UNDA project, on “Up-scaling Energy Efficiency in the residential and services sectors in the Arab Region”

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National Seminar on: National Workshop on “Development, Implementation and Evaluation of Energy Efficiency Policies in the Buildings Sector in Jordan”,

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MINISTRY OF ENERGY AND MINERAL RESOURCES
THE HASHEMITE KINGDOM OF JORDAN

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Energy consumption scenarios in the building sector as an instrument for the development and implementation of sustainable energy programs in this sector and methods of assessing energy efficiency potential in the residential and services sectors by branch of activities and type of building.

40 YEARS

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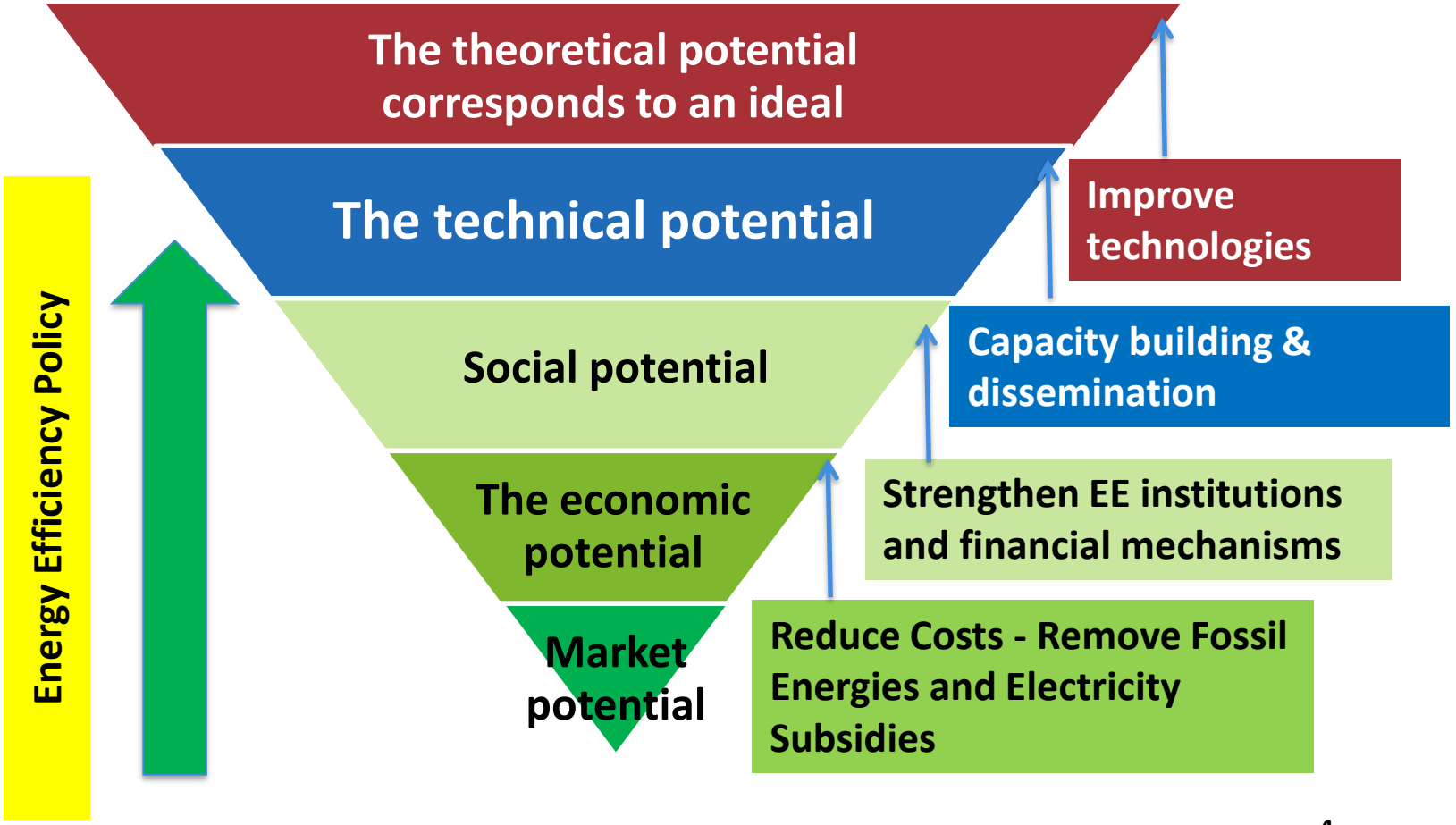
Introduction on the concept of Energy Efficiency (EE)

Energy efficiency can be measured according to different criteria, each with different potentials:

- **The theoretical potential corresponds to an ideal.**
- **The technical potential is one where the same service would be provided using the best technology available on the market, regardless of the cost.**
- **Social potential is a form of economic potential, but from the point of view of society and not of the user alone.**
- **Economic potential depends on energy costs and the cost of technologies.**
- **Market potential is the potential that should be realized in the "status quo", with all the current obstacles, as well as institutional and market imperfections, as well as energy prices or fossil fuel subsidies and electricity.**

Introduction on the concept of Energy Efficiency (EE)

From market potential to technical potential: the role of energy efficiency policies.



Energy efficiency Potential in the residential and tertiary sectors

The evaluation methodology of the EE potential is based on:

a) a brief overview of current trends in Jordan's energy supply and demand in buildings;

b) a "simple projection" of energy demand for 2025 and 2030 based on a historical trend in energy consumption; and

c) an estimation of the technical potential of energy efficiency.

The main consumer uses in the residential and tertiary sectors will be evaluated and the technical energy efficiency potential will be highlighted. Socio-economic structure and trends are expected to remain unchanged over the projection period.

Simple projection of energy demand for residential in 2025 and 2030

- **Size of residential real estate in Jordan and its average annual growth rate**

Year	number of housings	Growth rate
1975	XXXXXXX	--
1984	YYYYYYY	…..%
1994	ZZZZZZZ	…..%
2004	WWWW	……%
2014	YYYYYYY	……%
2020		**Growth rate = Linear adjusted in f (GDP growth, population growth)**
2025		**Growth rate = Linear adjusted in f (GDP growth, population growth)**
2030		**Growth rate = Linear adjusted in f (GDP growth, population growth)**

Simple projection of energy demand for residential in 2025 and 2030

- **Main energy services / uses to consider and changes in energy consumption**

Uses	Comsumption Year (2014 or ….)	Penetration rate of equipment	Projection of consumption year 2030
AC	…. GWH	%	…… GWH
Lighting			
……			

Estimation of the technical potential of energy efficiency

Estimated annual size of air conditioner stock and penetration rate in Jordan

Year	Number of households (1000)	Number of AC per household	Number of AC (1000)	Penetration rate of AC
2015				
2020				
2030				

The predicted rates of penetration and inventory of air conditioners (AC) are estimated using a scattering model, correlating household income and climatic conditions to climate change and purchase of air conditioners for cooling.

The diffusion model based on the household income and climate indicators (cooling degree-days) is used to predict future stocks of a wide range of systems energy consumers in different countries (McNeil et al., 2013).

Estimation of the technical potential of energy efficiency

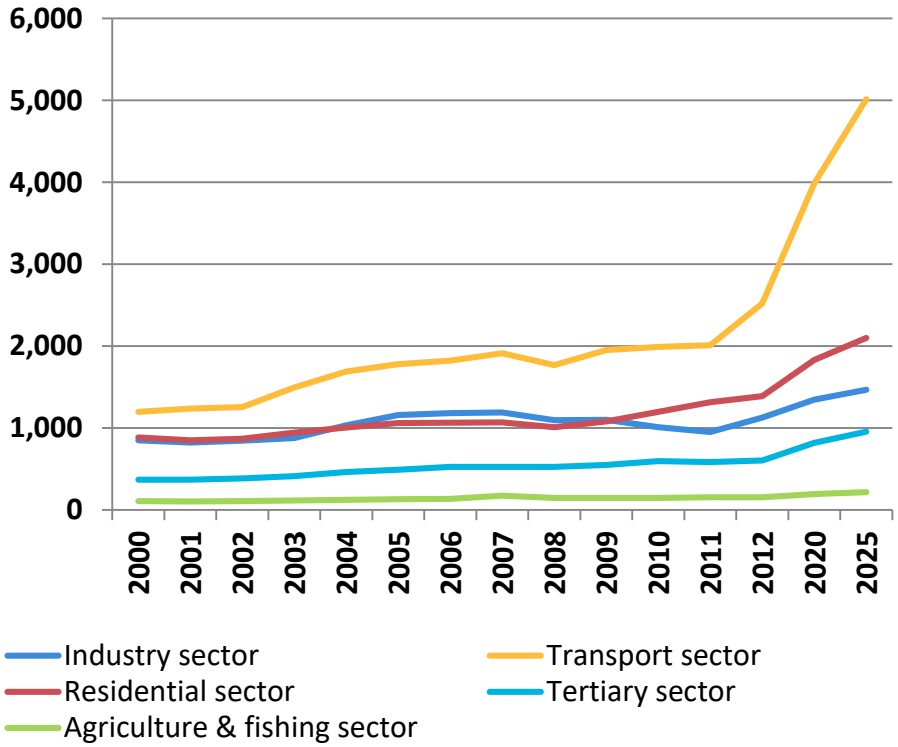
Energy efficiency potential for air conditioners (Technical Potential)

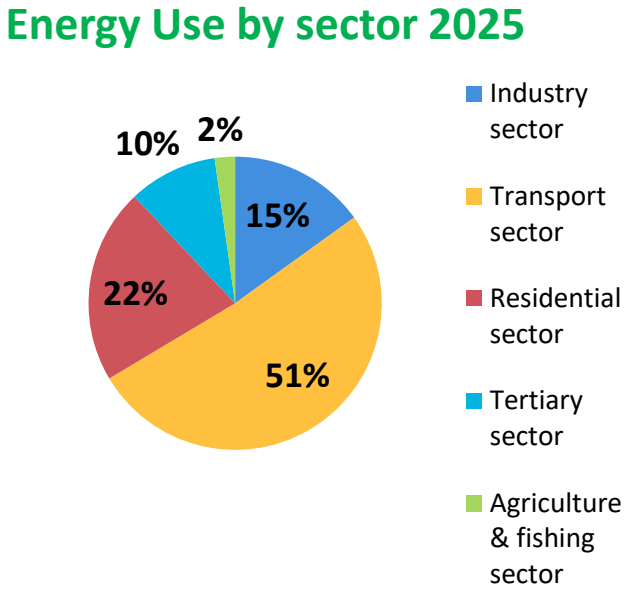
Year	Number of AC (1000)	Consumption of AC BAU **(A)**	Impact of new technologies on new air conditioners consumption % reduction in consumption	Air conditioning consumption Scenario New technologies (B)	Technical Potential EE **PT = A- B**
2015	XXXXX	-----			
2020	YYYYY	-----	Example 15%		
2030	ZZZZZ	------	Example 15%		

Method to be adapted by sector of tertiary buildings: Tourism, Hospital, Health, Education, Commerce, offices and other tertiary

Estimation of the technical potential of energy efficiency

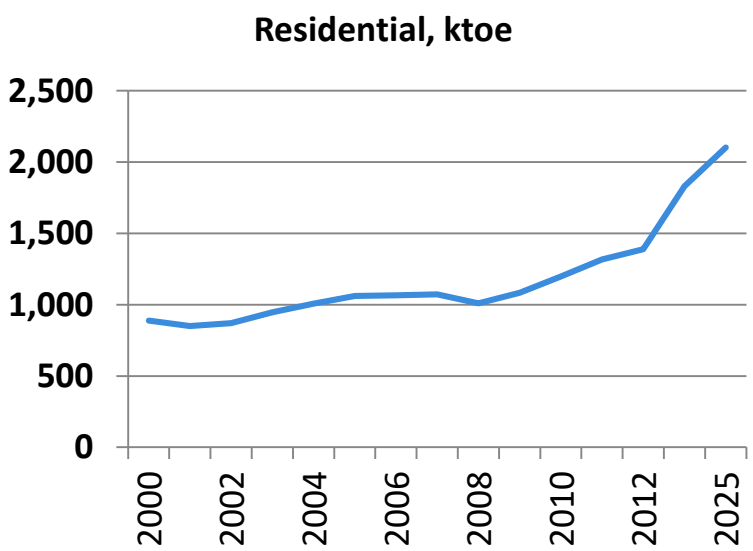
Final Energy Consumption by End-Use Sectors, ktoe: Sample Results for an Imagined Country

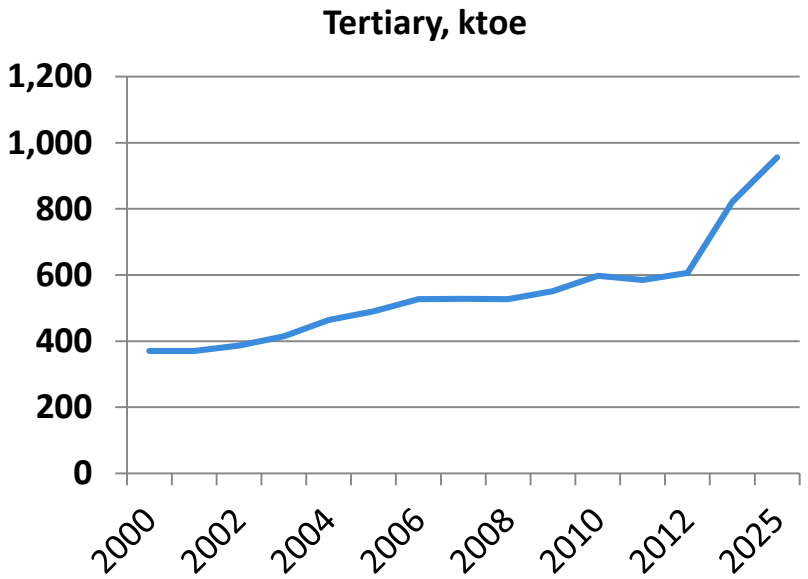




Estimation of the technical potential of energy efficiency

Trends in Energy Use in an Imagined Country by Residential and Tertiary Sector ktoe: Sample Results





Estimation of the technical potential of energy efficiency

Energy Efficiency Potential of an Imagined Country in 2017: Example of Results

Total primary energy supplied amounted to 7,463 ktoe in 2017, an increase of 55 percent from 2006. Of the total primary energy supplied, 79 percent was consumed by end-use sectors.

Total EE potential for all energy-consuming sectors was 1,612 ktoe in 2017. The electricity sector represented 14 percent of the total EE potential, while the end-use sector represented 86 percent. The EE potential amounted to 22 percent of total primary energy consumption for 2017. The residential sector has the highest EE potential within the end-use sectors at 30 percent, followed by tertiary at 23 percent, industry at 22 percent, transport at 10 percent, and agriculture and fishing at 1 percent.

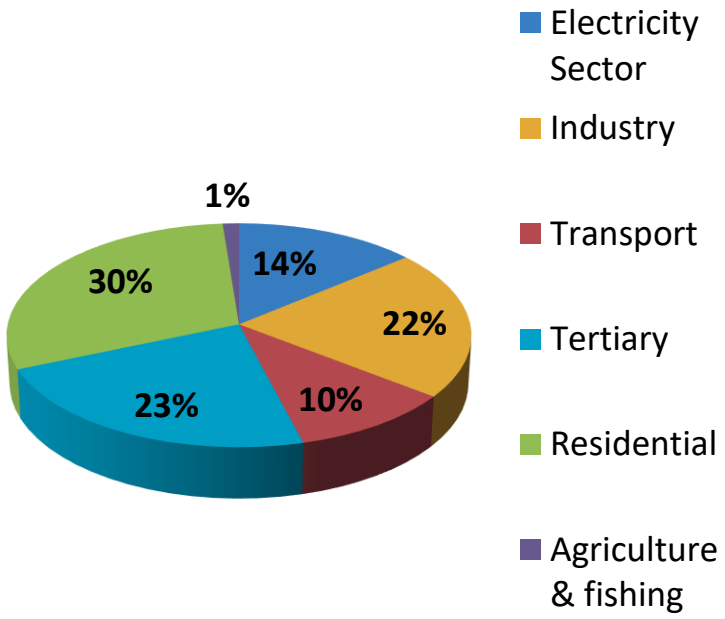
Estimation of the technical potential of energy efficiency

Energy Efficiency Potential in an imagined Country in 2017: Synthesis of Existing Studies

Potential EE in the country, ktoe in 2017

Sector	EE Potential, ktoe, 2017
Electricity Sector	224
End-Use Sectors	1,388
Industry	348
Transport	169
Residential	486
Tertiary	365
Agriculture and Fishing	20
TOTAL	1,612
	22% of TPES

EE potential in the country in 2017



Estimation of the technical potential of energy efficiency

Residential Sector : Example of results for an imagined country

The energy intensity of the residential sector was 0.124 toe/1,000 USD for 2017, while the specific consumption of energy per unit area was 7.6 kgoe/m2/yr. The EE potential for the residential sector in terms of final energy was 311 ktoe, based on country-tailored benchmark from the …… study that was set at 5.9 Kgoe/m2/yr for the specific consumption of energy for this sector. The EE potential represented 22 percent out of total energy consumed by this sector in 2017.

In addition, the final electricity efficiency potential of the sector converted in primary energy was 176 ktoe. This potential added to the EE potential in final energy estimated the total EE potential for the sector at 486 ktoe.

The unit consumption of energy per dwelling was 912 kgoe/Dw in 2017, while the unit consumption of electricity per dwelling was 4,024 kWh/Dw in the same year. In addition, the average emission factor for the sector amounted to 4.4 teCO2/toe while the CO2 intensity was 0.5 teCO2/1,000 USD.

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Estimation of the technical potential of energy efficiency

Tertiary Sector : Example of results for an imagined country

The final energy intensity of the tertiary sector was 0.062 toe/1,000 USD in 2017. Based on the country-tailored benchmark from the ……. study that was set at 0.043, the EE potential for the tertiary sector, in terms of final energy and based on energy intensity, was 184 ktoe. The EE potential represented 30 percent of total energy consumed by this sector in 2017.

In addition, the final electricity efficiency potential of the sector converted in primary energy was 182 ktoe. This potential added to the EE potential in final energy estimated the total EE potential for the sector at 365 ktoe.
The average emission factor for the tertiary sector in the country amounted to 5.9 teCO2/toe in 2017, compared to 5.2 teCO2/toe in 2006. The CO2 intensity of the sector was 0.4 teCO2/1,000 USD in the same year, compared to 0.4 in 2006
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Estimation of the technical potential of energy efficiency

Electricity Efficiency Potential Abatement Investment Costs by End-Use Sectors and EE Technologies for the imagined country over the Period 2017-2025: Example of results

Sectors/EE technologies	Electricity Efficiency Potential		Investment Cost		Net Abatement Cost
	Total of subsector	By EE technology			
	ktoe/y	ktoe/y	USD/toe	M USD/y	M USD/y
Tertiary	**165**	**48,0**		**9,2**	**-151,7**
SWH		38,7	170	6,6	-68,77
Street lighting		3,2	140	0,4	-70,33
Thermal insulation		6,2	350	2,2	-12,61
Residential	**155**	**128,1**		**21,6**	**-285,0**
Efficient fridges		13,5	120	1,6	-29,8
Efficient lighting		10,7	50	0,5	-90,48
SWH		90,3	170	15,4	-64,87
Thermal insulation		11,5	350	4,0	-23,4
Lighting ballasts		2,2	50	0,1	-76,44

Estimation of the technical potential of energy efficiency

Electricity Efficiency Potential and Net Abatement Cost by EE technologies for the imagined country over the period 2017-2025

	Electricity Efficiency Potential	Net Abatement Cost
	ktoe/y	M USD/y
Electric motors	21,5	-91,3
SWH (tertiary)	38,7	-68,8
Thermal insulation	6,2	-12,6
Efficient fridges	13,5	-29,8
Efficient lighting	10,7	-90,5
SWH (residential)	90,3	-64,9
Thermal insulation	11,5	-23,4
Lighting ballasts	2,2	-76,4
TOTAL	**194,6**	**-457,7**

Estimation of the technical potential of energy efficiency

Cost of Conserved Energy Curve for the imagined country over the period 2020-2030

The residential sector dominates with 62 percent of the total EE potential, followed by tertiary at 23 percent and industry at 15 percent. In terms of technologies, SWH and thermal insulation accounts for the largest share with 78 percent, while the shares of other technologies, such efficient lighting at 5 percent, are much lower.

The needed annual investment cost to realize this electricity potential is USD 36 million, mostly in the residential sector which represents 55 percent. SWH and building insulation account for the largest shares within the residential sector at …. percent and …… percent, respectively. Over the period 2020 to 2030, the total investment of USD 288 million will largely be compensated by net (negative) abatement cost savings of USD 4,705 million.

Proposed Considerations for Projected Energy Consumption Scenarios

- **Reference year = 2017 year;**
- **Econometric model, external variables based on GDP, population and international prices;**
- **Projection based on existing and / or already existing projects and objectives;**
- **Bottom-up model. Disaggregation by subsector and by energy source.**

Trend Scenario and Breakdown Scenario

Two scenarios of changes in the consumption of the building sector in the 2025 and 2030 horizons will be studied.

1- The first is a trend scenario which supposes an extension of the recent trends observed with regard to:

- ✓ **The rate of penetration of energy efficient equipment and renewable energies in buildings;**
- ✓ **Improving the performance of new household electrical appliances, according to international trends (improved performance of household appliances, etc.).**

Trend Scenario and Energy Efficiency Scenario

2- The second scenario, considered as a scenario of energy efficiency scenario. It involves a massive implementation of energy efficiency measures that are today the most technically and economically mature for widespread dissemination. Explicitly, these measures are as follows:

- ✓ **Generalization of efficient envelopes for new buildings; Energy impact estimated by simulation**
- ✓ **Elimination of incandescent lamps from the market and diffusion LED lamps; Energy impact estimated by calculation**
- ✓ **Thermal renovation of buildings (roof insulation); Energy impact estimated by simulation**
- ✓ **Diffussion of efficient household appliances; Energy impact estimated by MEPS and calculation**
- ✓ **Diffusion of solar water heaters. Projection and calculation**
- ✓ **The assumptions of the penetration rates of these measures to be validate with Ministry of Energy, NERC and the professionals of the sector**
- ✓ **Other measures ....**

Trend Scenario and energy efficiency Scenario

- **Assumptions of penetration rates of EE measures retained in the scenario of rupture in Jordan**

Residential Buildings	2020	2025	2030
Efficient buildings (% to the total of the park)	2%	6%	10%
Rate of thermal renovation of the existing park	8%	22%	70%
Diffusion rate of Energy Efficient appliancies	50%	65%	100%
Solar water heater penetration rate (m2 / 1000 inhabitants)	43	125	192
Others			

Values given for information only - To validate

Estimation of the potential of the energy efficiency market

Energy efficiency Potential for air conditioners (Market potential)

Year	Number of AC (1000)	AC consumption BAU	Number of air conditioners in housing compliant with the EEBC % reduction in cooling need	Impact of MEPS on new air conditioners % reduction in consumption	Impact increase electricity tariffs on consumption Air conditioning % reduction Impact purchasing power, etc.	Air conditioning consumption Scenario EE Market potential
2015	4108	-----				
2020	5082	-----	Exemple 4%	Exemple 15%	Exemple 10%	= f (all parameters)
2030	7438	------	Exemple 6%	Exemple 15%	Exemple 14%	

Values given for information only - To validate

Trend Scenario and Energy Efficiency Scenario

- **Assumptions of penetration rates of EE measures retained in the scenario of energy efficiency in Jordan**

Touism Sector	2020	2025	2030
Efficient buildings (% to the total of the park)	8%	15%	30%
Rate of thermal renovation of the existing park	10%	30%	75%
Diffusion rate of Energy Efficient appliancies	70%	90%	100%
Solar water heater penetration rate (m2 / 1000 inhabitants)	10	20	192
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THANK YOU FOR YOUR ATTENTION

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