considerable delays in the coordination of the tender documents for the 10 million CFLs and during the tender itself, which are partly due to the executing agency's lack of staff. The distribution of the CFLs did not take place in two years as planned, but rather was spread across ten years from 2014 to 2023. Finally, there were also further huge delays in the implementation of the newly added LED component, which was ultimately not carried out.

Due to the above-mentioned delay in the invitation to tender and the significant reduction in prices for CFLs during this period, only around EUR 10 million was required for the procurement of the 10 million CFLs instead of the originally assumed EUR 17.4 million. In the PP, costs of EUR 1.74 per CFL were still assumed; the contract with Philips then only had unit costs of EUR 1.01.

### Allocation efficiency

The evaluation of a high economic allocation efficiency can be confirmed by a cost-benefit comparison analogous to the calculation in the evaluation of the World Bank-financed first phase of the INARA programme (World Bank 2016, p. 41 et seq.). The World Bank reported an EIRR (Economic internal rate of return) of 312% for its project. The sensitivity analysis with a change in electricity tariffs and the duration of use per day revealed a range for the EIRR from 247% to 468%. Since the costs for the procurement and distribution of the CFLs had decreased

significantly from the start of INARA 1 to the start of the project under consideration, an even higher EIRR can be assumed.

According to the ex-post calculation in Annex 5.7 and ONEE's calculation in Annex 5.8 at the time of the EPE (95% distribution of CFLs), the total costs of the project of around EUR 13.4 million (of which approx. EUR 2.86 million as own share and EUR 10.54 million from FC funds) are offset by cumulative energy savings at ONEE of 4,359GWh, the reduction in peak load by an average of 253 MW per year and cumulative greenhouse gas reductions of approximately 3.0 million tCO<sub>2</sub> by 2023. At EUR 48.02–53.35 million (see table below), the annual savings in electricity consumption for ONEE's household customers in the ex-post analysis alone (CFLs with 20 W instead of 18 W) correspond to almost four times the total costs. The reduction in peak load reduces ONEE's investment costs in new power plants by EUR 151.8 million. The reduction in greenhouse gases in the European emissions trading system would currently have a value of EUR 30.5 million:

| Savings                                                                              | Savings in units        | Value per unit in EUR                    | Value of savings in EUR   |
|--------------------------------------------------------------------------------------|-------------------------|------------------------------------------|---------------------------|
| Reduction in electricity consumption (annually, per household, 83kWh x 7.7 CFL)      | 639.1kWh                | EUR 0.09–0.11/kWh <sup>19</sup>          | EUR 57.52–70.30/year      |
| Reduction in total electricity consumption (759,000 private households x 639kWh)     | 485 GWh                 | EUR 99–110/MWh                           | EUR 48.02–53.35 million   |
| Reduction of peak load (annually, for ONEE, Annex 5.8)                               | 253 MW                  | EUR 600,000/MW <sup>20</sup>             | EUR 151.8 million         |
| Reduction of greenhouse gases according to ex post calculation, Annex 5.7 (annually) | 381,434tCO <sub>2</sub> | EUR 15–80/tCO <sub>2</sub> <sup>21</sup> | EUR 5.7–30.5 million/year |

In the appraisal report, CO<sub>2</sub> avoidance costs of EUR 6.26/tCO<sub>2</sub> are assumed (ex ante calculation), with assumed investment costs of approximately EUR 24 million. However, the significantly lower procurement costs for the CFLs reduced the investment costs to approximately EUR 13.4 million, so that in the ex post calculation the CO<sub>2</sub> avoidance costs fall to approximately EUR 4.07/tCO<sub>2</sub> (EUR 13.4 million for 3,051,475tCO<sub>2</sub> savings). This still equates to a very profitable investment even with the very low prices for emission allowances in EU emissions trading (EUR 5–15, see footnote 13) in the 2010s.

Marketing and distribution of the CFLs via private actors such as lamp manufacturers or dealers could have constituted an alternative project design. However, with the resources available, it is doubtful that there would have been more positive effects and that the project would have been more cost effective. ONEE's direct contact with its customers has made it possible to disseminate information quickly and effectively about the advantages of the CFLs and the possibility of purchasing them through payment in instalments. Since ONEE also primarily supplies customers in outlying districts and rural regions, and information on new technologies spreads here less quickly than in urban centres, the choice of executing agency in the project's design appears to be expedient and efficient. In addition, it must be taken into account that customers perceive information provided by a government agency as credible. Finally, it was also expedient to continue the INARA programme with the same executing agency due to the positive experiences and the development of the corresponding resources in the first phase.

The implementation of an additional LED component, which would have been possible due to the lower procurement prices for the CFLs, would have further increased the project's efficiency and facilitated the foreseeable transition from the use of CFLs to LEDs.

### Summary of the rating:

<sup>19</sup> Both in the ex ante and ex post analysis of constant electricity prices during peak periods (17:00–22:00, i.e. at the time when lighting is needed), EUR 0.11/kWh is assumed. However, according to ONEE, there are no time-based tariffs for households, so a tariff of EUR 0.09/kWh is also used here in the calculation. This was calculated according to ONEE during the project period for the first 100kWh for households.

<sup>20</sup> Investment costs for a gas-powered power plant according to the information in the PP, p. 10. In addition, there are also the expenses for operating the power plant.

<sup>21</sup> The prices for emission allowances in the European Emissions Trading System (EU ETS) were between EUR 5–15 before 2020 and have been at around EUR 80 since the end of 2021.

The project's efficiency was high, as the cost-benefit ratio was extremely positive for both the users of the CFLs as well as for the executing agency and the Moroccan government. Although the planned implementation time of 33 months has more than tripled, this led to falling prices for the procurement of the CFLs and therefore to an even better cost-benefit ratio for the project. Particularly significant individual, macroeconomic and microeconomic benefits were achieved with a relatively low use of budgetary resources.

## Efficiency: 2

## Impact

### Overarching (intended) developmental changes

The achievement of the objective at impact level "Contribution to the efficient use of scarce energy resources and to climate action" can be summarised as follows:

| Indicator                                                                | PA status         | Target value according to PA         | (Optional) actual value at final inspection | Actual value at EPE (2023)                                                                              |
|--------------------------------------------------------------------------|-------------------|--------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>New:</b> Cumulatively avoiding 3.675 million tCO <sub>2</sub> by 2030 | 0tCO <sub>2</sub> | 460,000tCO <sub>2</sub> average p.a. |                                             | Value 83% achieved (3.051 million tCO <sub>2</sub> ), expected to be at least 95% by approximately 2030 |

### Contribution to overarching (intended) developmental changes

The project's targeted overarching developmental impact was to contribute to the efficient use of scarce energy resources and to climate action. The newly formulated indicator of this target has so far been predominantly achieved at the EPE (approx. 83%) and the cumulative reduction target is expected to be almost completely achieved by approximately 2030, as a total of approximately 95% of the 10 million CFLs were distributed by 2023.

The hypotheses for calculating the CO<sub>2</sub> reduction values are largely realistic. According to ONEE, the assumed emission factor of 0.7 tCO<sub>2</sub>/MWh remained largely constant between 2014 and 2022, and only increased from 2021 to 2022 as a result of the commissioning of an additional coal-fired power plant (see Annex 5.4 in the annexes). The other hypotheses also relevant for the calculation of the outcome indicators have already been discussed above under Effectiveness.

The intended beneficiaries of the project also benefit from the project at impact level; however, these effects are not directly tangible for them, as progress in climate action only has a long-term and global effect.

The project was efficient and broadly effective due to the large number of CFLs distributed (thereby making it model-based and replicable), but only taking into account the elements missing in the strategy to ensure sustainability in the future.

### Contribution to overarching (unintended) developmental changes

The project contributed to improving the living conditions of particularly disadvantaged and vulnerable parts of the target group by lowering electricity bills and thereby increasing disposable income. At around EUR 48–53 million annually, the value of the savings for the target group of 759.000 beneficiary households is quite relevant (see above under Efficiency) and has therefore also contributed to alleviating poverty and reducing inequality.

In the environmental and climate impact assessment, it was assumed that the project's net effect on the national economy through mercury emissions, which are damaging to the environment, is advantageous overall, as on the one hand the CFLs disposed of via the residual waste emits mercury in landfills, but on the other hand significantly less mercury is emitted in the first place due to the reduced electricity demand in the coal-fired power plants. In addition, the project has positive environmental impacts due to reduced particulate emissions.

### *Summary of the rating*

The project's intended overarching developmental impact is successfully achieved through a relevant contribution to the efficient use of scarce energy resources and to climate action. In addition, positive impacts were achieved in the areas of alleviating poverty and environmental protection. Overall, the overarching developmental impact can therefore be assessed as successful.

**Impact: 2**

## **Sustainability**

### *Capacities of participants and stakeholders*

The target group survey has revealed that the target group is aware of the financial benefits of ESLs and that the proportion of LI in households has significantly reduced overall (see Annex 5.2, p. 12–15). In this respect, the positive impacts of the project on the target group continue to be sustained.

Relatively speaking, the particularly disadvantaged parts of the target group gain higher percentage savings in their electricity bills through the use of the CFLs than wealthier households due to the relatively higher proportion constituted by lighting in their electricity consumption (e.g. due to the absence or lower number of air conditioning systems). However, despite the fact that the target group is aware of the financial benefits of ESLs, it is questionable whether they will buy them again at the end of their useful life, as LI are still available on the market and are significantly cheaper to buy than ESLs. Even at the time of the EPE, an ESL (LED) still cost about five times more than an LI (MAD 21.90 compared to MAD 4).<sup>22</sup>

The project implemented in parallel by UN Environment and GEF had several objectives at output and outcome level, which could have made an important contribution to the sustainability of the lighting sector transformation in addition to the KfW project: outcome 1.2 ("State Government legislation adopted for the phase-out of ILs"<sup>23</sup>) and Outcome 2.1 ("An effective and affordable certification and quality control scheme that is applicable to all CFLs imported in Morocco, and enhanced capacity of the supply chain to offer products and services promoting a sustainable CFL market"). However, these objectives could not be implemented due to resistance from the Ministry of Industry, among other things<sup>24</sup>.

### *Contribution to supporting sustainable capacities*

During the course of the two phases of the INARA programme, the executing agency ONEE built up extensive technical and organisational capacities for the design and implementation of funding programmes for ESLs, which would also be useful for comparable projects in the field of energy-efficient technologies, e.g. for the promotion of efficient household appliances. On 13 March 2023, ONEE concluded a framework agreement with the Société d'Ingénierie Energétique (SIE) for the implementation of energy efficiency projects (see Annex 5.3). If such projects are actually implemented, the ONEE capacities built up in the project will certainly be helpful.

### *Durability of effects over time*

The lighting market changed during the project period to focus more heavily on ESLs (CFLs and LEDs); the proportion of conventional light bulbs (LI) decreased from 69% to 48% from 2016 to 2018. However, the share of CFLs has also decreased since 2017 as the share of LEDs has increased. This is essentially due to the alignment of CFL and LED prices (see Figure 10) and the improved quality of LEDs. The following diagrams clearly

<sup>22</sup> Internet research on 7 February 2023 <https://mrbricolage.ma/>

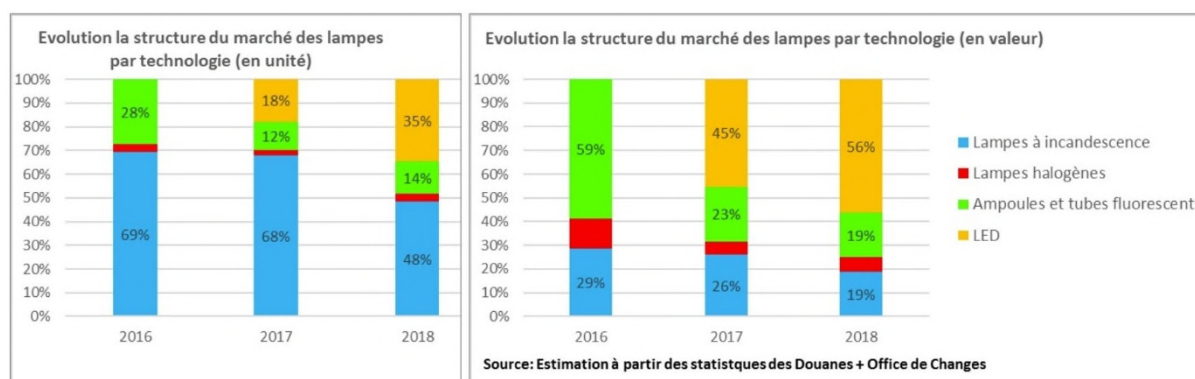
<sup>23</sup> IL = incandescent light

<sup>24</sup> UN Environment/GEF 2019, p. 10–11

show the downturn in CFLs in the part marked in green. Another key reason for this is also the price adjustment of the LEDs to the CFLs from 2018:

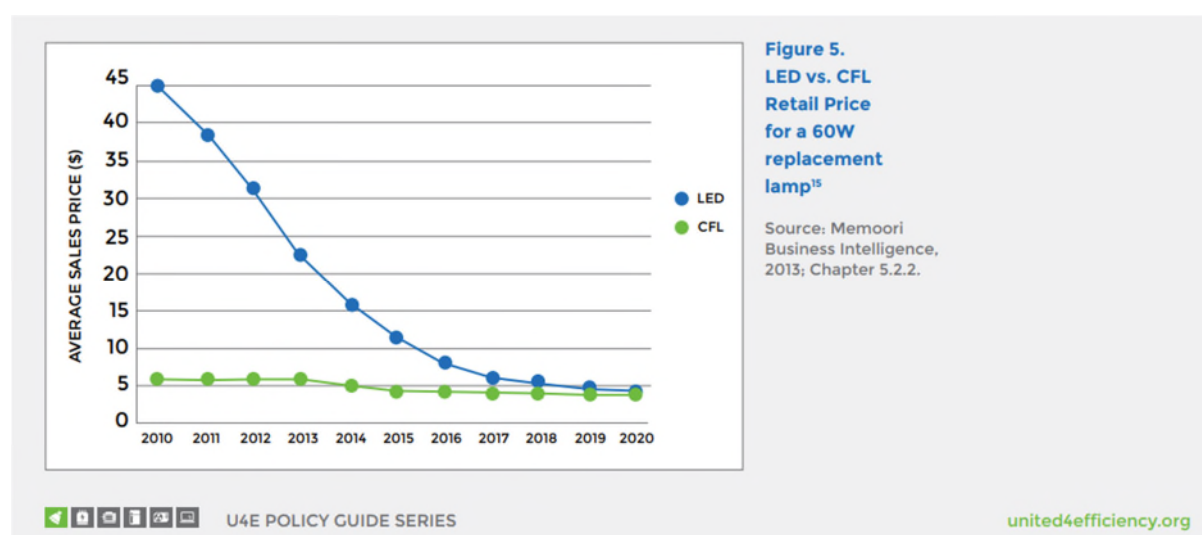
Figure 5: Development of the lamp market in Morocco, 2016–2018

### Structure du marché



Source: Missaoui 2019, blue = light bulbs (LI), green = CFL, red = halogen lamps and yellow = LED

Figure 6: Alignment of global market prices for CFLs and LEDs, 2010–2020



Source: [UN Environment et al. 2017](#), p. 25

However, the sector's sustainable transformation towards ESLs (CFLs and LEDs) does face risks. Since LI are still available on the market and there are still significant price differences compared with ESLs, there is a risk that poorer households in particular will buy inefficient bulbs again. The sustainability of the project's positive effects can be ensured if either the import and marketing of LI is prohibited (phase-out) or the prices of LI and ESLs are aligned through tax and other promotional measures. Alternatively or additionally, information campaigns are necessary that illustrate the short payback time of LEDs compared to LI (approx. 2.5 months, status of prices and tariffs in February 2023).

In the non-representative survey of 100 households in the target group, it became clear that around two-thirds of the respondents exclusively buy ESLs (mainly LEDs, but also CFLs) as a replacement for the CFLs distributed by ONEE, as they are aware of the (primarily) financial advantages of this type of bulb. However, there is still a risk to the sustainability of the project's impacts due to the lack of ESL standardisation and quality control. The willingness of Moroccan consumers to buy ESLs, which are still significantly more expensive compared to LI, may suffer over the long term as a result of poor quality ESLs, i.e. ESLs with significantly reduced useful life, being imported on a large scale. This may lead to the target group returning to buying LI.

### **Summary of the rating:**

The project was able to make a significant contribution to the lighting sector transformation towards ESLs (first towards CFLs, but then increasingly towards LEDs). However, as long as LI are available on the national market and significantly cheaper to purchase than ESLs, the quality of which still cannot be guaranteed, the sustainability of the ESLs' positive effects will be jeopardised when they come to the end of their useful life.

**Sustainability: 3**

### **Overall rating: 2**

The project was very relevant and well integrated into Moroccan energy and climate policy. German DC worked well together as part of the DC programme "Environment and climate change" and the project was implemented largely efficiently. No coordination with the project carried out in parallel by UN Environment and GEF was identified, but it would have been desirable. The originally planned indicators at outcome and impact level are largely met, albeit cumulatively and over a longer period than originally foreseen.

The project serves as a model for future projects both inside and outside Morocco that use the same technology. There were positive developmental impacts on climate action, poverty reduction and environmental protection at both national and global level. Only sustainability is limited, as after the end of the promotion there are still large price differences between the conventional bulbs still available on the market and ESLs, the quality of which cannot be guaranteed due to illegal imports and lack of quality controls.

### **Contributions to the 2030 Agenda**

The project was originally intended to contribute to the achievement of the eight Millennium Development Goals (MDGs) by 2015, namely to MDG 7 ("Ensure Environmental Sustainability"). By reducing the consumption of fossil-based electricity, the air quality has been improved and greenhouse gas emissions have been reduced.

At the end of September 2015, the MDGs were supplemented by the 17 Sustainable Development Goals (SDGs) adopted unanimously by the 193 current UN member states at the 2015 Summit on Sustainable Development in New York.

The project contributed to the achievement of SDG 7 "Affordable and Clean Energy", sub-goal 7.3 "By 2030, double the global rate of improvement in energy efficiency" and SDG 13 ("Climate Action"). In addition to the environmental protection aspects already mentioned above in the MDGs, the project's contribution to the SDGs must also be highlighted in that the target group's electricity bills were reduced and a contribution to national energy efficiency policy and global climate action was made.

### **Project-specific strengths and weaknesses as well as cross-project conclusions and lessons learned**

The project had the following strengths and weaknesses in particular:

- The project adequately addressed important core problems of the Moroccan energy sector and made significant contributions to national and global strategies, policies and objectives.
- The project continued and strengthened the lighting sector's transformation towards ESLs that the World Bank had successfully started as part of the INARA I project, making use of the experience and capacities already built up by project executing agency ONEE.
- The project is set to largely achieve the set objectives at outcome and impact level by 2030. However, the initial choice of indicators proved to be unsuitable, as their achievement depended on the distribution and installation of the 10 million CFLs in the first two years of the project's term (planned in 2012 and 2013). Because of all this, new cumulative indicators were formulated.
- Unfortunately, during the design phase, the project's likely positive and significant effects on the disposable incomes of disadvantaged households were not included in the target and indicator system, nor

was monitoring included in the financing plan. Doing so would have enabled the project to achieve another success component.

- Although there was internal coordination and alignment with the German DC projects, possible synergies and coordination with the UN Environment/GEF project to transform the Moroccan lighting sector, which was carried out in parallel, were not realised.
- Although the transformation of the lighting sector has been successfully initiated, there is a risk that inefficient lamps will regain higher market shares as they are still available and significantly cheaper than ESLs (CFLs and LEDs). This risk is further increased by a lack of quality controls, a lack of government labels and substantial illegal imports of ESLs, some of which have a short useful life. The sustainability of the project has therefore not yet been ensured.

#### Conclusions and lessons learned:

- Projects for the promotion of energy-efficient products and technologies often – as in this project – assume theoretical savings based on a simulation or a model based on certain assumptions. In practice, however, these assumptions are often only partially true, meaning that the actual impacts may be less than planned. It is therefore essential to provide for follow-up during the project with regard to the energy savings made and the validity of the assumptions with a representative selection of the target group as well as with a comparison group and corresponding financing. This is no longer possible within an ex-post evaluation due to limited time and financial possibilities as well as the often long time gap to the implementation of the project's measures.
- Since the implementation of projects is also often delayed, no annual average values should be chosen as indicators for energy efficiency or climate action projects, but rather cumulative values.
- When promoting the distribution of technological innovations, particularly in the field of energy efficiency, it should be noted that a theoretically high microeconomic and macroeconomic benefit of certain products or technologies does not automatically lead to market penetration. Numerous factors, such as high transaction costs for vendors and users, high initial investments, lack of quality controls, subsidies or the failure to take into account external costs for conventional products and energy, all lead in practice to a slow or unsuccessful distribution of innovations that are profitable in and of themselves. Therefore, additional promotional programmes with start-up financing, loan programmes and accompanying training, information and quality control measures as well as support through corresponding legal and tax provisions are generally necessary in order to achieve a sustainable transformation.
- Private and public energy suppliers normally have no major interest in energy efficiency promotion programmes unless they are network operators at the same time, as they generate their revenue and economic importance by selling electricity. Strong political will on the part of the government and corresponding financing options are therefore necessary in order to enable them to be suitable executing agencies for DC energy efficiency programmes. ONEE's refusal to integrate an LED component into the project indicates that these requirements were only partially met in Morocco.

## Evaluation approach and methods

### Ex-post evaluation methodology

Ex-post evaluations follow the approach of a rapid appraisal, i.e. a data-supported, qualitative contribution analysis resulting in an expert opinion. Effects are attributed to the project considering plausibilities, based on thorough analysis of documents, facts and impressions. This includes – if possible – the use of advanced technology (e.g. satellite imagery, online interviews, geocoding). There is a follow-up on possible conflicting information, attempting to eliminate inconsistencies and to base the rating on information that – to the extent possible – has been confirmed through different sources (triangulation).

#### Documents:

- ADEREE, 2014: “Stratégie Nationale d'Efficacité Energétique à horizon 2030”
- AHK Morocco 2018 (German Chamber of Industry and Commerce): “Morocco Factsheet – General Energy Market Information”
- GEF, UNDP 2018: “Final Report – Terminal Project Evaluation – Improving the energy efficiency of lighting and other building appliances”
- Gillingham, Stock 2018: “The Cost of Reducing Greenhouse Gas Emissions”
- Heinrich Böll Foundation Rabat, Mme. Touria Barradi, May 2019: “UN APERÇU DE LA SITUATION DE L'EFFICACITÉ ÉNERGÉTIQUE DES MÉNAGES AU MAROC”
- IEA 2019: “Energy Policy beyond IEA Countries, Morocco 2019”
- IRENA 2022: “Energy profile – Morocco”
- Lahcen El Iysaouy, Najiba El Idrissi, Manuela Tvaronavičienė, Mhammed Lahbabi, Abdelmajid Oumnad: “Towards energy efficiency: case of Morocco. Insights into Regional Development”, 2019, 1 (3), pp.259–271
- Law No. 47-09 on energy efficiency promulgated by Dahir No. 1-11-161 of 1st kaada 1432 (29 September 2011)
- McKinsey 2009: “Version 2.1 of the global greenhouse gas abatement cost curve”
- Ministère de l'Energie, des Mines et de l'Environnement (MEME), 2020 : “Stratégie Nationale d'Efficacité Energétique à horizon 2030”
- Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement (MEMEE), 2008/2009 : “Stratégie Energétique Nationale Horizon 2030”
- Missaoui, Rafik 2019: “Situation du marché de l'éclairage au Maroc”
- ONE 2011 : “Opération INARA - Rapport d'évaluation de la phase 1– Recommandations pour la phase 2”
- PNUE/UNEP 2017: “Rapport sur l'état national de l'éclairage au Maroc”
- Royaume du Maroc 2021: “Contribution Déterminée au niveau national – actualisée”
- UN Environment GEF Project Implementation Report (PIR), Fiscal Year 2019
- UN Environment, Global Environment Facility and United for Efficiency (U4E) 2017: “Accelerating the Global Adoption of Energy Efficient Lighting”
- World Bank 2016: “Implementation Completion and Results Report for the ONEE support project”

In addition, internal project documents (annual reporting by KfW and ONEE, project completion report) were evaluated.

#### Data sources and analysis tools:

**(digital) databases, data collection on site, monitoring data of the partner, survey of over 100 target group representatives with KoBo Toolbox (see Annex 5.2).**

#### Interview partners:

Project-executing agency ONEE, KfW Office Rabat, target group, representatives of bi- and multilateral DC organisations (GIZ, UNDP/GEF, World Bank) and the private sector (Philips Morocco).

The analysis of impacts is based on assumed causal relationships, documented in the results matrix developed during the project appraisal and, if necessary, updated during the ex-post evaluation. The evaluation report argues which factors contributed to the observed effects and why – as well as the probable extent of the project's contribution (contribution analysis). The context of the project is taken into account concerning its influence on the results. The conclusions are put into perspective regarding the availability and accuracy of the available data. An evaluation concept is the frame of reference for the evaluation.

On average, the methods offer a balanced cost-benefit ratio for project evaluations that maintains a balance between the knowledge gained and the evaluation costs, and allows an assessment of the effectiveness of FC

projects across all project evaluations. The individual ex-post evaluation therefore does not meet the requirements of a scientific assessment in line with a clear causal analysis.

The following aspects limit the evaluation:

**Due to the large time gap to the distribution of CFLs, only rough estimates and rather vague recollections could be documented in some cases when carrying out the target group survey.**

**ONEE'S final report for the project completion report agreed in the Convention Séparée (see page 9, IV, 1.), which would have contained information relevant for the EPE, was not compiled.** It took repeated requests before the executing agency ONEE provided a delayed submission of important information, e.g. on the number of CFLs distributed per year or on the emission factors.

## Methods used to evaluate project success

Projects are rated on a six-point scale for each of the OECD DAC criteria. The scale is as follows:

- Level 1** very successful: result that clearly exceeds expectations
- Level 2** successful: fully in line with expectations and without any significant shortcomings
- Level 3** moderately successful: project falls short of expectations but the positive results dominate
- Level 4** moderately unsuccessful: significantly below expectations, with negative results dominating despite discernible positive results
- Level 5** unsuccessful: despite some positive partial results, the negative results clearly dominate
- Level 6** highly unsuccessful: the project has no impact or the situation has actually deteriorated

The overall rating on the six-point-scale is compiled by weighting all six individual criteria as appropriate to the project in question. Rating levels 1–3 of the overall rating denote a "successful" project while rating levels 4–6 denote an "unsuccessful" project. It should be noted that a project can generally be considered developmentally "successful" only if the achievement of the project objective ("effectiveness"), the impact on the overall objective ("impact") and the sustainability are rated at least "moderately successful" (level 3).

## About this publication

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Annex 5.6: Ex ante calculation of energy/greenhouse gas savings (cumulative values in the “Total” line were used for the new indicators)

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Annex 5.9: Explanatory notes on the CDM methodology as well as ex ante and ex-post calculations

## Annex 1: Target system and indicators

| Project purpose at outcome level                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Evaluation of appropriateness (former and current view) |                     |                                                                           |                                                                                                                      |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| During project appraisal: Saving electrical energy                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Appropriate                                             |                     |                                                                           |                                                                                                                      |
| During EPE (if target modified)                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                         |                     |                                                                           |                                                                                                                      |
| Indicator                                                                        | Evaluation of appropriateness<br>(for example, regarding impact level, accuracy of fit, target level, smart criteria)                                                                                                                                                                                                                                                                                                                                                                                                                                                          | PA target level<br><br>Optional:<br>EPE target level    | PA status<br>(2011) | Status at final inspection<br>(2019)                                      | Optional:<br>Status at EPE<br>(2023)                                                                                 |
| Indicator 1 (PA): Savings of an average of around 660 GWh/year                   | The indicator is not appropriate. Since experience has shown that the implementation of energy efficiency projects is regularly delayed, the use of cumulative values is more appropriate than average values per year. A very optimistic speed of implementation was assumed for this here (distribution of all 10 million CFLs in the first two project years).                                                                                                                                                                                                              | 660 GWh/year                                            | 660 GWh/year        | 90% of CFL installed, therefore theoretically: 594 GWh/year               | Indicator 1 replaced by cumulative indicator no. 3                                                                   |
| Indicator 2 (PA): In purely mathematical terms, 360 MW peak load is not required | This indicator is also inadequate for the above reasons. However, as for executing agency ONEE, the reduction of peak load was the most important motivation for implementing the project, this is retained here.                                                                                                                                                                                                                                                                                                                                                              | 360 MW peak load                                        | 360 MW peak load    | Value approx. 70% achieved (according to ONEE for 2015–2020: 253 MW/year) | Value approx. 70% achieved (according to ONEE for 2015–2020: 253 MW/year, see Annex 5.8)                             |
| NEW: Indicator 3: (EPE) Cumulative savings of 5.250GWh by 2030                   | The above-mentioned framework conditions for the theoretical savings included the assumption that all 10 million CFLs would be distributed in the first two years after the start of the project. In fact, only approximately 1.7 million CFLs were distributed during this period, meaning that it is no longer possible to achieve the annual average savings by 2020. On the other hand, the cumulative savings are almost fully achieved over a longer period (until approx. 2030; corresponding to the actual number of CFL distributed amounting to approx. 9.5 million) | 5,250 GWh                                               | 0 GWh               |                                                                           | Value approx. 83% achieved: 4,359GWh cumulative<br>By 2030, at least 95% of the savings are expected to be achieved. |

| Project objective at impact level                                                                            |                                                                                                                   | Evaluation of appropriateness (former and current view) |                            |                                      |                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| During project appraisal: Contribution to the efficient use of scarce energy resources and to climate action |                                                                                                                   | Appropriate                                             |                            |                                      |                                                                                                                                 |
| During EPE (if target modified):                                                                             |                                                                                                                   |                                                         |                            |                                      |                                                                                                                                 |
| Indicator                                                                                                    | Rating of appropriateness<br>(for example, regarding impact level, accuracy of fit, target level, smart criteria) | Target level<br>PA / EPE (new)                          | PA status<br>(2011)        | Status at final inspection<br>(2019) | Status at EPE (2023)                                                                                                            |
| <b>Indicator 1 (PA):</b><br>Avoidance of an average of 460,000 tonnes of CO <sub>2</sub> /year               | Not appropriate, according to the evaluation of Outcome Indicator 1.                                              | 460,000 tCO <sub>2</sub> /year                          | 0 tCO <sub>2</sub> e/year  |                                      | See Indicator 2                                                                                                                 |
| <b>NEW: Indicator 2:</b><br>Cumulatively avoiding 3.675 million tCO <sub>2</sub> by 2030                     | Evaluation analogous to above under Outcome Indicator 3                                                           | cumulative 3.675 million tCO <sub>2</sub>               | 0 million tCO <sub>2</sub> |                                      | 83% value achieved: 3.051 million tCO <sub>2</sub><br>In total, 95% of the indicator is expected to be achieved by around 2030. |

## Annex 2: Risk analysis

All risks should be included in the following table as described above:

| Risk                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Relevant OECD-DAC criterion |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <p><b>Improper handling and disposal of CFLs could adversely impact the positive environmental footprint (ex ante in PP LogFrame and paragraph 3.39)</b></p> <p><b>Risk materialised:</b> the measures proposed in the disposal study for the disposal and recycling of the CFLs as well as for health and environmental protection at the landfill sites were not implemented</p>                                                                           | Sustainability              |
| <p><b>Customers cannot be convinced of the project (use of CFLs), therefore only limited installation of CFLs (ex ante in PP LogFrame)</b></p> <p><b>Risk did not materialise:</b> approximately 95% of the CFLs were distributed by the time of the EPE and are also installed according to the survey (interviews of 100 ONEE customers)</p>                                                                                                               | Effectiveness               |
| <p><b>Technical, organisational and financial performance of ONE(E) (ex ante in the PP, paragraph 3.38)</b></p> <p><b>Risk partially materialised:</b> significant delays in project implementation, especially in the tendering of the CFLs, the design of the additional LED component and in the distribution of the CFLs</p>                                                                                                                             | Relevance, effectiveness    |
| <p><b>Not all CFLs provide the desired output and expected useful life (at least 10,000 hours) (ex ante in the PP, paragraph 3.40)</b></p> <p><b>Risk has not materialised:</b> service life performance guarantee in supply contract at 12,000 hours. No indications of lower output and useful life in the survey</p>                                                                                                                                      | Effectiveness               |
| <p><b>Premature saturation of the market: not all 10 million CFLs can be distributed (ex ante, in PP paragraph 3.41)</b></p> <p><b>Risk did not materialise or only to a very low degree:</b> approximately 95% of the CFLs were distributed by the time of the EPE and are also installed according to the survey (interviews of 100 ONEE customers). However, demand for CFLs has now fallen significantly in favour of even more efficient LED lamps.</p> | Effectiveness               |

### Annex 3: Project measures and their results

The following measures were implemented by the project:

| Measure                                                                                                                                                                                                                                                                              | Status                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Procurement of 10 million CFLs                                                                                                                                                                                                                                                       | In July 2014 Philips signed a supply contract for 10 million CFLs. Delivery to ONEE took place as planned in nine batches between 2014 and 2019.                                                                                                                                                                                                                                                                                      |
| Implementation of a communication campaign with customers and in the sales network (radio and TV adverts as well as marketing material such as posters, flyers, notepads, pens, etc.)                                                                                                | Supply and service contract for the communication campaign concluded in October 2015. In 2016, marketing articles (flyers, posters, etc. valued at approximately EUR 60.000 were supplied and used at the points of sale. In 2017, there was mass communication with TV and radio advertising. Contracts were concluded for this with four radio and television stations that broadcast the campaigns in June, July and October 2017. |
| Carry out a disposal study (because there is a risk of mercury leaking into soil, air and water if CFL lamps are not disposed of properly).                                                                                                                                          | The contract for the disposal study was concluded at the end of 2016. The final version of the study was submitted to KfW on 9 July 2019.                                                                                                                                                                                                                                                                                             |
| Own contributions of ONEE according to PP: Assumption of CFL deliveries, training of the sales network (installers, direct marketing agents and sales outlets), as well as conception of a contract with the latter and finally project management for implementation of the project | The own contributions were realised. Project implementation has been significantly delayed (almost five years) compared to the design in the PP                                                                                                                                                                                                                                                                                       |
| LED component for approximately 1.9 million LED lamps                                                                                                                                                                                                                                | The invitation to tender for approximately 1.9 million LED lamps launched at the beginning of 2016 was cancelled in September 2017 due to significant quality defects in the tenders submitted. At the end of 2018, ONEE decided to no longer implement the LED component for strategic and business policy reasons.                                                                                                                  |

## Annex 4: Evaluation questions in line with OECD-DAC criteria / ex post evaluation matrix

### Relevance

| Evaluation question                                                                                                                                                                                                                           | Specification of the question for the present project                                                                                                                                                                                                                                         | Data source (or rationale if the question is not relevant/applicable)                                                                                                                                                                                                                                                                                                                                                                                                      | Rating | Weighting ( - / 0 / + ) | Reason for weighting |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Policy and priority focus                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1      | 0                       |                      |
| Are the objectives of the programme aligned with the (global, regional and country-specific) policies and priorities, in particular those of the (development policy) partners involved and affected and the BMZ?                             | <p>Which official Moroccan documents listed energy efficiency and climate action objectives and measures at the time of the appraisal?</p> <p>Which of the German Federal Ministry for Economic Cooperation and Development (BMZ) quality characteristics are relevant for the programme?</p> | <ul style="list-style-type: none"> <li>Plan National des Actions Prioritaires (PNAP)</li> <li>STRATÉGIE NATIONALE DE L'EFFICACITÉ ÉNERGÉTIQUE À L'HORIZON 2030 (August 2020)</li> <li>TROISIÈME RAPPORT BIENNAL ACTUALISÉ DU MAROC DANS LE CADRE DE LA CCNUCC (2022)</li> <li>Actualisation de la contribution déterminée au niveau national pour la période 2020–2030 (NDC/CDN, June 2021)</li> </ul> <p>Stratégie Bas Carbone à Long Terme Maroc 2050 (October 2021)</p> |        |                         |                      |
| Do the objectives of the programme take into account the relevant political and institutional framework conditions (e.g. legislation, administrative capacity, actual power structures (including those related to ethnicity, gender, etc.))? | Were relevant and functional existing authorities and organisations involved in the implementation of the project?                                                                                                                                                                            | Executing agency analysis in PP and final follow-up, donor survey, analysis documents                                                                                                                                                                                                                                                                                                                                                                                      |        |                         |                      |
| Other evaluation question 1                                                                                                                                                                                                                   | How relevant was the use of light bulbs for electricity consumption and electricity supply?                                                                                                                                                                                                   | ONEE survey, document analysis                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |                         |                      |

|                                                                                                                                                                                                                                         |                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                       |   |   |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|
| Evaluation dimension: Alignment with needs and capacities of persons concerned                                                                                                                                                          |                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                       | 2 | 0 |  |
| Are the programme objectives focused on the developmental needs and capacities of the target group? Was the core problem identified correctly?                                                                                          | Did the programme help to stabilise or increase the target group's disposable income?<br>To what extent have poor households benefited from the programme?                                                                   | Target group survey                                                                                                                                                                                                                                                                                                   |   |   |  |
| Were the needs and capacities of particularly disadvantaged or vulnerable parts of the target group taken into account (possible differentiation according to age, income, gender, ethnicity, etc.)? How was the target group selected? | How were the beneficiaries of the programme selected?<br><br>What share of the distribution of CFLs did particularly disadvantaged or vulnerable parts of the target group receive?                                          | ONEE survey                                                                                                                                                                                                                                                                                                           |   |   |  |
| Would the programme (from an ex post perspective) have had other significant gender impact potentials if the concept had been designed differently? (FC-E-specific question)                                                            | Were potential gender impact potentials identified during the course of the programme and, where applicable, taken into account?                                                                                             | Survey of KfW, ONEE                                                                                                                                                                                                                                                                                                   |   |   |  |
| Evaluation dimension: Appropriateness of design                                                                                                                                                                                         |                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                       | 2 | 0 |  |
| Was the design of the programme appropriate and realistic (technically, organisationally and financially) and in principle suitable for contributing to solving the core problem?                                                       | Was the programme's design appropriate, realistic and suitable for making a relevant contribution to solving the core problems (increasing energy demand, capacity bottlenecks, import dependency and environmental impact)? | Comparison of the estimate of actual savings with the business-as-usual scenario and with the development of electricity demand during the programme period. However, since no follow-up of actual savings in the budgets was carried out, an estimate will be made based on the most up-to-date theoretical savings. |   |   |  |
| Is the programme design sufficiently precise and plausible (transparency and verifiability of the                                                                                                                                       | Why were the theoretical savings in household electricity consumption not verified by a monitoring system?                                                                                                                   | Survey of ONEE, KfW, target group                                                                                                                                                                                                                                                                                     |   |   |  |

|                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                    |                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| target system and the underlying impact assumptions)?                                                                                                                                                                                                                                                                                                                          | Were the defined framework conditions (use and useful life of the CFLs, constant emission factor, rebound effect, etc.) realistic?                                                                                                 |                                                 |
| Please describe the results chain, incl. complementary measures, if necessary in the form of a graphical representation. Is this plausible? As well as specifying the original and, if necessary, adjusted target system, taking into account the impact levels (outcome and impact). The (adjusted) target system can also be displayed graphically. (FC-E-specific question) | See logframe in the PP (Annex 2)<br><br>See above for plausibility.                                                                                                                                                                |                                                 |
| To what extent is the design of the programme based on a holistic approach to sustainable development (interplay of the social, environmental and economic dimensions of sustainability)?                                                                                                                                                                                      | Has the programme sufficiently taken all dimensions of sustainability into account?<br><br>Why was the aspect of increasing the disposable income of particularly poor households not included in the target and indicator system? | Survey of KfW, ONEE                             |
| For projects within the scope of DC programmes: is the programme, based on its design, suitable for achieving the objectives of the DC programme? To what extent is the impact level of the FC module meaningfully linked to the DC programme (e.g. outcome impact or output outcome)? (FC-E-specific question)                                                                | Did the programme make a relevant contribution to the DC programme's objectives?                                                                                                                                                   | Survey of GIZ, KfW. Document analysis           |
| Other evaluation question 1                                                                                                                                                                                                                                                                                                                                                    | Given their advantages in the market, why weren't CFLs successful on their own, but needed government support?                                                                                                                     | Survey of target group, ONEE. Document analysis |

|                                                                                                                               |                                                                                                                            |                     |   |  |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|---|--|
| Evaluation dimension: Response to changes/adaptability                                                                        |                                                                                                                            | 3                   | 0 |  |
| Has the programme been adapted in the course of its implementation due to changed framework conditions (risks and potential)? | Why were the funds saved by the price reduction in CFL purchases not used for the distribution of additional CFLs or LEDs? | Survey of ONEE, KfW |   |  |

## Coherence

| Evaluation question                                                                                                                                                                           | Specification of the question for the present project                                                                                                                            | Data source (or rationale if the question is not relevant/applicable) | Rating | Weighting ( - / o / + ) | Reason for weighting |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Internal coherence (division of tasks and synergies within German development cooperation):                                                                             |                                                                                                                                                                                  |                                                                       | 1      | 0                       |                      |
| To what extent is the programme designed in a complementary and collaborative manner within the German development cooperation (e.g. integration into DC programme, country/sector strategy)? | Was the FC measure complementary to TC measures, including the measures that ADEREE advised on in improving the legal framework conditions for renewables and energy efficiency? | GIZ                                                                   |        |                         |                      |
| Do the instruments of the German development cooperation dovetail in a conceptually meaningful way, and are synergies put to use?                                                             | What conceptual links were there with other DC instruments and what synergies were able to be used?                                                                              | Survey of GIZ, KfW                                                    |        |                         |                      |
| Is the programme consistent with international norms and standards to which the German development cooperation is committed (e.g. human rights, Paris Climate Agreement, etc.)?               | Which international norms and standards, in addition to the MDGs/SDGs and the Paris Agreement, does the programme touch upon?                                                    | Document analysis                                                     |        |                         |                      |

|                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                  |   |   |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---|---|--|
| Other evaluation question 1                                                                                                                                                                              | Have other countries in the region benefited from the programme's experiences?                                                                                                                                                                                                                                                                                                                                                  | ONEE survey                                                                      |   |   |  |
| Evaluation dimension: External coherence (complementarity and co-ordination with actors external to German DC):                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                  | 3 | 0 |  |
| To what extent does the programme complement and support the partner's own efforts (subsidiarity principle)?                                                                                             | <p>What efforts did the partner make on its own to supplement and support the programme?</p> <p>What other measures has the government taken to reduce the electricity consumption through household appliances?</p> <p>Was the financial and organisational contribution of the project-executing agency ONEE on its own behalf suitable?</p> <p>In what respects did the partner have a special need for support from FC?</p> | Project documents, ONEE survey                                                   |   |   |  |
| Is the design of the programme and its implementation coordinated with the activities of other donors?                                                                                                   | <p>What coordination was there with other relevant donors?</p> <p>Which other donors are active in the sector and with which projects?</p>                                                                                                                                                                                                                                                                                      | Survey of UNDP/GEF, World Bank                                                   |   |   |  |
| Was the programme designed to use the existing systems and structures (of partners/other donors/international organisations) for the implementation of its activities and to what extent are these used? | <p>What experiences from the INARA programme with the World Bank and ONE were taken into account in the programme's design?</p>                                                                                                                                                                                                                                                                                                 | Evaluation study on the INARA programme and survey of KfW, ONEE                  |   |   |  |
| Are common systems (of partners/other donors/international organisations) used for monitoring/evaluation, learning and accountability?                                                                   | <p>Were there systems for follow-up/evaluation, learning and accountability, including World Bank systems, that would have been helpful for the programme?</p>                                                                                                                                                                                                                                                                  | World Bank survey, World Bank reports (final report, possibly evaluation report) |   |   |  |

## Effectiveness

| Evaluation question                                                                                                                                               | Specification of the question for the present project                                                                                                                                                                                                                                                                              | Data source (or rationale if the question is not relevant/applicable) | Rating | Weighting ( - / 0 / + ) | Reason for weighting |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Achievement of (intended) targets                                                                                                           |                                                                                                                                                                                                                                                                                                                                    |                                                                       | 2      | 0                       |                      |
| Were the (if necessary, adjusted) objectives of the programme (incl. capacity development measures) achieved?<br>Table of indicators: Comparison of actual/target | Have the planned theoretical savings in electricity consumption and greenhouse gas emissions actually been achieved through the distribution of energy-saving lamps?                                                                                                                                                               | Survey of target group, ONEE. Document analysis                       |        |                         |                      |
| Other evaluation question 1                                                                                                                                       | How plausible are the assumptions on which the calculation of the savings is based?                                                                                                                                                                                                                                                | Survey of target group, analysis of ONEE data                         |        |                         |                      |
| Other evaluation question 2                                                                                                                                       | What monitoring data was gathered to provide plausible evidence of the achievement of the objectives and the outputs on which they are based?                                                                                                                                                                                      | ONEE                                                                  |        |                         |                      |
| Evaluation dimension: Contribution to achieving targets:                                                                                                          |                                                                                                                                                                                                                                                                                                                                    |                                                                       | 2      | 0                       |                      |
| To what extent were the outputs of the programme delivered as planned (or adapted to new developments)? ( <i>Learning/help question</i> )                         | Have all 10 million CFLs been sold or distributed to the target group?<br>Did the sales price remain constant during the project period or was it adjusted to the price trend for light sources?<br>Were the communication campaign, training and equipment of the distribution network and disposal study implemented as planned? | Reports, ONEE survey                                                  |        |                         |                      |
| Are the outputs provided and the capacities created used?                                                                                                         | Are/were the 10 million CFLs actually used according to their theoretical useful life?                                                                                                                                                                                                                                             | Survey of target group, ONEE                                          |        |                         |                      |

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                             |                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                        | <p>How was the communication campaign used by customers and in the distribution network?</p> <p>How was the training and equipment used by the distribution network?</p> <p>What impact did the disposal study have on the potentially negative environmental impacts of disposed CFLs?</p> |                                                                                                       |
| To what extent is equal access to the outputs provided and the capacities created guaranteed (e.g. non-discriminatory, physically accessible, financially affordable, qualitatively, socially and culturally acceptable)?              | How did ONEE ensure equal access to the CFLs within the target group?                                                                                                                                                                                                                       | ONEE survey                                                                                           |
| To what extent did the programme contribute to achieving the objectives?                                                                                                                                                               | How did the households use the purchased CFLs (replacement of either functioning or defective bulbs, installation in new lamps or resale)?                                                                                                                                                  | Target group survey                                                                                   |
| To what extent did the programme contribute to achieving the objectives at the level of the intended beneficiaries?                                                                                                                    | Were the theoretical savings in electricity consumption actually achieved, and were there factors that limited the positive effect on disposable income?                                                                                                                                    | Target group survey                                                                                   |
| Did the programme contribute to the achievement of objectives at the level of the particularly disadvantaged or vulnerable groups involved and affected (potential differentiation according to age, income, gender, ethnicity, etc.)? |                                                                                                                                                                                                                                                                                             | No objectives were formulated at the level of particularly disadvantaged or vulnerable target groups. |
| Were there measures that specifically addressed gender impact potential (e.g. through the involvement of women in project committees, water committees, use of social                                                                  |                                                                                                                                                                                                                                                                                             | The programme did not address any gender impact potentials.                                           |

|                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                             |                       |   |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---|---|
| workers for women, etc.)? (FC-E-specific question)                                                                                                                                                                                                   |                                                                                                                                                                                                                                             |                       |   |   |
| Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended objectives of the programme? ( <i>Learning/help question</i> )                                          | In addition to its organisational and financial situation, how decisive was the kind of technology used by ONEE to the programme's success?                                                                                                 | ONEE survey           |   |   |
| Which external factors were decisive for the achievement or non-achievement of the intended objectives of the programme (also taking into account the risks anticipated beforehand)? ( <i>Learning/help question</i> )                               | Were there rebound effects in the form of the use of additional lighting or other electrical equipment compared to the condition before the programme?                                                                                      | Target group survey   |   |   |
| Evaluation dimension: Quality of implementation                                                                                                                                                                                                      |                                                                                                                                                                                                                                             |                       | 3 | 0 |
| How is the quality of the management and implementation of the programme (e.g. project-executing agency, consultant, taking into account ethnicity and gender in decision-making committees) evaluated with regard to the achievement of objectives? | How does the target group assess the quality of the management and implementation of the programme by ONEE? Did the composition of ONEE's decision-making bodies have an impact on the target achievement in terms of gender and ethnicity? | Target group survey   |   |   |
| How is the quality of the management, implementation and participation in the programme by the partners/sponsors evaluated?                                                                                                                          | Are the significant delays in the programme's implementation attributable to the quality of ONEE's management, implementation and participation?                                                                                            | KfW survey, documents |   |   |
| Were gender results and relevant risks in/through the project (gender-based violence, e.g. in the context of infrastructure or empowerment                                                                                                           | Has the programme achieved positive or negative gender results?                                                                                                                                                                             | Target group survey   |   |   |

|                                                                                                                                                                                                       |                                                                                                                            |                              |   |   |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------|---|---|--|
| projects) regularly monitored or otherwise taken into account during implementation? Have corresponding measures (e.g. as part of a CM) been implemented in a timely manner? (FC-E-specific question) |                                                                                                                            |                              |   |   |  |
| Evaluation dimension: Unintended effects (positive or negative)                                                                                                                                       |                                                                                                                            |                              | 2 | 0 |  |
| Can unintended positive/negative direct impacts (social, economic, ecological and, where applicable, those affecting vulnerable groups) be seen (or are they foreseeable)?                            | Was there any negative environmental impact caused by the disposal of the CFLs?                                            | Survey of target group, ONEE |   |   |  |
| What potential/risks arise from the positive/negative unintended effects and how should they be evaluated?                                                                                            | Is a regulated and environmentally compatible system for the disposal of the CFLs in place, under construction or planned? | ONEE survey                  |   |   |  |
| How did the programme respond to the potential/risks of the positive/negative unintended effects?                                                                                                     | Based on the disposal study, what measures were taken to avoid negative effects of unregulated disposal of CFLs?           | ONEE survey                  |   |   |  |

## Efficiency

| Evaluation question                                                                         | Specification of the question for the present project                                                                                 | Data source (or rationale if the question is not relevant/applicable)                                                                                     | Rating | Weighting ( - / 0 / + ) | Reason for weighting |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Production efficiency                                                 |                                                                                                                                       |                                                                                                                                                           | 1      | 0                       |                      |
| How are the inputs (financial and material resources) of the programme distributed (e.g. by | Was the executing agency ONEE's own share appropriate?<br>Were the costs of the communication campaign, training and equipment of the | Final inspection, analysis evaluation of the preliminary phase (INARA programme) and, if applicable, comparison with similar projects in other countries. |        |                         |                      |

|                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                         |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|
| instruments, sectors, sub-measures, also taking into account the cost contributions of the partners/executing agency/other participants and affected parties, etc.)? (Learning and help question)                                                                              | distribution network and the disposal study reasonable?                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                         |   |   |
| To what extent were the inputs of the programme used sparingly in relation to the outputs produced (products, capital goods and services) (if possible in a comparison with data from other evaluations of a region, sector, etc.)? For example, comparison of specific costs. | How high was the subsidy for the CFLs? How high was the price of subsidised and non-subsidised CFLs compared to light bulbs? Was the amount of the subsidy appropriate? Is the distribution of 10 million energy-saving lamps a cost-effective measure compared to other measures to achieve significant savings in electricity consumption and greenhouse gas emissions? | Current CO2 price in the European carbon market.<br>Investment costs for conventional power plants in Morocco.<br>Marginal abatement cost (MAC) curves. |   |   |
| If necessary, as a complementary perspective: To what extent could the outputs of the programme have been increased by an alternative use of inputs (if possible in a comparison with data from other evaluations of a region, sector, etc.)?                                  | Would the private sector have been better suited to carry out the advertising/information, distribution and installation of the CFLs efficiently and effectively?                                                                                                                                                                                                         | Interview with Philips                                                                                                                                  |   |   |
| Were the outputs produced on time and within the planned period?                                                                                                                                                                                                               | Have the significant delays in the implementation of the project led to cost increases?                                                                                                                                                                                                                                                                                   | Comparison of planned costs in the PP and actual costs.                                                                                                 |   |   |
| Were the coordination and management costs reasonable (e.g. implementation consultant's cost component)? (FC-E-specific question)                                                                                                                                              | Was the involvement of INSTELEC necessary, efficient and effective for the implementation of the project?                                                                                                                                                                                                                                                                 | Interviews with target group and ONEE                                                                                                                   |   |   |
| Evaluation dimension: Allocation efficiency                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                         | 1 | 0 |

|                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                           |                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| In what other ways and at what costs could the effects achieved (outcome/impact) have been attained? ( <i>Learning/help question</i> )                                                                                                                                                                                                                   | Would an alternative project design, e.g. involving the private sector, have led to greater efficiency and effectiveness? | Survey of target group and private sector |
| To what extent could the effects achieved have been attained in a more cost-effective manner, compared with an alternatively designed programme?                                                                                                                                                                                                         | See above                                                                                                                 |                                           |
| If necessary, as a complementary perspective: To what extent could the positive effects have been increased with the resources available, compared to an alternatively designed programme?                                                                                                                                                               | See above                                                                                                                 |                                           |
| Note: If the internal identifier PSP (Private Sector Participation; see Inpro under 1.11) was issued for the project or there is generally cooperation with private actors (commercial banks, companies, professional NGOs) in the implementation of FC (private sector as an instrument), the following evaluation question must be taken into account: |                                                                                                                           |                                           |
| In what respect was the use of public funds financially complementary?                                                                                                                                                                                                                                                                                   |                                                                                                                           |                                           |

## Impact

| Evaluation question                                                                                                                     | Specification of the question for the present project                                                                  | Data source (or rationale if the question is not relevant/applicable)                                             | Rating | Weighting ( - / o / + ) | Reason for weighting |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Overarching (intended) developmental changes                                                                      |                                                                                                                        |                                                                                                                   | 2      | o                       |                      |
| Is it possible to identify overarching developmental changes to which the programme should contribute? (Or if foreseeable, please be as | Has the project made a significant contribution to the efficient use of scarce energy resources and to climate action? | Estimate of the actual energy savings achieved along with the corresponding CO2 reduction and CO2 avoidance costs |        |                         |                      |

|                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                   |                                                           |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---|---|
| specific as possible in terms of time.)                                                                                                                                                                                                                                  |                                                                                                                                                                                                   |                                                           |   |   |
| Is it possible to identify overarching developmental changes (social, economic, environmental and their interactions) at the level of the intended beneficiaries? (Or if foreseeable, please be as specific as possible in terms of time)                                | Have there been unplanned negative environmental effects, e.g. due to unregulated disposal of defective CFLs?                                                                                     | Interviews with target group                              |   |   |
| To what extent can overarching developmental changes be identified at the level of particularly disadvantaged or vulnerable parts of the target group to which the programme should contribute? (Or, if foreseeable, please be as specific as possible in terms of time) | Why were disadvantaged or vulnerable target groups not explicitly taken into account in the PP and in the implementation of the project?                                                          | ONEE and KfW survey<br>Interviews with target group       |   |   |
| Evaluation dimension: Contribution to overarching (intended) developmental changes                                                                                                                                                                                       |                                                                                                                                                                                                   |                                                           | 2 | 0 |
| To what extent did the programme actually contribute to the identified or foreseeable overarching developmental changes (also taking into account the political stability) to which the programme should contribute?                                                     | Was the assumption of a constant grid emission factor realistic?<br>Were there rebound effects (e.g. by using additional lamps)?<br>Were CFLs installed with a time delay only when bulbs failed? | IEA statistics, ONEE data<br>Interviews with target group |   |   |
| To what extent did the programme achieve its intended (possibly adjusted) developmental objectives? In other words, are the project impacts sufficiently tangible not only at outcome level, but at impact                                                               | To what extent have the actually achieved emission reductions helped Morocco achieve the mitigation targets outlined in its NDC?                                                                  | Research, NDC, BUR 1–3                                    |   |   |

|                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                  |                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| level? (e.g. drinking water supply/health effects)                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                  |                                                                                                |
| Did the programme contribute to achieving its (possibly adjusted) developmental objectives at the level of the intended beneficiaries?                                                                                                                                                                               |                                                                                                                                                                                                                                  | The programme had no development policy objectives at the level of the intended beneficiaries. |
| Has the programme contributed to overarching developmental changes or changes in life situations at the level of particularly disadvantaged or vulnerable parts of the target group (potential differentiation according to age, income, gender, ethnicity, etc.) to which the programme was intended to contribute? | Has the focus on rural target groups outside cities led to proven increases in the target group's disposable income?<br>Why was there no follow-up on the assumed reduction in electricity bills?                                | Survey of KfW and ONEE                                                                         |
| Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended developmental objectives of the programme? ( <i>Learning/help question</i> )                                                                                            | In addition to its organisational and financial situation, how decisive was the kind of technology used by ONEE to the programme's success?                                                                                      | ONEE survey                                                                                    |
| Which external factors were decisive for the achievement or non-achievement of the intended developmental objectives of the programme? ( <i>Learning/help question</i> )                                                                                                                                             | What influence did electricity prices have on the programme's success?<br>Would a transformation of the lighting market to CFLs have taken place over time even without the project due to the sharply falling costs for CFLs?   | ONEE survey, if applicable comparison with countries without CFL promotional programmes        |
| Does the project have a broad-based impact?<br>- To what extent has the programme led to structural or institutional changes (e.g. in                                                                                                                                                                                | What share of the total market for lamps (bulbs, CFLs and LED) do the CFLs installed by the project have in the years 2012–2020?<br><br>Have there been any structural, institutional or regulatory changes since 2012 to reduce | Research and survey of ONEE and private sector.<br>Documents                                   |

|                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                         |                                                                                                  |   |   |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---|---|--|
| <p>organisations, systems and regulations)? (Structure formation)</p> <ul style="list-style-type: none"> <li>- Was the programme exemplary and/or broadly effective and is it reproducible? (Model character)</li> </ul>                                                                                          | <p>or ban the production or import and use of conventional light bulbs?<br/>Have other countries asked about the experiences gained from the programme and used it for their own CFL programmes if applicable?</p>                                      | <p>Survey of ONEE and, if necessary, Ministry of Energy/Environment</p>                          |   |   |  |
| <p>How would the development have gone without the programme (developmental additionality)?</p>                                                                                                                                                                                                                   | <p>Between 2012 and 2020, what proportion of households that are ONEE customers, but have not benefited from the project, had light bulbs and CFLs?</p>                                                                                                 | <p>Document analysis</p>                                                                         |   |   |  |
| <p>Evaluation dimension: Contribution to overarching (unintended) developmental changes</p>                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                         |                                                                                                  | 2 | 0 |  |
| <p>To what extent can unintended overarching developmental changes (also taking into account political stability) be identified (or, if foreseeable, please be as specific as possible in terms of time)?</p>                                                                                                     | <p>Was there any negative environmental impact due to unregulated disposal of defective CFLs?<br/>What happened to light bulbs on the market that were replaced by the CFLs?<br/>To what extent was the marketing of LEDs impeded by the programme?</p> | <p>Survey of target group, ONEE and, if necessary, Ministry of Environment/Energy, producers</p> |   |   |  |
| <p>Did the programme noticeably or foreseeably contribute to unintended (positive and/or negative) overarching developmental impacts?</p>                                                                                                                                                                         | <p>Increased disposable income of disadvantaged/vulnerable population groups?</p>                                                                                                                                                                       | <p>Target group survey</p>                                                                       |   |   |  |
| <p>Did the programme noticeably (or foreseeably) contribute to unintended (positive or negative) overarching developmental changes at the level of particularly disadvantaged or vulnerable groups (within or outside the target group) (do no harm, e.g. no strengthening of inequality (gender/ethnicity))?</p> | <p>Increased disposable income of disadvantaged/vulnerable population groups?</p>                                                                                                                                                                       | <p>Target group survey</p>                                                                       |   |   |  |

## Sustainability

| Evaluation question                                                                                                                                                                                                                                                          | Specification of the question for the present project                                                                                                                                                                                                                                                             | Data source (or rationale if the question is not relevant/applicable) | Rating | Weighting ( - / o / + ) | Reason for weighting |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------|-------------------------|----------------------|
| Evaluation dimension: Capacities of participants and stakeholders                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                   |                                                                       | 2      | o                       |                      |
| Are the target group, executing agencies and partners institutionally, personally and financially able and willing (ownership) to maintain the positive effects of the programme over time (after the end of the promotion)?                                                 | Are further programmes for ESL promotion planned?<br><br>How did the market for conventional bulbs and for ESLs (CFL, LED) develop after the end of the project in 2021 and 2022?                                                                                                                                 | ONEE survey, research                                                 |        |                         |                      |
| To what extent do the target group, executing agencies and partners demonstrate resilience to future risks that could jeopardise the impact of the programme?                                                                                                                | Is the target group aware of the financial benefits of ESLs and has this also led to the disappearance of conventional light bulbs in their households after 2020?                                                                                                                                                | Target group survey                                                   |        |                         |                      |
| Evaluation dimension: Contribution to supporting sustainable capacities:                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                   |                                                                       | 2      | o                       |                      |
| Did the programme contribute to the target group, executing agencies and partners being institutionally, personally and financially able and willing (ownership) to maintain the positive effects of the programme over time and, where necessary, to curb negative effects? | Have quality assurance measures been introduced for the CFLs?<br>How many poor quality CFLs are imported and how much of a problem is product piracy (fake lamps of poor quality imitating well-known manufacturers)?<br>Are there now ways of disposing of defective CFLs, or are there disposal plans in place? | Survey of ONEE, Philips                                               |        |                         |                      |
| Did the programme contribute to strengthening the resilience of the                                                                                                                                                                                                          | Does ONEE have the financial and human resources to combat product                                                                                                                                                                                                                                                | ONEE survey                                                           |        |                         |                      |

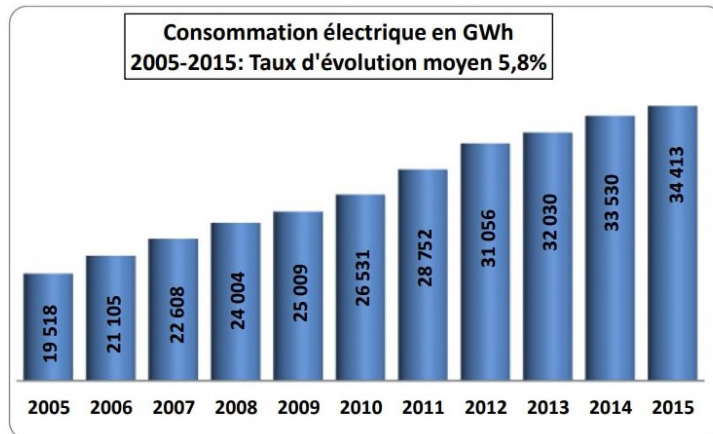
|                                                                                                                                                                 |                                                                                                                                                                                                                   |                                                 |   |   |                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---|---|------------------------------------------------------------------------------|
| target group, executing agencies and partners to risks that could jeopardise the effects of the programme?                                                      | piracy and ensure the minimum quality of the CFLs on the Moroccan market?                                                                                                                                         |                                                 |   |   |                                                                              |
| Did the programme contribute to strengthening the resilience of particularly disadvantaged groups to risks that could jeopardise the effects of the programme?  | Did particularly disadvantaged groups benefit from the programme and if so, how?                                                                                                                                  | Target group survey                             |   |   |                                                                              |
| Evaluation dimension: Durability of effects over time                                                                                                           |                                                                                                                                                                                                                   |                                                 | 3 | + | This aspect was not sufficiently taken into account in the project's design. |
| How stable is the context of the programme (e.g. social justice, economic performance, political stability, environmental balance)?<br>(Learning/help question) | Has the programme's context changed significantly over time?<br><br>Does the development of the target group's economic performance mean that they are able to purchase ESLs even without promotional programmes? | Survey of ONEE, target group                    |   |   |                                                                              |
| To what extent is the durability of the positive effects of the programme influenced by the context?<br>(Learning/help question)                                | What influence do electricity prices have on demand for ESLs?                                                                                                                                                     | Survey of target group, ONEE. Document analysis |   |   |                                                                              |
| To what extent are the positive and, where applicable, the negative effects of the programme likely to be long-lasting?                                         | To what extent have electricity price increases reduced the positive impact on households' budgets?                                                                                                               | Research, ONEE survey                           |   |   |                                                                              |
| Other evaluation question 1                                                                                                                                     | Did the programme produce any gender results?                                                                                                                                                                     | Survey of target group, ONEE                    |   |   |                                                                              |



## Annex 5: Annexes to the main section

### Annex 5.1: Supplementary diagrams for the Relevance section

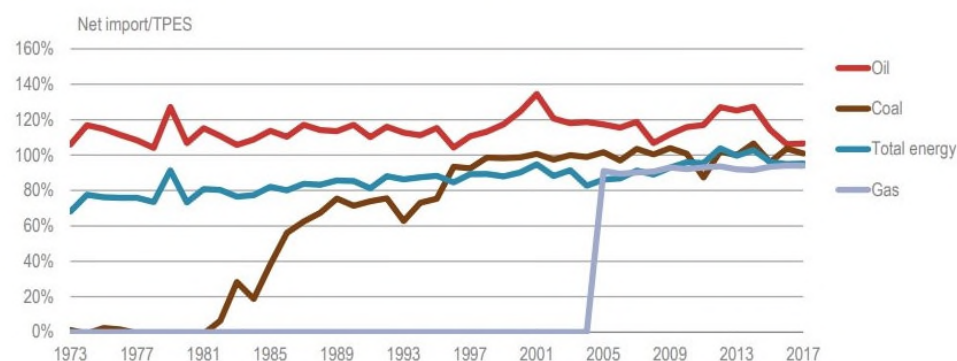
#### Development of electricity consumption 2005–2015



Source: PNUE/UNEP  
2017, p. 16

#### Import dependence of Morocco by energy source, 1973–2017

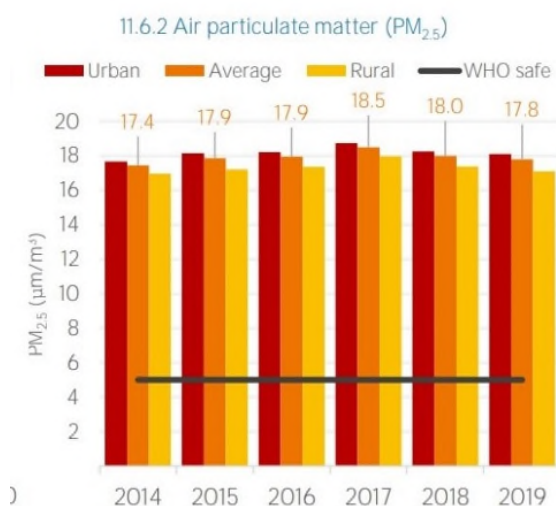
Figure 2.4 Import dependency by fuel, 1973-2017



Source: IEA  
2019, p. 19

Source: IEA (2019 forthcoming), *World Energy Balances 2019 preliminary edition*, [www.iea.org/statistics/](http://www.iea.org/statistics/).

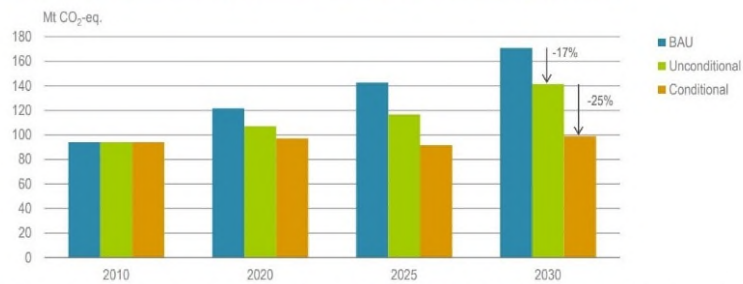
#### Morocco particulate matter concentration and WHO reference value, 2014–2019



Source: IRENA  
2022, p. 1

## Predicted greenhouse gas emissions Morocco, 2010–2030

Figure 3.1 Projected GHG emissions in different mitigation scenarios



Notes: The emissions include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Fluorinated gases are not covered; their emissions are marginal. The sectors covered: electricity production, housing (residential and tertiary), agriculture; industry; transportation, waste and forestry.

Source: IEA based on Government of Morocco, Morocco's NDC, 2016.

Source: IEA 2019, p. 35

(BAU=business as usual,  
unconditional from national  
own resources,  
conditional with debt  
financing)

## Annex 5.2: Summary analysis of the survey of 100 ONEE customers using the KoBo toolbox (data element) and National Expert report

- KoBo toolbox (data element):

### LBC Maroc



Dies ist ein automatisch erstellter Bericht, der auf für dieses Projekt eingereichten Rohdaten basiert. Bitte führen Sie eine ordnungsgemäße Datenbereinigung durch, bevor Sie die auf dieser Seite verwendeten Diagramme und Zahlen verwenden.

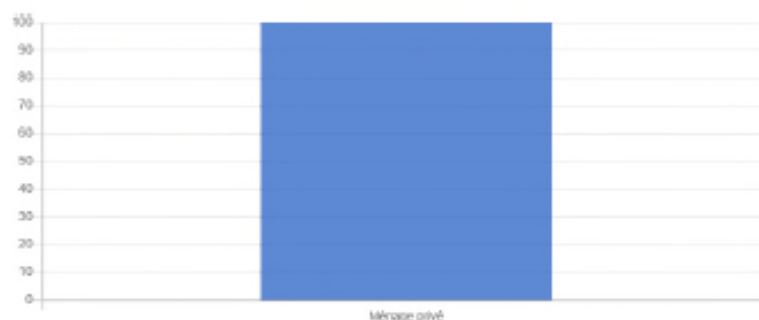
#### Numéro d'ordre de l'interview

TYPBEZEICHNUNG: "INTEGER". 99 von 100 Befragten hat diese Frage beantwortet.  
(1 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 52.66      | 54.00  | 7.00  | 30.31              |

#### Type de répondant

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

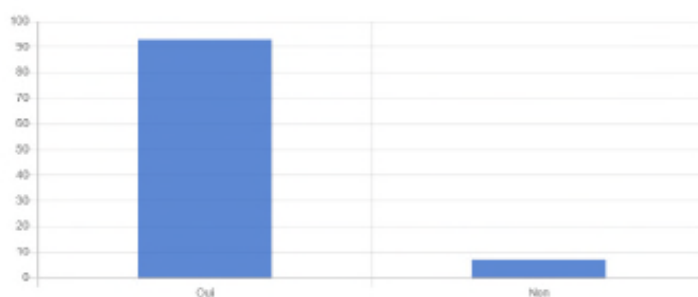


| Wert         | Frequenz | Prozentsatz |
|--------------|----------|-------------|
| Ménage privé | 100      | 100         |

### Connaissez-vous le programme "INARA"?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

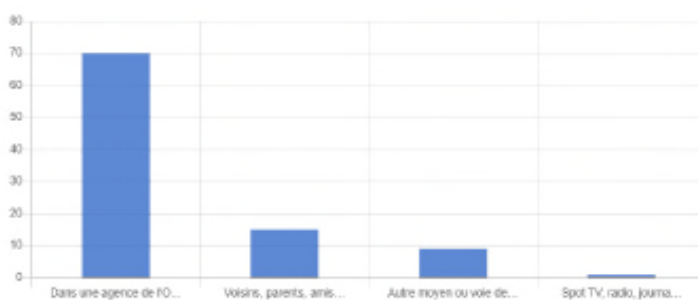


| Wert | Frequenz | Prozentsatz |
|------|----------|-------------|
| Oui  | 93       | 93          |
| Non  | 7        | 7           |

### Comment avez-vous pris connaissance du programme INARA?

...

TYPBEZEICHNUNG: "SELECT\_MULTIPLE". 93 von 100 Befragten hat diese Frage beantwortet. (7 waren ohne Daten.)

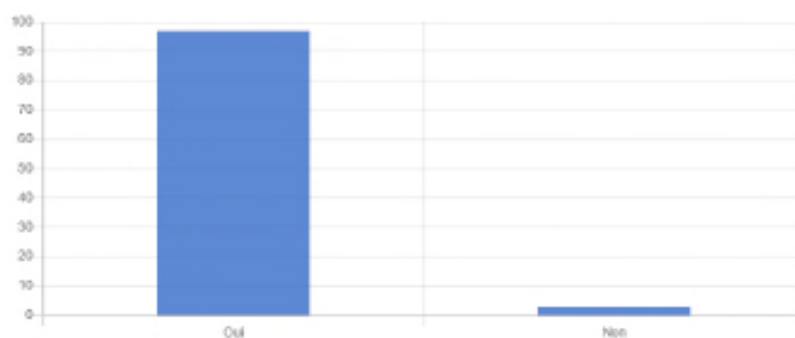


| Wert                                            | Frequenz | Prozentsatz |
|-------------------------------------------------|----------|-------------|
| Dans une agence de l'ONEE ou par info de l'ONEE | 70       | 70          |
| Voisins, parents, amis, etc.                    | 15       | 15          |
| Autre moyen ou voie de communication            | 9        | 9           |
| Spot TV, radio, journal, etc.                   | 1        | 1           |

### Aviez-vous reçu ou acheté des CFL dans un programme de l'ONEE entre 2014 et 2020?



TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

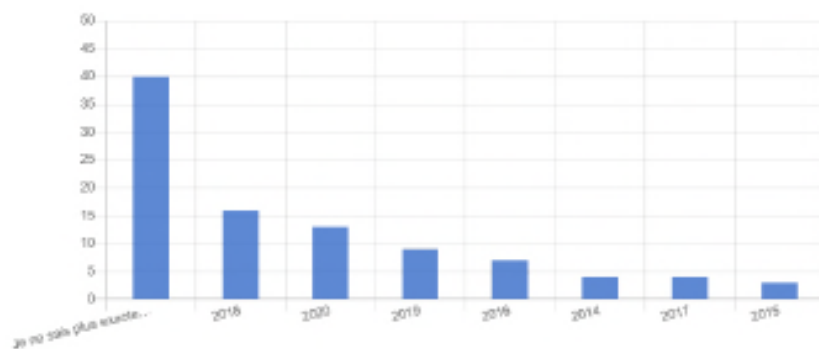


| Wert | Frequenz | Prozentsatz |
|------|----------|-------------|
| Oui  | 97       | 97          |
| Non  | 3        | 3           |

## L'achat était dans quelle année?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 96 von 100 Befragten hat diese Frage beantwortet. (4 waren ohne Daten.)

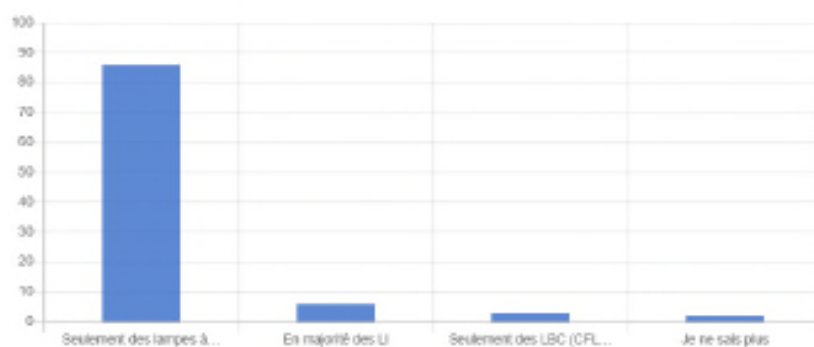


| Wert                               | Frequenz | Prozentsatz |
|------------------------------------|----------|-------------|
| Je ne sais plus exactement l'année | 40       | 40          |
| 2018                               | 16       | 16          |
| 2020                               | 13       | 13          |
| 2019                               | 9        | 9           |
| 2016                               | 7        | 7           |
| 2014                               | 4        | 4           |
| 2017                               | 4        | 4           |
| 2015                               | 3        | 3           |

## Quel type de lampes aviez-vous eu dans votre ménage (ou unité de commerce/administration) avant la participation au programme INARA?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 97 von 100 Befragten hat diese Frage beantwortet. (3 waren ohne Daten.)

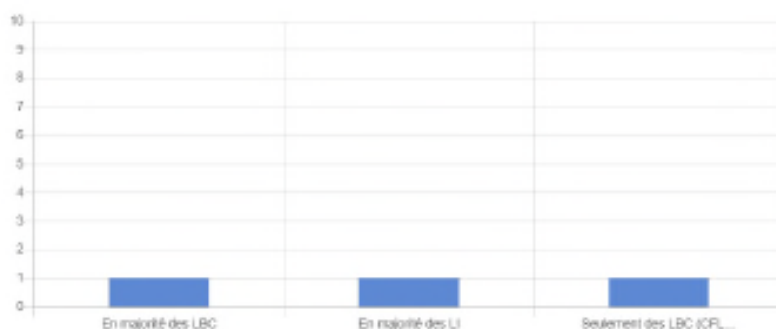


| Wert                                      | Frequenz | Prozentsatz |
|-------------------------------------------|----------|-------------|
| Seulement des lampes à incandescence (LI) | 86       | 86          |
| En majorité des LI                        | 6        | 6           |
| Seulement des LBC (CFL ou LED)            | 3        | 3           |
| Je ne sais plus                           | 2        | 2           |

### Quel type de lampes aviez-vous eu dans votre ménage en 2018 (si inconnu: 2019, 2020)?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 3 von 100 Befragten hat diese Frage beantwortet. (97 waren ohne Daten.)



| Wert                           | Frequenz | Prozentsatz |
|--------------------------------|----------|-------------|
| En majorité des LBC            | 1        | 1           |
| En majorité des LI             | 1        | 1           |
| Seulement des LBC (CFL ou LED) | 1        | 1           |

### Estimation approximative: combien de lampes (ampoules) aviez-vous eu dans votre ménage (ou unité de commerce/administration) à cet époque ?

TYPBEZEICHNUNG: "INTEGER". 97 von 100 Befragten hat diese Frage beantwortet. (3 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 10.85      | 8.00   | 8.00  | 6.23               |

**Estimation approximative: combien de lampes (ampoules) aviez-vous eu dans votre ménage en 2018 (si inconnu: 2019, 2020)?**

TYPBEZEICHNUNG: "INTEGER". 3 von 100 Befragten hat diese Frage beantwortet.  
(97 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 8.33       | 6.00   | *     | 5.86               |

**Estimation approximative: quelle était la puissance moyenne en Watt des lampes?**

TYPBEZEICHNUNG: "INTEGER". 97 von 100 Befragten hat diese Frage beantwortet.  
(3 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 73.45      | 75.00  | 75.00 | 16.65              |

**Estimation approximative: quelle était la puissance moyenne en Watt des lampes?**

TYPBEZEICHNUNG: "INTEGER". 3 von 100 Befragten hat diese Frage beantwortet.  
(97 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 39.67      | 35.00  | *     | 33.25              |

**Estimation approximative: combien d'heures en moyenne étaient-elles allumées par jour?**

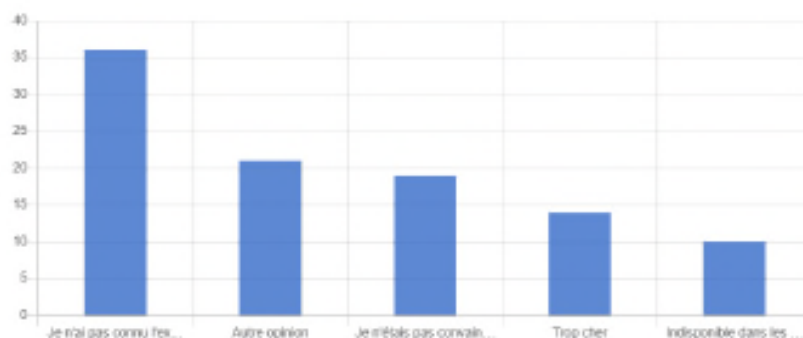
TYPBEZEICHNUNG: "INTEGER". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 2.50       | 2.00   | 2.00  | 1.05               |

### Quelle était votre opinion vis-à-vis des CFL à cette époque?

...

TYPBEZEICHNUNG: "SELECT\_MULTIPLE". 99 von 100 Befragten hat diese Frage beantwortet. (1 waren ohne Daten.)



| Wert                                                      | Frequenz | Prozentsatz |
|-----------------------------------------------------------|----------|-------------|
| Je n'ai pas connu l'existence et/ou les avantages des CFL | 36       | 36          |
| Autre opinion                                             | 21       | 21          |
| Je n'étais pas convaincu des avantages des CFL            | 19       | 19          |
| Trop cher                                                 | 14       | 14          |
| Indisponible dans les magasins                            | 10       | 10          |

### Quel était le prix pour une CFL dans les magasins à l'époque?

TYPBEZEICHNUNG: "INTEGER". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 23.95      | 20.00  | 20.00 | 11.16              |

Combien de CFL avez-vous reçu dans le cadre du programme INARA?

TYPBEZEICHNUNG: "INTEGER". 96 von 100 Befragten hat diese Frage beantwortet.  
(4 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 11.76      | 11.00  | 12.00 | 7.04               |

Combien de ces CFL avez-vous installé tout de suite en remplaçant des LI?

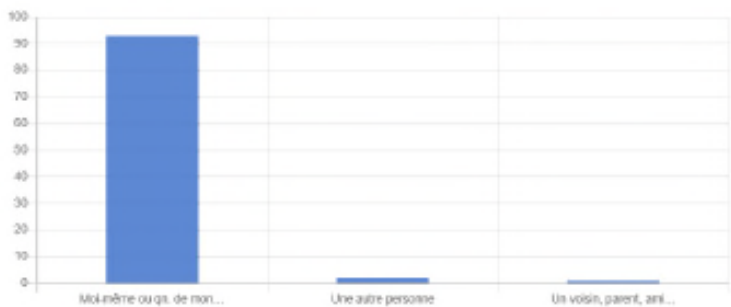
TYPBEZEICHNUNG: "INTEGER". 96 von 100 Befragten hat diese Frage beantwortet.  
(4 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 8.86       | 7.00   | 6.00  | 5.12               |

Qui a installé les CFL?

TYPBEZEICHNUNG: "SELECT\_ONE". 96 von 100 Befragten hat diese Frage beantwortet. (4 waren ohne Daten.)

...

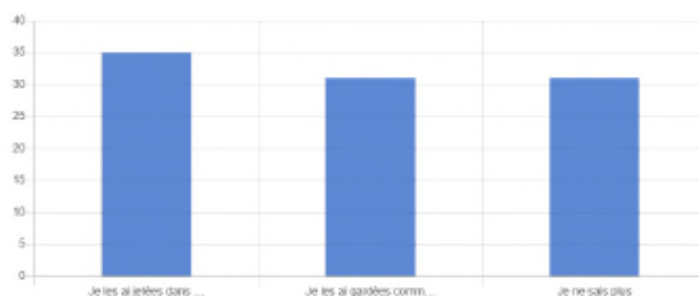


| Wert                                                                | Frequenz | Prozentsatz |
|---------------------------------------------------------------------|----------|-------------|
| Moi-même ou qn. de mon ménage (ou unité de commerce/administration) | 93       | 93          |
| Une autre personne                                                  | 2        | 2           |
| Un voisin, parent, ami, etc.                                        | 1        | 1           |

### Qu'est-ce que vous avez fait avec les lampes à incandescente qui ont été remplacées par les CFL?

...

TYPBEZEICHNUNG: "SELECT\_MULTIPLE". 96 von 100 Befragten hat diese Frage beantwortet. (4 waren ohne Daten.)

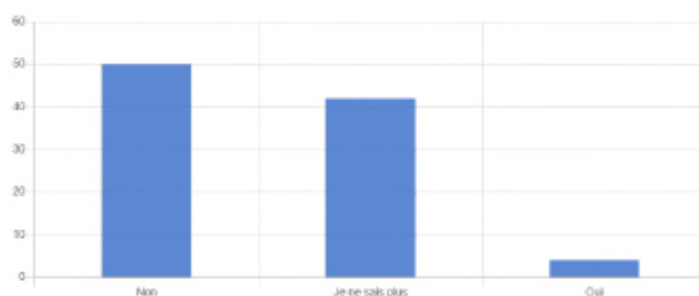


| Wert                              | Frequenz | Prozentsatz |
|-----------------------------------|----------|-------------|
| Je les ai jetées dans la poubelle | 35       | 35          |
| Je les ai gardées comme réserve   | 31       | 31          |
| Je ne sais plus                   | 31       | 31          |

### Avez-vous reçu des informations comment agir en cas de bris des CFL?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 96 von 100 Befragten hat diese Frage beantwortet. (4 waren ohne Daten.)

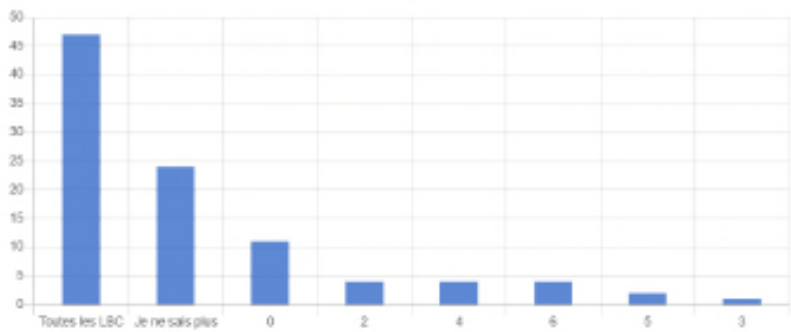


| Wert            | Frequenz | Prozentsatz |
|-----------------|----------|-------------|
| Non             | 50       | 50          |
| Je ne sais plus | 42       | 42          |
| Oui             | 4        | 4           |

Combien des CFL, que vous avez reçu dans le cadre du programme INARA 2, sont tombées défectueuses ou sont brisées?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 97 von 100 Befragten hat diese Frage beantwortet. (3 waren ohne Daten.)

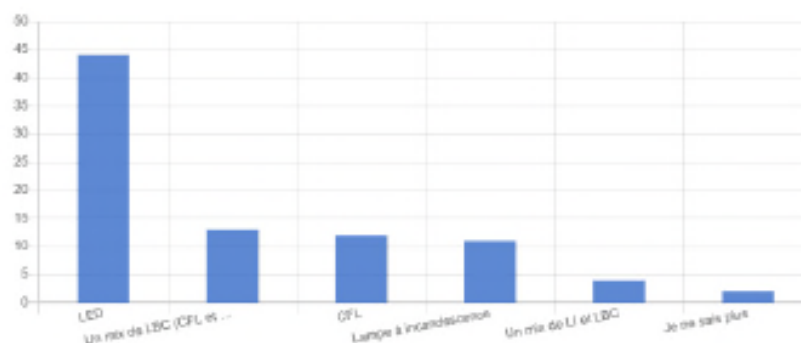


| Wert            | Frequenz | Prozentsatz |
|-----------------|----------|-------------|
| Toutes les LBC  | 47       | 47          |
| Je ne sais plus | 24       | 24          |
| 0               | 11       | 11          |
| 2               | 4        | 4           |
| 4               | 4        | 4           |
| 6               | 4        | 4           |
| 5               | 2        | 2           |
| 3               | 1        | 1           |

## Quelle sorte de lampe a remplacé les CFL brisées ou défectueuses?

...

TYPBEZEICHNUNG: "SELECT\_MULTIPLE". 86 von 100 Befragten hat diese Frage beantwortet. (14 waren ohne Daten.)

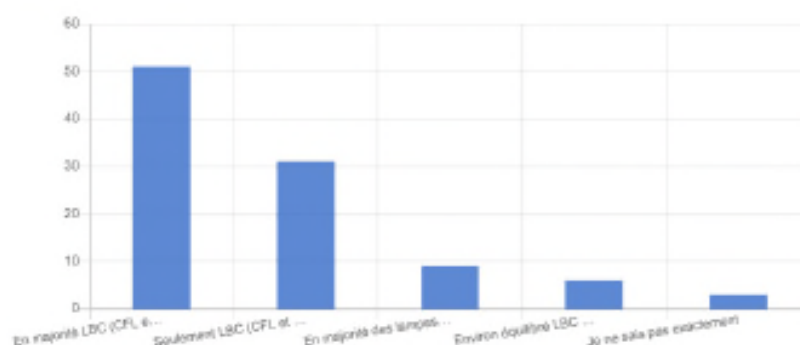


| Wert                       | Frequenz | Prozentsatz |
|----------------------------|----------|-------------|
| LED                        | 44       | 44          |
| Un mix de LBC (CFL et LED) | 13       | 13          |
| CFL                        | 12       | 12          |
| Lampe à incandescence      | 11       | 11          |
| Un mix de LI et LBC        | 4        | 4           |
| Je ne sais plus            | 2        | 2           |

## Combien et quelle sorte de lampe avez-vous actuellement dans votre ménage (ou unité de commerce/administration)?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

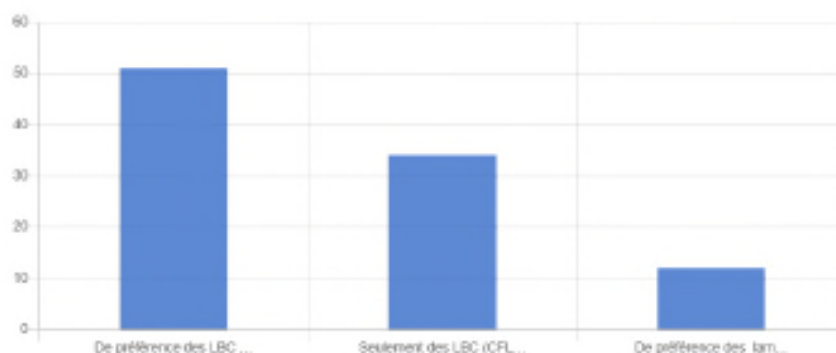


| Wert                                   | Frequenz | Prozentsatz |
|----------------------------------------|----------|-------------|
| En majorité LBC (CFL et LED)           | 51       | 51          |
| Seulement LBC (CFL et LED)             | 31       | 31          |
| En majorité des lampes à incandescence | 9        | 9           |
| Environ équilibré LBC et LI            | 6        | 6           |
| Je ne sais pas exactement              | 3        | 3           |

### En cas de bris ou de défection d'une LBC (CFL ou LED), quelle sorte de lampes achetez-vous aujourd'hui?



TYPBEZEICHNUNG: "SELECT\_MULTIPLE". 97 von 100 Befragten hat diese Frage beantwortet. (3 waren ohne Daten.)

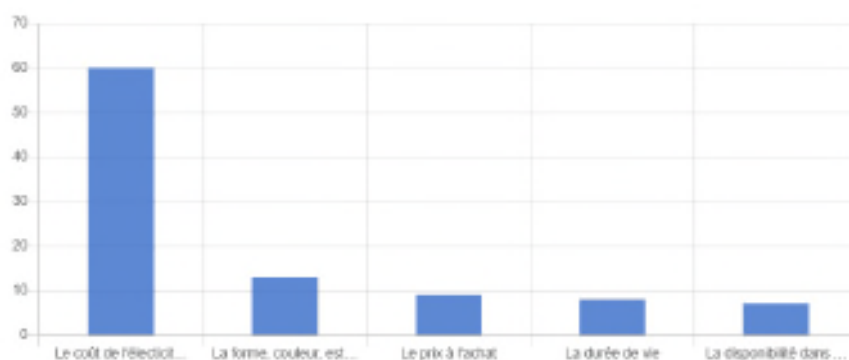


| Wert                                     | Frequenz | Prozentsatz |
|------------------------------------------|----------|-------------|
| De préférence des LBC (CFL ou LED)       | 51       | 51          |
| Seulement des LBC (CFL ou LED)           | 34       | 34          |
| De préférence des lampes à incandescence | 12       | 12          |

## Quelle est la raison principale de votre choix de l'achat de lampes?



TYPBEZEICHNUNG: "SELECT\_ONE". 97 von 100 Befragten hat diese Frage beantwortet. (3 waren ohne Daten.)

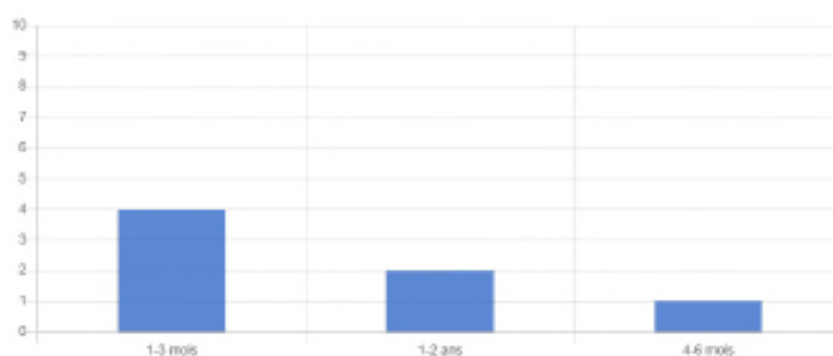


| Wert                                                     | Frequenz | Prozentsatz |
|----------------------------------------------------------|----------|-------------|
| Le coût de l'électricité sur la durée de vie de la lampe | 60       | 60          |
| La forme, couleur, esthétique                            | 13       | 13          |
| Le prix à l'achat                                        | 9        | 9           |
| La durée de vie                                          | 8        | 8           |
| La disponibilité dans le magasin                         | 7        | 7           |

Une LBC (CFL ou LED) coute actuellement environ 20 Dh tandis qu'une LI coute environ 4 Dh. Selon votre estimation: combien de mois faut-il pour récupérer le prix plus élevé d'achat par la réduction de la facture d'électricité?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 7 von 100 Befragten hat diese Frage beantwortet. (93 waren ohne Daten.)

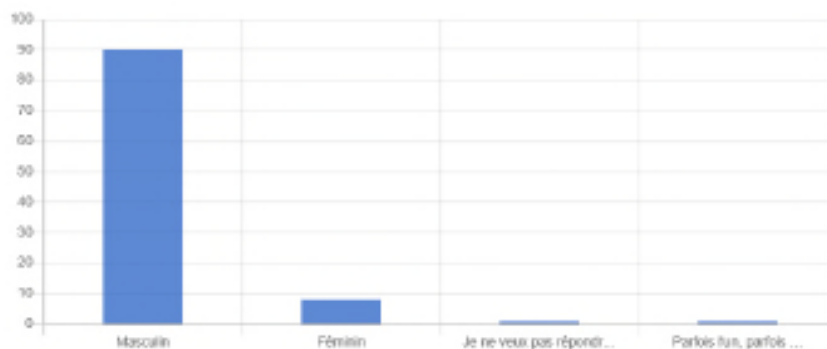


| Wert     | Frequenz | Prozentsatz |
|----------|----------|-------------|
| 1-3 mois | 4        | 4           |
| 1-2 ans  | 2        | 2           |
| 4-6 mois | 1        | 1           |

### Quel genre a la personne qui paie dans votre ménage la facture d'électricité?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

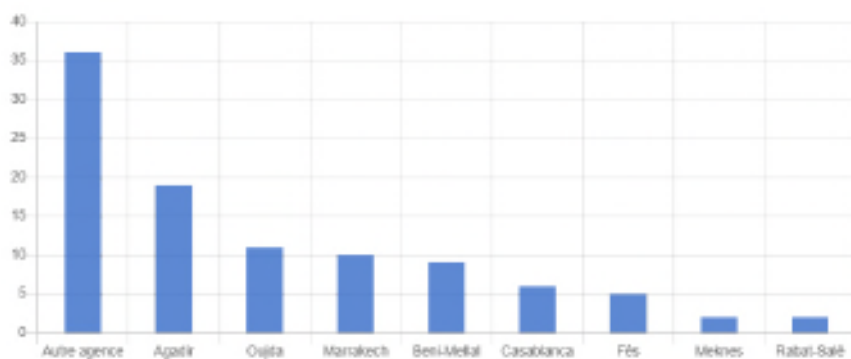


| Wert                                     | Frequenz | Prozentsatz |
|------------------------------------------|----------|-------------|
| Masculin                                 | 90       | 90          |
| Féminin                                  | 8        | 8           |
| Je ne veux pas répondre à cette question | 1        | 1           |
| Parfois l'un, parfois l'autre            | 1        | 1           |

## Agence régionale de l'ONEE responsable pour le client

...

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

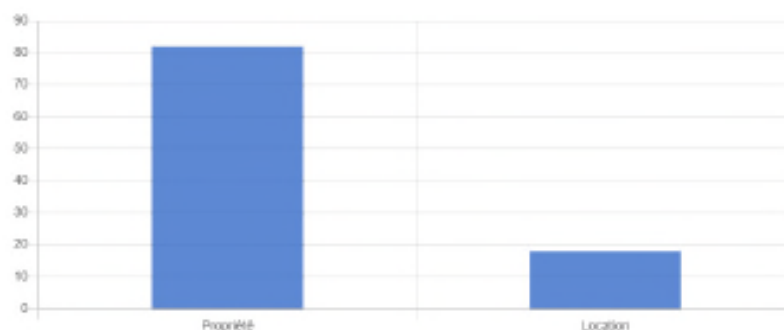


| Wert         | Frequenz | Prozentsatz |
|--------------|----------|-------------|
| Autre agence | 36       | 36          |
| Agadir       | 19       | 19          |
| Oujda        | 11       | 11          |
| Marrakech    | 10       | 10          |
| Beni-Mellal  | 9        | 9           |
| Casablanca   | 6        | 6           |
| Fès          | 5        | 5           |
| Meknes       | 2        | 2           |
| Rabat-Salé   | 2        | 2           |

### Habitez-vous en location ou dans votre propriété?

...

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)



| Wert      | Frequenz | Prozentsatz |
|-----------|----------|-------------|
| Propriété | 82       | 82          |
| Location  | 18       | 18          |

### Combien de m² a votre appartement/maison?

TYPBEZEICHNUNG: "INTEGER". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

| Mittelwert | Median | Modus  | Standardabweichung |
|------------|--------|--------|--------------------|
| 106.28     | 100.00 | 100.00 | 59.79              |

### Combien de chambres a votre appartement/maison?

TYPBEZEICHNUNG: "INTEGER". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 4.38       | 4.00   | 3.00  | 3.51               |

### Combien de personnes vivent dans votre ménage?

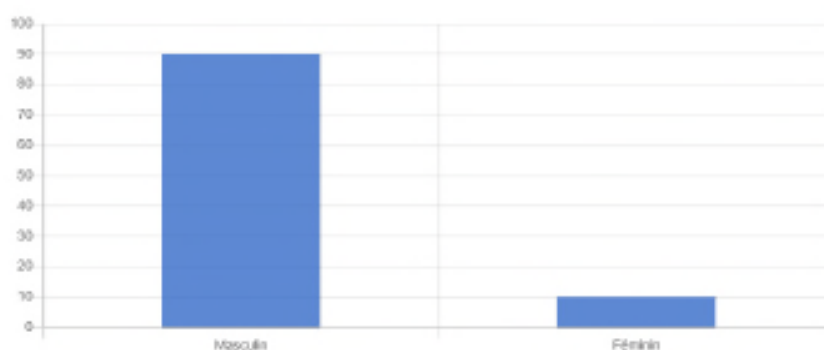
TYPBEZEICHNUNG: "INTEGER". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

| Mittelwert | Median | Modus | Standardabweichung |
|------------|--------|-------|--------------------|
| 5.78       | 5.00   | 4.00  | 2.90               |

### Est-ce que le répondant était féminin ou masculin?

TYPBEZEICHNUNG: "SELECT\_ONE". 100 von 100 Befragten hat diese Frage beantwortet. (0 waren ohne Daten.)

...



| Wert     | Frequenz | Prozentsatz |
|----------|----------|-------------|
| Masculin | 90       | 90          |
| Féminin  | 10       | 10          |

## National Expert report

Coopération financière germano-marocaine

### **Evaluation ex post**

Programme de Lampes à Basse Consommation (LBC)

No BMZ 2009.66.754

## **Synthèse des interviews de bénéficiaires du programme INARA**

# Présentation

- Utilisation de la plate forme KOBOTOOLBOX pour la réalisation des enquêtes
  - ✓ création de formulaires d'enquête de collecte d'informations auprès de ménages, d'administrations et d'abonnés patentés
  - ✓ Réalisation d'interviews par téléphone et recueil de données relatives à:
    - Localisation
    - Accès au Programme "INARA"
    - Eclairage initiale
    - Acquisition et exploitation des CFL
    - Nouvelles pratiques d'éclairage
    - Caractéristiques de l'habitat
  - ✓ Traitement des données par Kobotoolbox
- Bases de contacts ménages, Administrations et patentés

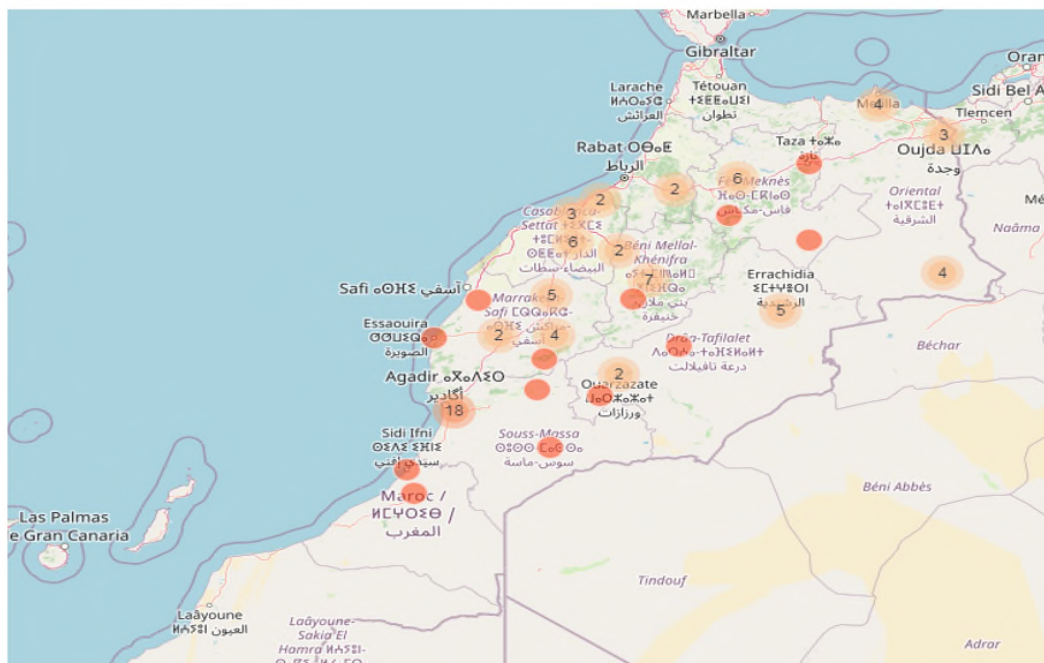
## Interviews ménages

- Bases de contacts ménages
  - ✓ Contraintes liées à: déménagements des ménages, réaffectation des numéros, numéros non affectés, ...
  - ✓ Les Réponses: un appel sur 3 en moyenne (100/291)
  - ✓ Difficultés de réponses: oublis, méfiance, indisponibilités
  - ✓ 100 personnes interviewées (ménages), à partir d'une base de données, fournie par l'ONEE, d'environ 2.200 clients bénéficiaires du programme LBC (INARA)
  - ✓ En conséquence des contraintes d'exploitation des contacts administration/commerce (voir slide suivant) seulement les interviews avec 100 ménages privés sont synthétisés ici

## Interviews administration/commerce

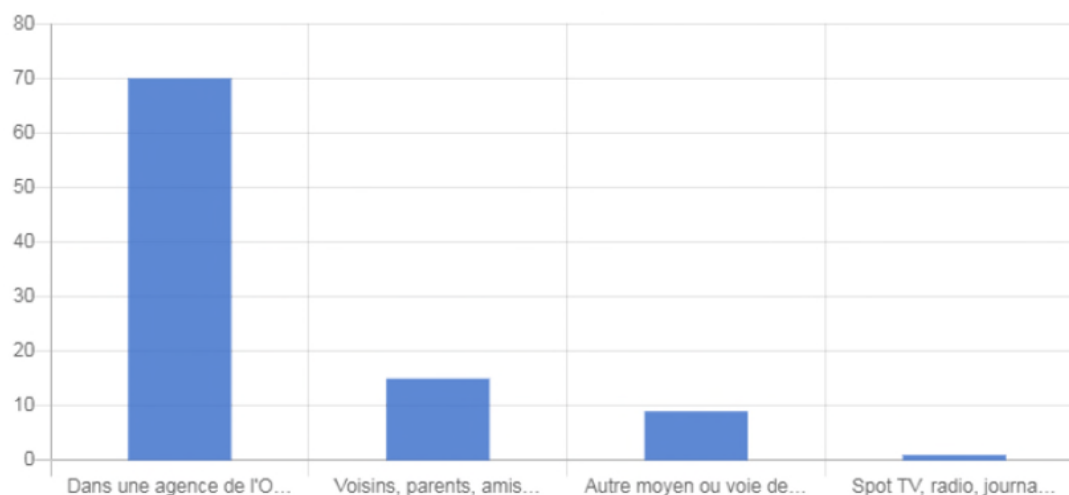
- Bases initiale de contacts administrations et patentés: Fortes contraintes d'exploitation pour la réalisation de 10 enquêtes:
  - ✓ Une première base de 26 contact administration et abonnés patentés (mars 2023):
    - La moitié des appels réalisés (8/14) sont restés sans réponses ou se sont avérés de faux numéros
    - Les appels qui ont abouti concernent plutôt des abonnés patentés disposant de petits commerces ou TPE ruraux
    - Les réactions des contacts : ne se rappellent pas du programme, ont installé les lampes dans leurs maisons, ou encore ont gardé les lampes en stock (faible sensibilisation)
  - ✓ Base complémentaire de contacts demandée par l'expert (juillet 2023):
    - Celle-ci concerne quelques 330 administrations (collectivités territoriales et administrations publiques) qui ont signé des conventions de coopération avec l'ONEE
    - Les numéros de téléphone communiqués ne ciblent pas les personnes ressources qui détiennent l'information recherchée
    - Plus de 20 appels réalisés sans succès: pas de réponse, faux numéros, n'ont pas bénéficié de INARA 2 on ne sont pas au courant du programme
    - Quelques contacts ruraux mentionnent l'usage des LBC pour l'éclairage public (collectivités territoriales)
    - Les discussions tenues avec quelques contacts montrent une réelle orientation aujourd'hui pour les lampes LED, un intérêt pour l'efficacité énergétique (administration pénitentiaire), un besoin de spécifications techniques permettant d'assurer l'achat de lampes performantes et de qualité

## Zones couvertes par les entretiens



## Accès à l'information relative à INARA

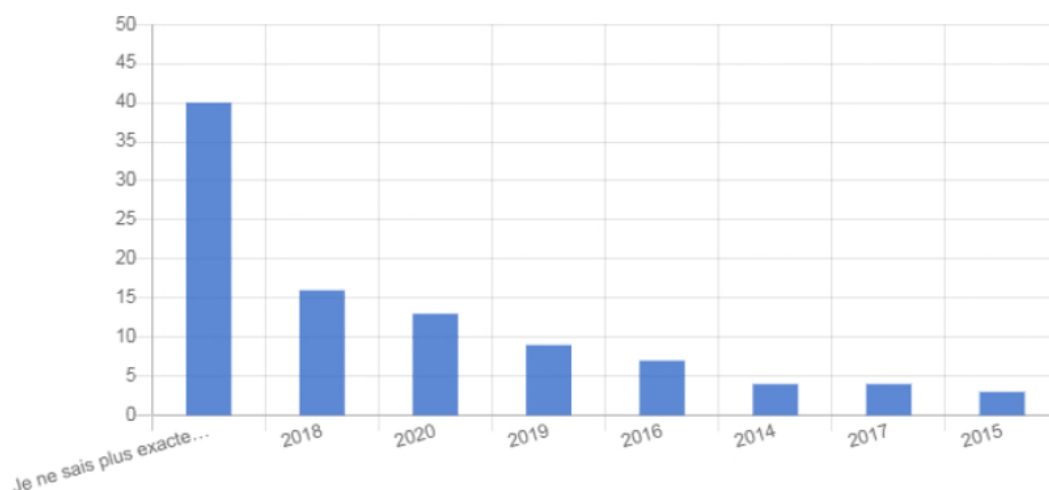
Comment avez-vous pris connaissance du programme INARA



# Années d'achat des lampes

Promotion des CFL, un effort placé dans la durée

Date d'achat des lampes



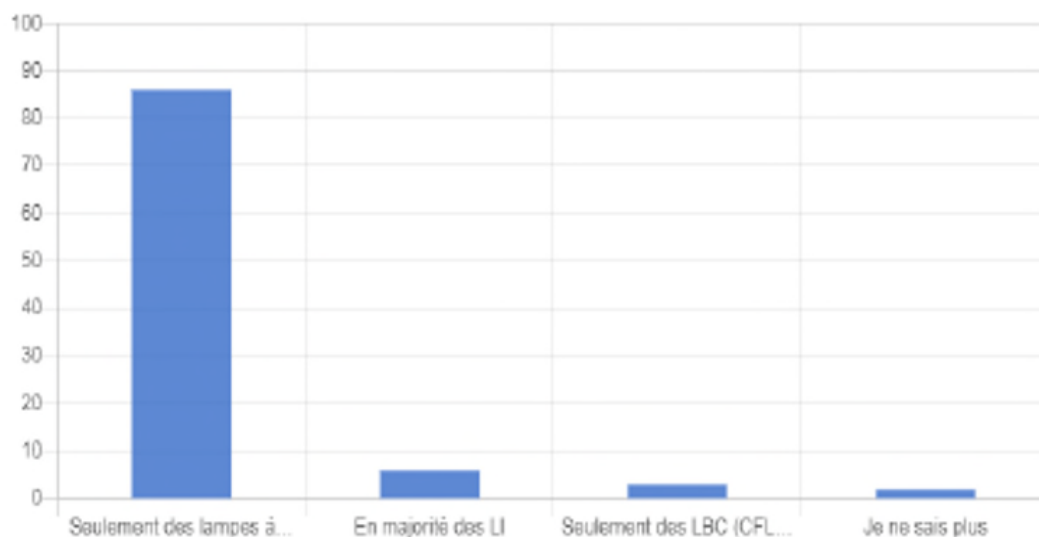
## Equipement initial

Principalement des lampes incandescentes

En moyenne 10,85 lampes par foyer

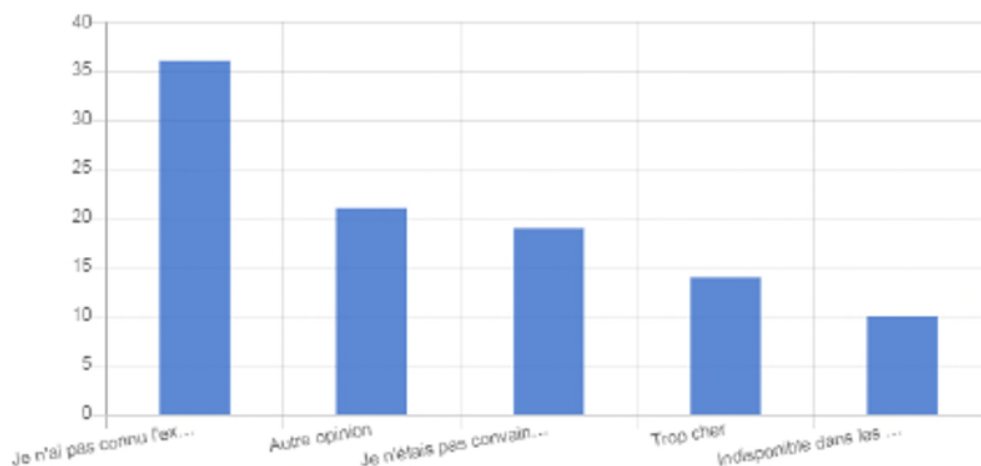
Puissance moyenne par lampe 73,45 W

Fonctionnement 2,5 heures par lampe et par jour



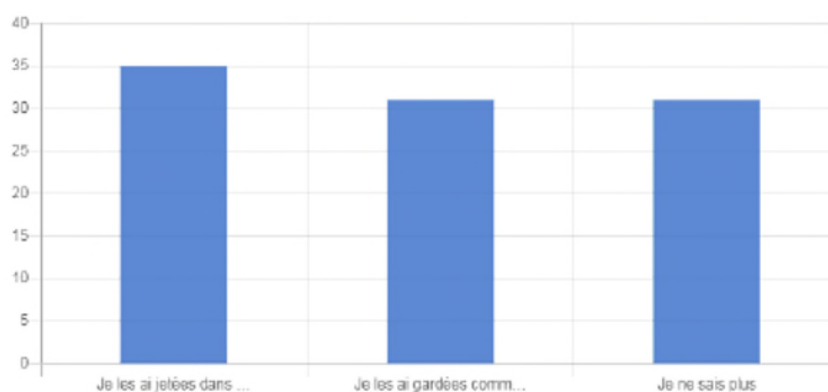
# Opinions vis-à-vis des lampes CFL

## Un appui certain à l'ouverture du marché des LBC



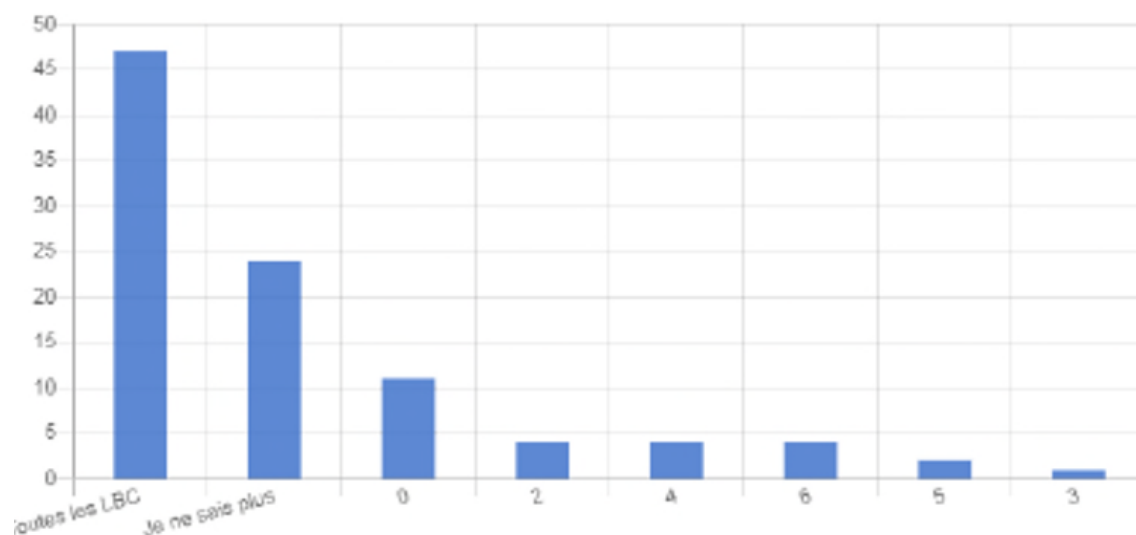
## L'achat des CFL

- En moyenne 11,76 lampes (en plusieurs fois)
- Installation de 8,85 lampes en moyenne
- Installation par un membre de la famille
- Pas d'information sur le traitement des CFL en cas de bris, les anciennes lampes souvent jetées

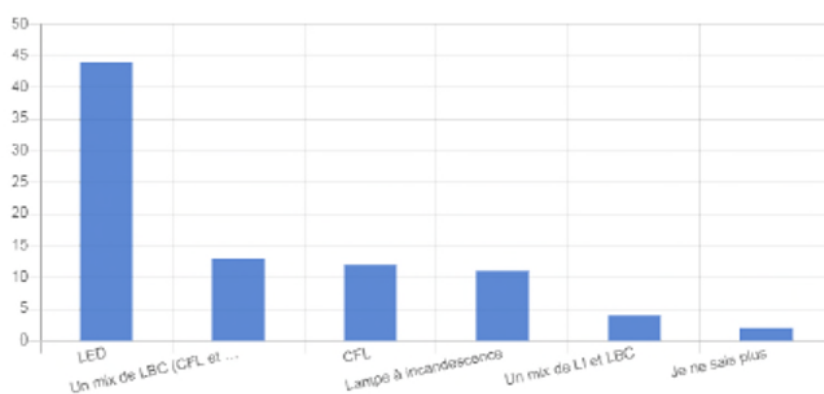


# Pratiques avec les CFL

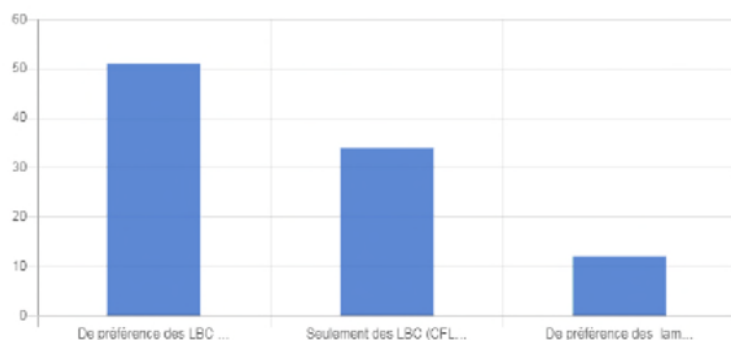
## Lampes défectueuses



## Pratiques vis-à-vis de l'éclairage



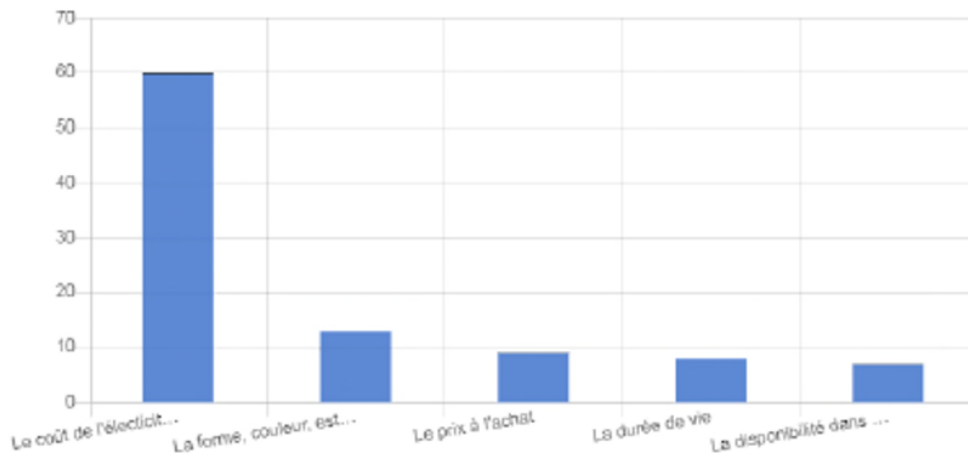
Remplacement des  
CFL défectueuses



Equipement actuel

# Motivation pour l'éclairage basse consommation

## La culture de l'efficacité énergétique



## Indications sur l'habitat

- Statut logement : 80% En propriété
- Superficie moyenne : 106 M<sup>2</sup>
- Nombre moyen de pièces : 4,38
- Nombre moyen d'Habitants: 5,78

## Conclusion & Recommandations

- Grande sensibilisation des ménages à l'éclairage performant apportée par le programme INARA ainsi que par la forte mobilisation des agences commerciales de l'ONEE et de leurs partenaires locaux tels que les techniciens agréés «Instelec»;
- Les LED et les CFL sont introduites en force dans les foyers ruraux et «rurbains»
- Le retour aux lampes incandescentes semble limité, il se justifierait par le coût faible à l'achat des LI ou encore par le fait que l'achat de lampes de remplacement s'effectue souvent auprès de commerces de proximité dont l'offre en lampes reste conventionnelle;
- Le marché des LED est en forte croissance mais il nécessite un encadrement technique approprié de la part des pouvoirs publics pour assurer aux consommateurs qualité et performances minimales: besoin d'adoption de normes obligatoires en la matière et vérifier le respect de celles-ci par les opérateurs (fabricants, importateurs, distributeurs)
- Il est recommandé également de procéder à l'interdiction d'importation de lampes LI ou bien relever le niveau de taxation de ces dernières en vue de réduire davantage l'écart entre les prix des LI et ceux des LED
- L'effort de sensibilisation des ménages au niveau des agences commerciales de l'ONEE gagnerait à être maintenu et étendu aux agences des autres distributeurs d'électricité
- Si une nouvelle phase INARA devait être lancée, il est recommandé de concevoir et mettre en œuvre un système de suivi et d'évaluation d'impact dès la mise en place du projet

### Annex 5.3: Press release on ONEE-SIE framework agreement for energy efficiency promotion

المكتب الوطني للكهرباء و الماء الصالح للشرب  
Office National de l'Electricité et de l'Eau Potable

13 mars 2023

## COMMUNIQUE DE PRESSE

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### PERFORMANCE ENERGETIQUE L'ONEE DONNE L'EXEMPLE EN COLLABORATION AVEC LA SIE

M. Abderrahim EL HAFIDI, Directeur Général de l'Office National de l'Electricité et de l'Eau Potable (ONEE) et M. Ahmed BAROUDI Directeur Général de la Société d'Ingénierie Energétique (SIE) ont signé, le 13 mars 2023 à Rabat, une Convention Cadre de coopération pour la mise en place de projets de performance énergétique.

En vertu de cette convention, l'ONEE, opérateur historique du secteur de l'électricité et garant de l'équilibre Offre-Demande et la SIE, société nationale de services énergétiques « Super Esco », s'engagent à développer et réaliser des projets et offres de performance énergétique au profit des secteurs public et privé. Parmi les objectifs de cette collaboration, la valorisation, à travers une approche intégrée, du potentiel des énergies renouvelables notamment pour les bâtiments, le secteur tertiaire et surtout l'industrie pour contribuer aux impératifs de la décarbonation qui constitue aujourd'hui un atout majeur pour pérenniser la dynamique du tissu industriel national.

Cette coopération vient couronner la volonté des deux institutions à développer leurs relations de partenariat autour d'actions et de sujets portant sur la mise en œuvre de mesures d'efficacité énergétique et de promotion de la performance énergétique, aussi bien au niveau du secteur public qu'au niveau du secteur privé et aussi, la volonté de l'ONEE de mettre en place des solutions d'optimisation des charges relatives aux consommations d'énergie au niveau de ses bâtiments administratifs et industriels et ce, conformément aux hautes directives et orientations Royales pour densifier et encourager la force d'exemplarité de l'administration publique en maximisant l'efficacité énergétique et réalisant des économies significatives.

Sur un autre plan, cette coopération constitue une réelle opportunité pour l'échange de savoir-faire en matière d'Efficacité Energétique dans un objectif de démultiplier les compétences dans le domaine et d'encourager et soutenir le développement d'expertises, de services et de produits nationaux.

## Annex 5.4: ONEE list of electricity production and consumption, peak load and emission factors for 2010–2022 (data element)

|                                               | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   | 2021   | 2022   | Total | Moyenne/an |
|-----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------------|
| Energie nette appelée (GWh)                   | 26.531 | 28.752 | 31.056 | 32.026 | 33.530 | 34.413 | 35.415 | 37.217 | 37.440 | 38.853 | 38.372 | 40.512 | 42.317 |       |            |
| Consommation (GWh)                            | 23.762 | 25.678 | 27.603 | 27.786 | 29.372 | 29.732 | 30.911 | 32.293 | 32.394 | 33.217 | 32.488 | 34.323 | 35.868 |       |            |
| Pointe max (MW)                               |        |        | 5.280  | 5.580  | 5.670  | 5.860  | 6.050  | 6.180  | 6.310  | 6.540  | 6.440  | 6.710  | 7.250  |       |            |
| Facteur d'émission du réseau national (g/kWh) |        |        |        |        | 693    | 669    | 649    | 642    | 658    | 655    | 674    | 677    | 720    | 6.037 | 670,8      |

## Annex 5.5: ONEE's annual list of sold CFLs (data element)

| Année | Quantité totale LBC vendues | Quantité LBC vendues aux ménages | Quantité ménages bénéficiaires | Quantité lampes par ménage | Quantité personnes bénéficiaires aux ménages | Quantité LBC vendues commerce/ad ministration | Quantité unités de commerce/ admin. | Quantité lampes/unité commerce/ administration | Quantité LBC Ventes directes (*) | Facteur d'émission (tCO2/MWh) |
|-------|-----------------------------|----------------------------------|--------------------------------|----------------------------|----------------------------------------------|-----------------------------------------------|-------------------------------------|------------------------------------------------|----------------------------------|-------------------------------|
| 2014  | 7.636                       | 6.529                            | 783                            | 8,34                       | NA                                           | 1.107                                         | 118                                 | 9,38                                           | 0                                | NA                            |
| 2015  | 1.686.790                   | 1.003.080                        | 133.497                        | 7,51                       |                                              | 382.480                                       | 16.920                              | 22,61                                          | 301.230                          |                               |
| 2016  | 2.700.764                   | 1.546.121                        | 197.344                        | 7,83                       |                                              | 678.569                                       | 22.318                              | 30,40                                          | 476.074                          |                               |
| 2017  | 2.488.292                   | 1.565.848                        | 193.930                        | 8,07                       |                                              | 543.253                                       | 20.820                              | 26,09                                          | 379.190                          |                               |
| 2018  | 1.385.856                   | 935.865                          | 121.351                        | 7,71                       |                                              | 220.812                                       | 12.247                              | 18,03                                          | 229.180                          |                               |
| 2019  | 690.310                     | 470.181                          | 61.342                         | 7,66                       |                                              | 118.635                                       | 5.888                               | 20,15                                          | 101.494                          |                               |
| 2020  | 247.688                     | 163.063                          | 21.629                         | 7,54                       |                                              | 46.274                                        | 2.455                               | 18,85                                          | 38.351                           |                               |
| 2021  | 158.140                     | 109.155                          | 14.861                         | 7,35                       |                                              | 30.111                                        | 1.825                               | 16,50                                          | 18.874                           |                               |
| 2022  | 126.735                     | 74.498                           | 11.018                         | 6,76                       |                                              | 36.883                                        | 1.777                               | 20,76                                          | 15.354                           |                               |
| 2023  | 51.056                      | 22.233                           | 3.271                          | 6,80                       |                                              | 20.243                                        | 666                                 | 30,39                                          | 8.579                            |                               |
| Total | 9.543.267                   | 5.896.574                        | 759.027                        | 7,77                       |                                              | 2.078.366                                     | 85.034                              | 24,44                                          | 1.568.327                        |                               |
|       | 9.543.267                   | 5.896.573                        | 759.026                        | 7,77                       |                                              | 2.078.367                                     | 85.034                              |                                                | 1.568.326                        |                               |
|       | 9.543.266                   |                                  |                                |                            |                                              |                                               |                                     |                                                |                                  |                               |

(\*) Il s'agit des LBC achetées directement par des au niveau des Points de service agréés par l'ONEE et des Agence ONEE (Vente sans engagement). Ces lampes concernent tous les usages et tout type de distributeurs (ONEE et autres Distributeurs).

## Annex 5.6: Ex ante calculation of energy/greenhouse gas savings (cumulative values in the "Total" line were used for the new indicators)

| Année                                                                                           | Indice | Quantité LBC installée | Quantité LBC installée cumulée | y*Xi       | LFR  | Economie d'énergie (NES) en KWh | Réduction d'émission CO2 (tonne CO2) | kumulierte CO2-Einsparung (Tonnen CO2)                                  | Investitions-kosten (EUR) | CO2-Vermeidungskosten (EUR pro Tonne CO2) GEF-Methode | kumulierte eingesparte Stromkosten in EUR |             |
|-------------------------------------------------------------------------------------------------|--------|------------------------|--------------------------------|------------|------|---------------------------------|--------------------------------------|-------------------------------------------------------------------------|---------------------------|-------------------------------------------------------|-------------------------------------------|-------------|
| 2012                                                                                            | 0      | 5.994.600              | 5.994.600                      | 0          | 0,00 | 541.597.956                     | 379.119                              | 379.119                                                                 | 14.198.409                | 34,68                                                 | 57.456.478,82                             |             |
| 2013                                                                                            | 1      | 4.005.400              | 10.000.000                     | 1.278      | 0,06 | 845.766.875                     | 592.037                              | 971.155                                                                 | 9.866.691                 | 15,43                                                 | 89.724.833,71                             |             |
| 2014                                                                                            | 2      | 0                      | 10.000.000                     | 2.555      | 0,13 | 788.057.318                     | 551.640                              | 1.522.796                                                               | 0,00                      | 0,00                                                  | 83.602.602,43                             |             |
| 2015                                                                                            | 3      | 0                      | 10.000.000                     | 3.833      | 0,19 | 730.347.761                     | 511.243                              | 2.034.039                                                               | 0,00                      | 0,00                                                  | 77.480.371,15                             |             |
| 2016                                                                                            | 4      | 0                      | 10.000.000                     | 5.110      | 0,26 | 672.638.204                     | 470.847                              | 2.504.886                                                               | 0,00                      | 0,00                                                  | 71.358.139,88                             |             |
| 2017                                                                                            | 5      | 0                      | 10.000.000                     | 6.388      | 0,32 | 614.928.647                     | 430.450                              | 2.935.336                                                               | 0,00                      | 0,00                                                  | 65.235.908,60                             |             |
| 2018                                                                                            | 6      | 0                      | 10.000.000                     | 7.665      | 0,38 | 557.219.090                     | 390.053                              | 3.325.389                                                               | 0,00                      | 0,00                                                  | 59.113.677,33                             |             |
| 2019                                                                                            | 7      | 0                      | 10.000.000                     | 8.943      | 0,45 | 499.509.532                     | 349.657                              | 3.675.046                                                               | 0,00                      | 0,00                                                  | 52.991.446,05                             |             |
| 2020                                                                                            | 8      | 0                      | 10.000.000                     | 10.220     | 1,00 | 0                               | 0                                    | 3.675.046                                                               | 0,00                      | 0,00                                                  | 0,00                                      |             |
| 2021                                                                                            | 9      | 0                      | 10.000.000                     | 11.498     | 1,00 | 0                               | 0                                    | 3.675.046                                                               | 0,00                      | 0,00                                                  | 0,00                                      |             |
|                                                                                                 |        |                        |                                |            |      | Total                           | 5.250.065.383                        | 3.675.046                                                               | ---                       | 24.065.100                                            | 50,11                                     | 556.963.458 |
|                                                                                                 |        |                        |                                |            |      | Moyenne par an                  | 656.258.173                          | 459.381                                                                 | ---                       | ---                                                   | 6,26                                      | 69.620.432  |
| Variables du modèle AMS.II.J./Version 04                                                        |        |                        |                                |            |      |                                 |                                      | Variablen für die Co2-Vermeidungskostenberechnung                       |                           |                                                       |                                           |             |
| Puissance moyenne lampe à incandescence (W)<br>Pbl: Rated power of the baseline lighting device |        |                        |                                | 85         |      |                                 |                                      | Diskontfaktor                                                           |                           |                                                       |                                           | 1,08        |
| Durée moyenne de fonctionnement lampe (H/j)<br>O: Average daily operating hours                 |        |                        |                                | 3,5        |      |                                 |                                      | Amortisationszeitraum (in Jahren)                                       |                           |                                                       |                                           | 1           |
| Puissance unitaire LBC (W)<br>Ppj: Rated power of the project lighting device                   |        |                        |                                | 18         |      |                                 |                                      | durchschnittlicher Strompreis in Spitzenzeiten (17h bis 22h) in EUR/kWh |                           |                                                       |                                           | 0,11        |
| Taux de perte (Distribution & Transport)<br>TD: Average annual technical grid losses            |        |                        |                                | 10,0%      |      |                                 |                                      | Lebensdauer der Lampen (in Jahren)                                      |                           |                                                       |                                           | 7,8         |
| Facteur d'ajustement<br>NTG: Net-to-gross adjustment factor                                     |        |                        |                                | 95%        |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| Durée de vie des LBC (heures)<br>L: Average life of CFLs                                        |        |                        |                                | 10.000     |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| Durée de fonctionnement annuelle (h)<br>X: Number of operating hours per year                   |        |                        |                                | 1.278      |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| Durée de fonctionnement (année)<br>Qpj: Number of pieces                                        |        |                        |                                | 7,8        |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| Quantité de LBC Projet<br>Qpj: Number of pieces                                                 |        |                        |                                | 10.000.000 |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| ES : Electricity Saved                                                                          |        |                        |                                | 86         |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |
| EF : Emission Factor (tCO2/MWh)                                                                 |        |                        |                                | 0,7        |      |                                 |                                      |                                                                         |                           |                                                       |                                           |             |

## Annex 5.7: Ex post calculation of energy/greenhouse gas savings (LBC is the French term for ESL; this only refers to the CFL distributed by ONEE)

| Année | Indice | Quantité LBC installée | Quantité LBC installée cumulée | y*Xi   | LFR  | Economie d'énergie (NES) en KWh | Réduction d'émission CO <sub>2</sub> (tonne CO <sub>2</sub> ) | kumulierte CO <sub>2</sub> -Einsparung (Tonnen CO <sub>2</sub> ) | Investitions-kosten (EUR) | CO <sub>2</sub> -Vermeidungskosten (EUR pro Tonne CO <sub>2</sub> ) GEF-Methode | kumulierte eingesparte Stromkosten in EUR |             |
|-------|--------|------------------------|--------------------------------|--------|------|---------------------------------|---------------------------------------------------------------|------------------------------------------------------------------|---------------------------|---------------------------------------------------------------------------------|-------------------------------------------|-------------|
| 2014  | 0      | 7.636                  | 7.636                          | 0      | 0,00 | 708.671                         | 496                                                           | 496                                                              | 13.400.000                | 4,07                                                                            | 75.180,78                                 |             |
| 2015  | 1      | 1.686.790              | 1.694.426                      | 1.278  | 0,05 | 148.883.449                     | 104.218                                                       | 104.714                                                          | 0,00                      | 0,00                                                                            | 15.794.592,03                             |             |
| 2016  | 2      | 2.700.764              | 4.395.190                      | 2.555  | 0,11 | 364.478.074                     | 255.135                                                       | 359.849                                                          | 0,00                      | 0,00                                                                            | 38.666.369,62                             |             |
| 2017  | 3      | 2.488.292              | 6.883.482                      | 3.833  | 0,16 | 536.819.088                     | 375.773                                                       | 735.622                                                          | 0,00                      | 0,00                                                                            | 56.949.503,26                             |             |
| 2018  | 4      | 1.385.856              | 8.269.338                      | 5.110  | 0,21 | 604.046.545                     | 422.833                                                       | 1.158.455                                                        | 0,00                      | 0,00                                                                            | 64.081.459,59                             |             |
| 2019  | 5      | 690.310                | 8.959.648                      | 6.388  | 0,27 | 610.210.473                     | 427.147                                                       | 1.585.602                                                        | 0,00                      | 0,00                                                                            | 64.735.371,93                             |             |
| 2020  | 6      | 247.688                | 9.207.336                      | 7.665  | 0,32 | 581.595.228                     | 407.117                                                       | 1.992.719                                                        | 0,00                      | 0,00                                                                            | 61.699.667,62                             |             |
| 2021  | 7      | 158.140                | 9.365.476                      | 8.943  | 0,37 | 545.318.750                     | 381.723                                                       | 2.374.442                                                        | 0,00                      | 0,00                                                                            | 57.851.206,51                             |             |
| 2022  | 8      | 126.735                | 9.492.211                      | 10.220 | 0,43 | 505.806.382                     | 354.064                                                       | 2.728.507                                                        | 0,00                      | 0,00                                                                            | 53.659.459,61                             |             |
| 2023  | 9      | 51.056                 | 9.543.267                      | 11.498 | 0,48 | 461.383.056                     | 322.968                                                       | 3.051.475                                                        | 0,00                      | 0,00                                                                            | 48.946.724,19                             |             |
|       |        |                        |                                |        |      | Total                           | 4.359.249.716                                                 | 3.051.475                                                        | ---                       | 13.400.000                                                                      | 4,07                                      | 462.459.535 |
|       |        |                        |                                |        |      | Moyenne par an                  | 544.906.215                                                   | 381.434                                                          | ---                       | ---                                                                             | 0,51                                      | 44.981.669  |

| Variables du modèle AMS.II.J./Version 04                                                        |           |
|-------------------------------------------------------------------------------------------------|-----------|
| Puissance moyenne lampe à incandescence (W)<br>Pbl: Rated power of the baseline lighting device | 85        |
| Durée moyenne de fonctionnement lampe (H/j)<br>O: Average daily operating hours                 | 3,5       |
| Puissance unitaire LBC (W)<br>Ppj: Rated power of the project lighting device                   | 20        |
| Taux de perte (Distribution & Transport)<br>TD: Average annual technical grid losses            | 15,0%     |
| Facteur d'ajustement<br>NTG: Net-to-gross adjustment factor                                     | 95%       |
| Durée de vie des LBC (heures)<br>L: Average life of CFLs                                        | 12.000    |
| Durée de fonctionnement annuelle (h)<br>X: Number of operating hours per year                   | 1.278     |
| Durée de fonctionnement (année)                                                                 | 9,4       |
| Quantité de LBC Projet<br>Qpj: Number of pieces                                                 | 9.543.000 |
| ES : Electricity Saved                                                                          | 83        |
| EF : Emission Factor (tCO <sub>2</sub> /MWh)                                                    | 0,7       |

| Variablen für die Co <sub>2</sub> -Vermeidungskostenberechnung          |      |
|-------------------------------------------------------------------------|------|
| Diskontfaktor                                                           | 1,08 |
| Amortisationszeitraum (in Jahren)                                       | 1    |
| durchschnittlicher Strompreis in Spitzenzeiten (17h bis 22h) in EUR/kWh | 0,11 |
| Lebensdauer der Lampen (in Jahren)                                      | 9,4  |

## Annex 5.8: ONEE internal calculation of electricity and peak load savings (data element) with updated values for technical losses and useful life of the CFL

|                                             | Estimation de l'impact annuel en énergie et en effacement MW |      |      |      |      |      |       |            |
|---------------------------------------------|--------------------------------------------------------------|------|------|------|------|------|-------|------------|
|                                             | 2015                                                         | 2016 | 2017 | 2018 | 2019 | 2020 | Total | Moyenne/an |
| GWh (cumulées)                              | 79                                                           | 300  | 540  | 721  | 815  | 859  | 3314  | 552        |
| MW (cumulées)                               | 68                                                           | 171  | 265  | 317  | 343  | 352  | 1516  | 253        |
|                                             |                                                              |      |      |      |      |      |       |            |
|                                             |                                                              |      |      |      |      |      |       |            |
|                                             |                                                              |      |      |      |      |      |       |            |
| HYPOTHESES :                                |                                                              |      |      |      |      |      |       |            |
| Puissance moyenne lampe à incandescence (W) | 85                                                           |      |      |      |      |      |       |            |
| Durée moyenne de fonctionnement lampe (H/j) | 3,5                                                          |      |      |      |      |      |       |            |
| Puissance unitaire LBC (W)                  | 20                                                           |      |      |      |      |      |       |            |
| Taux de perte (Distribution & Transport)    | 0,15                                                         |      |      |      |      |      |       |            |
| Facteur d'ajustement                        | 95%                                                          |      |      |      |      |      |       |            |
| Durée de vie des LBC (heures)               | 12000                                                        |      |      |      |      |      |       |            |
| Durée de fonctionnement annuelle (h)        | 1278                                                         |      |      |      |      |      |       |            |
| Durée de fonctionnement (année)             | 9.4                                                          |      |      |      |      |      |       |            |

## Annex 5.9: Explanatory notes on the CDM methodology as well as ex ante and ex post calculations

The CDM methodology “AMS.II.J./Version 04” used in the PP calculates the energy savings attributable to the project and avoided emissions for energy efficiency projects from the perspective of the energy producers (here: ONEE). In contrast to the savings for the target group, influencing factors such as network losses as well as deadweight and role model effects (free-rider, spill-over), in addition to failure rates must still be taken into account.

The following figures refer to the ex ante calculation in the PP, in which several default values specified in the CDM methodology were used. The methodology of the ex-post calculations is analogous; only the values of various factors (CFL output, grid losses, useful life and timing of lamp distribution) have been updated, i.e. the default values have been replaced by available actual values in Morocco. The rationale for the changes is explained in the main part of the EPE.

### Ex ante calculation

1. **The annual saving per CFL** is calculated from the difference between the output in watts of the LIs and the CFLs:  $85W - 18W = 67W \times 3.5 \text{ hours average usage time/CFL/day} \times 365 \text{ days} = 86 \text{ kWh}$ .
2. Due to the **technical losses in the grid** (10%), the power generator must generate more output than is then consumed, for example, in the household. This increases the saving per CFL per year by 10% to approximately 94.6 kWh/year.
3. The savings attributable to the project are reduced by 5%, i.e. from 94.6 to 89.8 kWh/year, due to (contradictory) **deadweight and role model effects** (target group households would have bought CFLs even without the project / households outside the target group bought CFLs because they heard about the savings made by the target group).
4. In addition, with the large number of distributed CFLs, it is to be assumed that **6% of lamps are defective** and do not reach the guaranteed useful life of 10,000 hours. This reduces the saving per CFL from 89.8 to approximately 84.5 kWh/year.
5. For **year 2 of the ex ante calculation, this results in a saving** of  $84.5 \text{ kWh} \times 10 \text{ million distributed CFLs} = 845 \text{ million kWh}$ . A cumulative saving of 5,250 million kWh is made over the course of the lamps' 7.8-year useful life (9.4 years ex post).
6. The resulting **reduction in greenhouse gas emissions** in year two is calculated by using the emission factor  $0.7 \text{ tCO}_2/\text{MWh}$ :  $845 \text{ million kWh} \times 0.7 = 592,000 \text{ tCO}_2$  ( $1 \text{ MWh} = 1,000 \text{ kWh}$ ); accumulated over the CFLs' useful life 3.675 million tCO<sub>2</sub>.
7. The **CO<sub>2</sub> avoidance costs** are calculated from the sum of the investment costs (EUR 24 million) divided by the sum of the reduced greenhouse gas emissions (3.675 million tCO<sub>2</sub>) = EUR 6.24/tCO<sub>2</sub>. The applied discount factor of 1.08 increases the value to EUR 6.26.
8. The **cumulative electricity costs saved** are the sum of the savings (5,250 million kWh) multiplied by the average electricity price (EUR 0.11/kWh:  $5,250 \text{ million} \times \text{EUR } 0.11 \text{ million} = \text{EUR } 577.5 \text{ million}$ ). Discounting must also be taken into account here. As a result, savings are reduced to around EUR 557 million.

### Ex post calculation

1. **The annual saving per CFL** is calculated from the difference between the output in watts of the LIs and the CFLs:  $85W - 20W = 65W \times 3.5 \text{ hours average usage time/CFL/day} \times 365 \text{ days} = 83 \text{ kWh}$  (due to the higher output of the actually purchased CFLs).
2. Due to the **technical losses in the grid** (15%, information from ONEE), the power generator must produce more output than is then consumed, for example, in the household. This increases the saving per CFL per year by 15% to approximately 95.5 kWh/year.
3. The savings attributable to the project are reduced by 5%, i.e. from 95.5 to 90.7 kWh/year, due to (contradictory) **deadweight and role model effects** (target group households would have bought CFLs even without the project / households outside the target group bought CFLs because they heard about the savings made by the target group).
4. In addition, with the large number of CFLs distributed, it must be assumed that 6% of **lamps are defective** and do not reach the guaranteed useful life of 12,000 hours (corresponding to the quality of the CFLs purchased from Philips). This reduces the saving per CFL from 90.7 to approximately 85.3 kWh/year.
5. In the ex-post calculation, this results in savings of  $85.3 \text{ kWh} \times 9.54 \text{ million distributed CFLs} = 814 \text{ million kWh}$ . Over the course of the lamps' 9.4-year useful life up to around 2030, cumulative savings of 7,649 million kWh will

be achieved. However, in the ex-post calculation in Annex 5.7, only the savings up to 2023, i.e. at the time of the EPE, were calculated (4,359 million kWh).

6. The resulting **reduction in greenhouse gas emissions** by 2023 is calculated by using the emission factor 0.7 tCO<sub>2</sub>/MWh: 4.359 million kWh x 0.7 = 3.051 million tCO<sub>2</sub>.
7. The **CO<sub>2</sub> avoidance costs** are the sum of investment costs (EUR 13.4 million) divided by the sum of reduced greenhouse gas emissions (3.051 million tCO<sub>2</sub>) = EUR 4.39/tCO<sub>2</sub>. The applied discount factor of 1.08 reduces the value to EUR 4.07, as the savings extend over a longer period of time.
8. The cumulative electricity costs saved (by 2023) are the sum of the savings (4,359 million kWh) multiplied by the average electricity price (EUR 0.11/kWh: 4,359 million x EUR 0.11 = EUR 479.5 million. Discounting must also be taken into account here. As a result, the savings are reduced to around EUR 462 million.