

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



Shared Prosperity **Dignified Life**



Economic and Social Commission for Western Asia

Draft results of the baseline mapping study of the energy use situation in the buildings sector in Jordan

Draft findings about the characteristics and profiles of energy consumption of the residential Sector in Jordan

Taskforce Meeting, 27 November 2019 –Amman, Jordan

Topics covered in this presentation:

1- Overview of the existing building stock and summary of its characterization:

2- Overall Energy Consumption in the Residential Sector:

3- End-Use Energy Consumption in the Existing Residential Sector in Jordan:

1- Overview of the existing building stock and summary of its characterization

This part covers the following topics:

- 1.1: Setbacks and Total number of units per Governorate in 2017: ^{(1), (2)}
- 1.2: General Typology of Building Envelope for apartment buildings:
- 1.3: General Typology of Buildings: Existing & New Construction in the housing sector: ⁽¹⁾
- 1.4: Number of permits granted per year ; ^{(1),(2)}
- 1.5 Number of Existing Residential Buildings according to the year of Construction.
- 1.6: Total Number of Housing Units/ year:
- 1.7: Building Envelope Materials:

1- Overview of the existing building stock & Summary of its characterization (Typology)

1.1: Setbacks and Total number of units per Governorate in 2017: (1), (2)

Table 3: Zoning Provisions of Housing Sector A, B, C, and D. (GAM, 2011)

Housing Sector	Max. building area %	Max. no. of Floors	Max FAR	Max building height (m)	Setback (m)		
					Front	Back	Sides
A	39	4	1.6	15	5	7	4
B	45	4	1.8	15	4	6	4
C	51	4	2.0	15	4	4	3
D	55	4	2.2	15	3	2.5	2.5
Popular	-	4	-	-	2	2	-

Governorate	Climate Zone	District	Population	No. Housing Units
Amman	2	Middle District	3,952,251	843,559
Balqa	2		489,686	99,696
Zarqa	1		1,359,110	279,704
Madaba	1		188,134	38,119
Irbid	2	North District	1,765,788	355,008
Mafraq	2		548,720	106,368
Jarash	2		236,843	46,736
Ajloun	2		175,991	34,932
Karak	2	South District	312,995	63,414
Tafiela	2		95,623	19,212
Ma'an	3		143,094	28,430
Aqaba	4		184,889	38,028
Total			9,293,053	1,941,903

(1): GAM, 2011,

(2): DOS, 2017

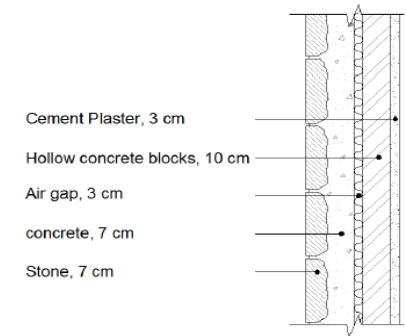
1- Overview of the existing building stock & Summary of its characterization

1.2: General Typology of Building Envelope for apartment buildings:

Table 4: Construction Materials of apartments in Jordan.

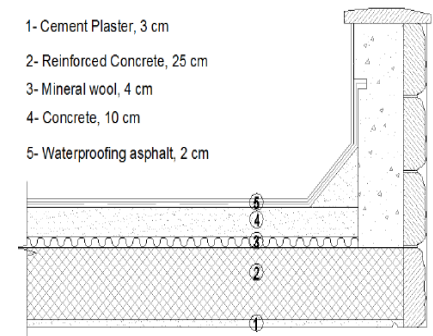
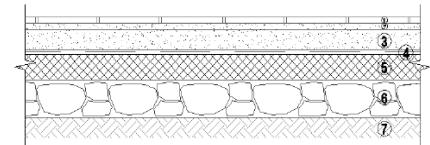
Building Element	Composition	Thickness (mm)
External walls	Jordan Stone	70
	Concrete	180
	Polystyrene insulation	50
	Concrete hollow block	100
	Cement Plaster	25
Roof	Gravel	100
	Waterproofing asphalt	5
	Screed	100
	Reinforced Concrete	250
	Cement Plaster	25
Floor	Earth	500
	Screed	150
	Concrete Slab	200
	Gravel + Tiles	150

The Typical Wall Detail and its U value



The typical Floor detail and its U value

- 1- Tiles, 2.5 cm
- 2- Mortar, 2.5 cm
- 3- Sand, 6 cm
- 4- Insulation Materials, 2 cm
- 5- Reinforced Concrete, 10 cm
- 6- well compacted crushed or other granular materials, 15 cm
- 7- Earth, 30 cm



(1): GAM, 2011

(2): DOS, 2014

(3): MEMR, 2017

1- Overview of the existing building stock & Summary of its characterization

1.3: General Typology of Buildings: Existing & New Construction in the housing sector: ⁽¹⁾

Total of New Housing Units 2017, (1)			
	Licensing of Existing Buildings	New Extensions of Existing Buildings	New Buildings
No. of Licenses	36582	690	6006
Total Area (Sq. M)	7,900,000	379,000	5,629,000
Estimated costs (JD)	999,141,000	60,390,000	892,523,000

Table 5: number of total new dwellings built by the end of 2017, by governorate. (DOS, 2018c)

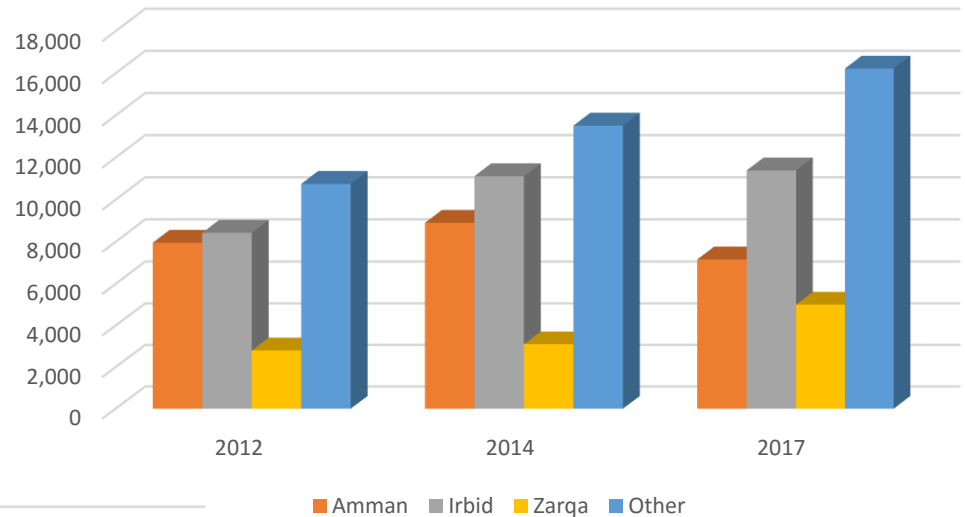
Governorate	Climate Zone	District	No. of Completed Dwellings	Average Cost M ² (JD)	Total Cost (000 JD)	Average Building Area (M ²)	Total Buildings Area (000 M ²)	No. of Completed Buildings (Res. & Non Res.)
Amman	2	Middle District	14616	190	706,398	1310	3713	2835
Balqa	2		1570	168	51,056	627	304	485
Zarqa	1		2528	165	71,901	586	437	746
Madaba	1		415	168	12,104	649	72	111
Irbid	2	North District	2313	221	101,421	436	459	1053
Mafrq	2		237	230	8,290	199	36	181
Jarash	2		49	237	1,895	222	8	36
Ajloun	2		9	164	164	143	1	7
Karak	2	South District	551	184	17,995	334	98	293
Tafiela	2		41	213	1,492	184	7	38
Ma'an	3		224	137	5,202	247	38	154
Aqaba	4		724	132	17,667	601	134	223
Total			23277	188	995,586	861	5304	6162

(1): DOS, 2018

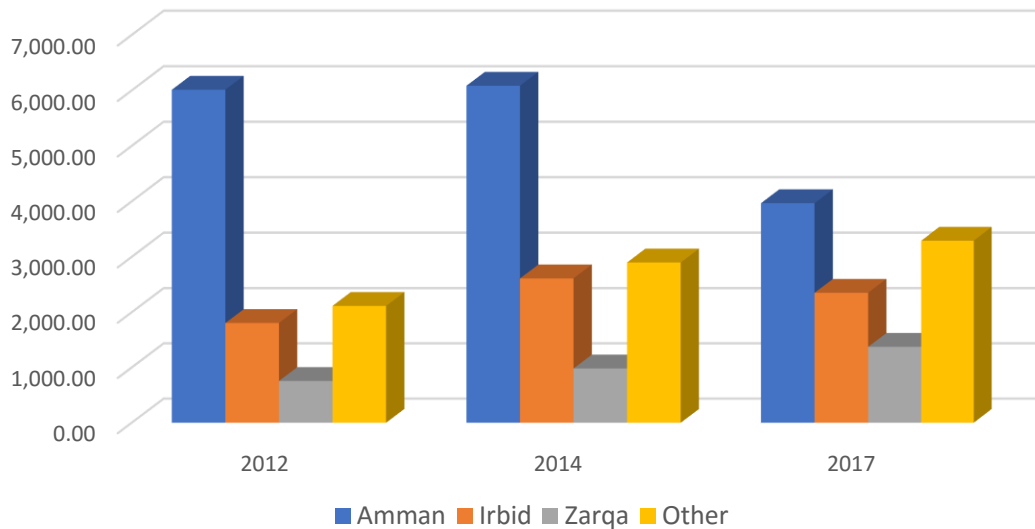
1- Overview of the existing building stock & Summary of its characterization

1.4: Number of permits granted per year ; (1),(2)

Number of New Permits Per Governorate/year



Total area of new Permits Per Governorate/ year



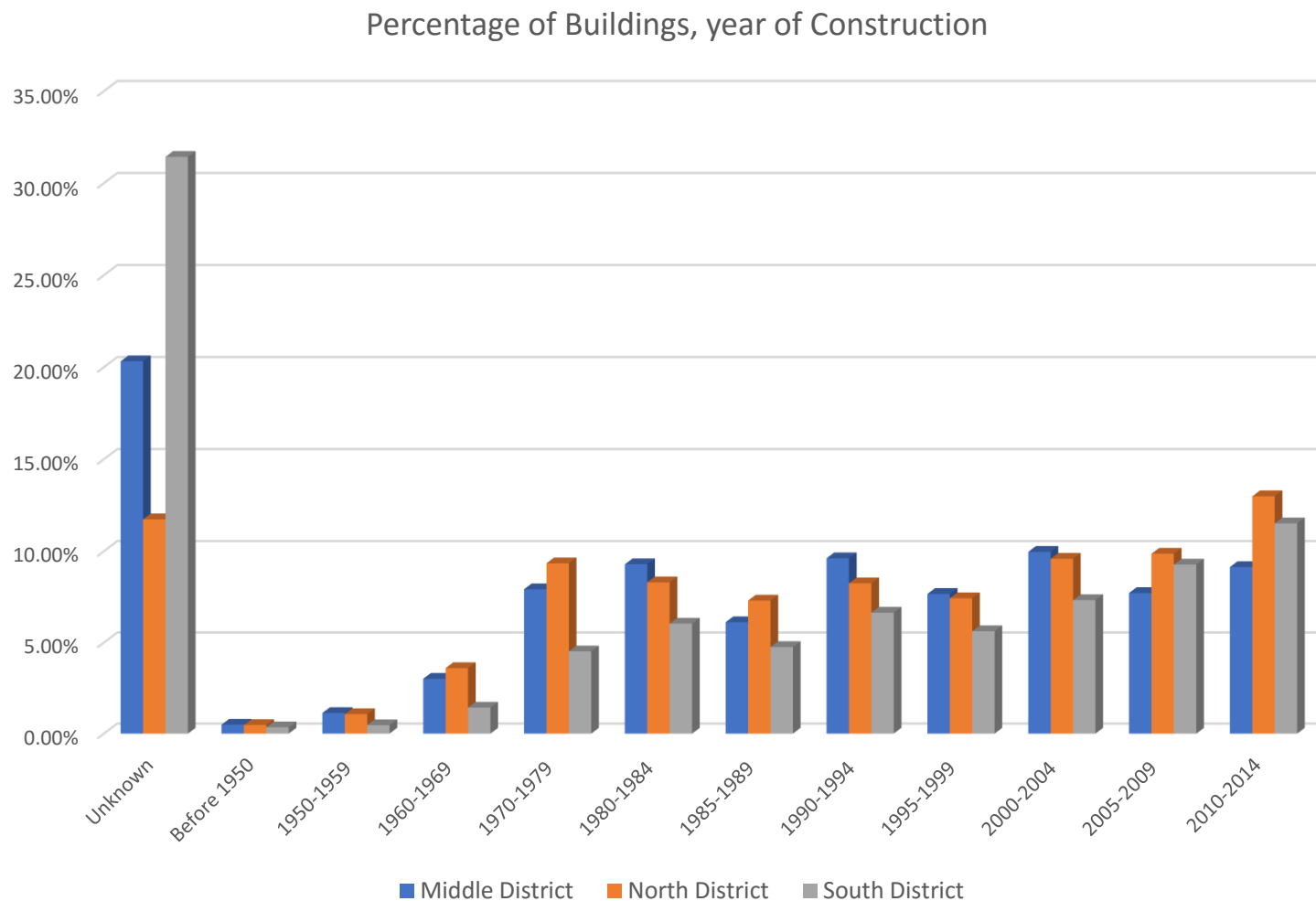
27/11/2019

Presentation two, Tala Awadallah, ESCWA, 2019

7

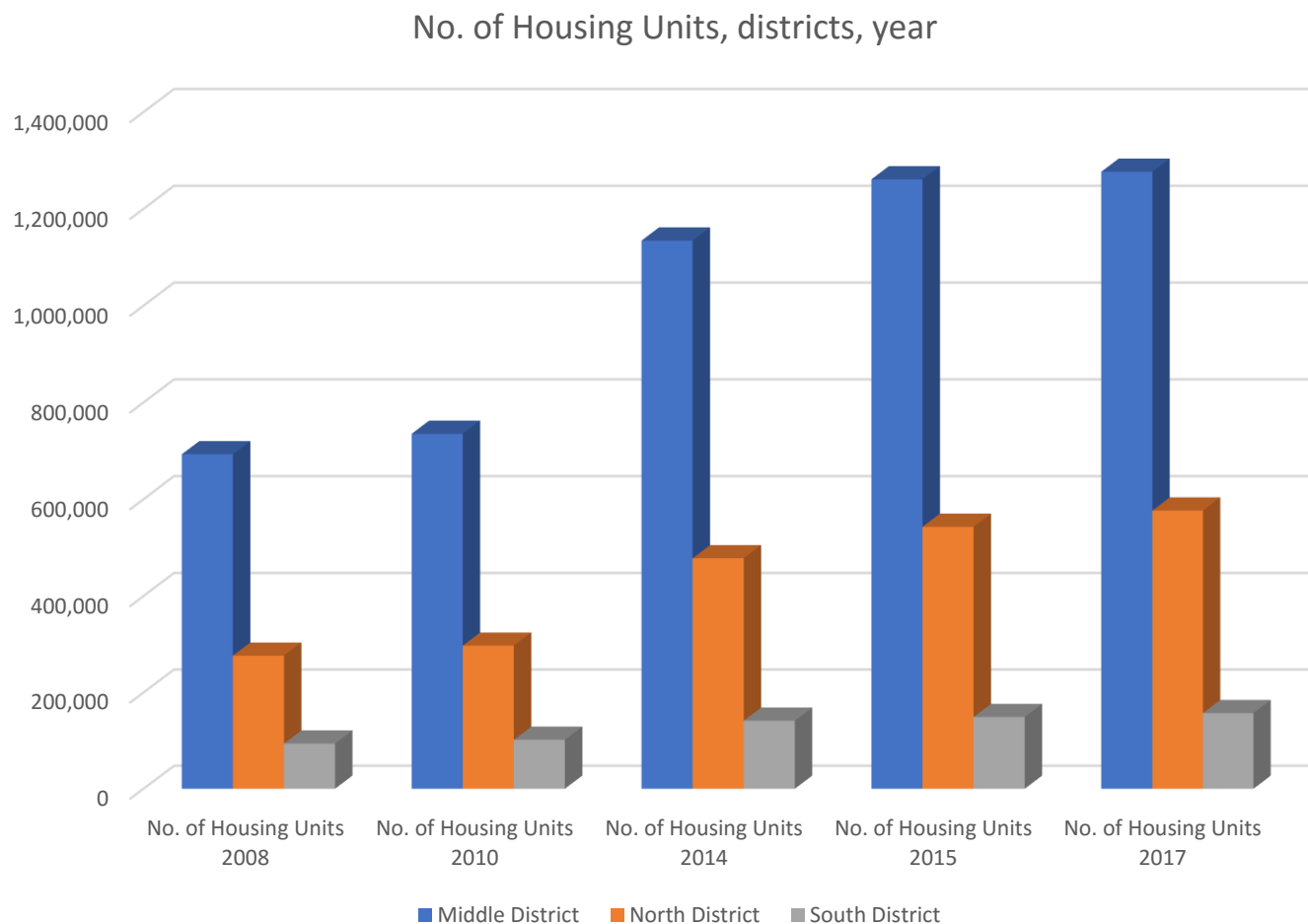
1- Overview of the existing building stock & Summary of its characterization

1.5 Number of Existing Residential Buildings according to the year of Construction.



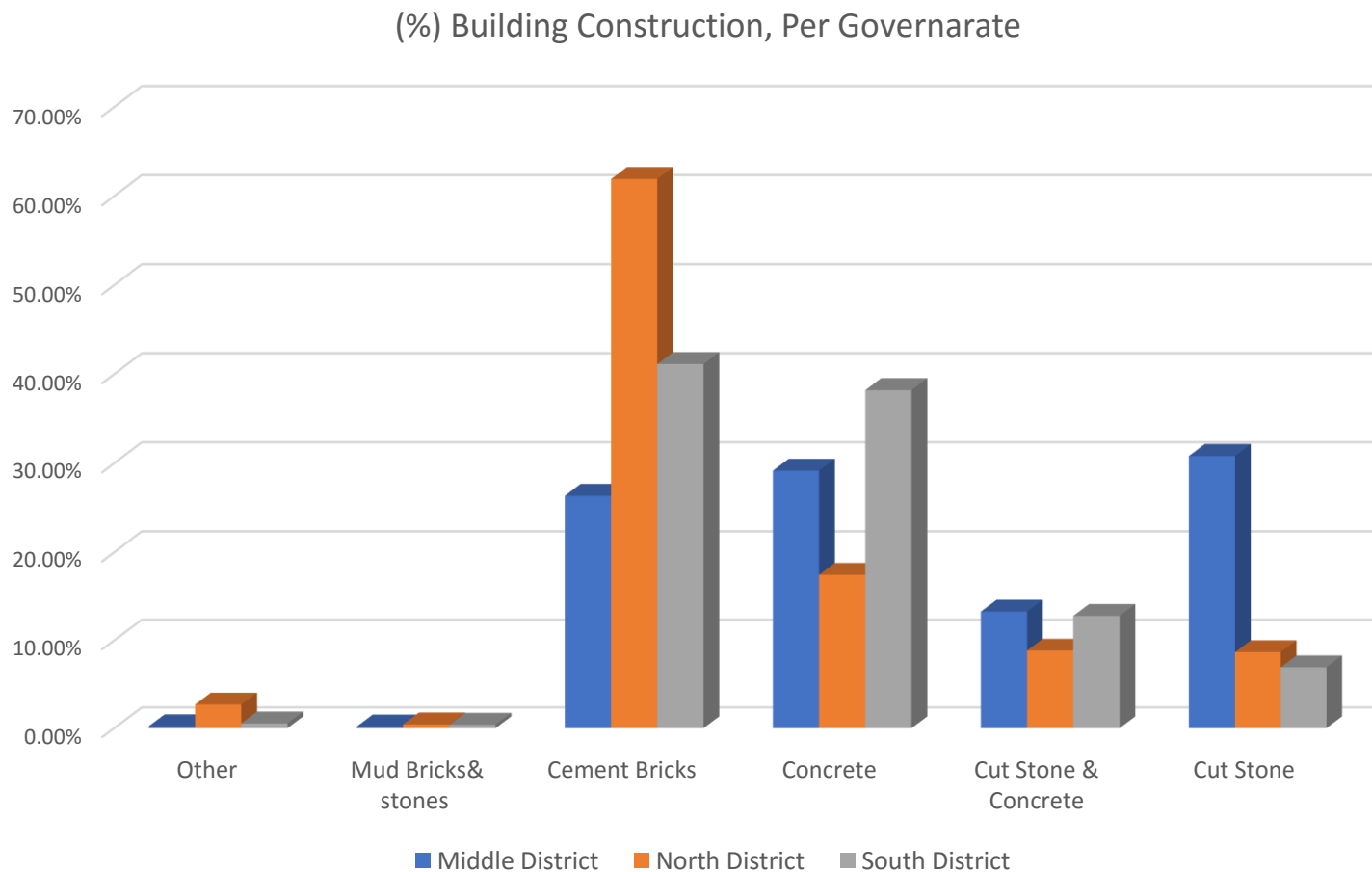
1- Overview of the existing building stock & Summary of its characterization

1.6: Total Number of Housing Units/ year:



1- Overview of the existing building stock & Summary of its characterization

1.7: Building Envelope Materials:



2- Overall Energy Consumption in the Residential Sector:

This part covers the following topics:

- 2.1: Overall energy consumption for 2006, 2008, 2010, 2014, 2017 per district & Sector
- 2.2: Electricity Use per sector for 2006, 2008, 2010, 2014, 2017, 2018
- 2.3: Housing Energy Consumption for 2010, 2014, 2017
- 2.4: Percentage of type of energy consumption in relation to the housing sector and in relation to the total Jordan energy consumption
- 2.5: percentage of residential energy consumption in relation to the total energy consumption of Jordan for year 2010, 2014, 2017
- 2.6: residential energy consumption (TOE 000) for year 2010, 2014, 2017

2- Overall Energy Consumption in the Residential Sector:

2.1: Overall energy consumption for 2006, 2008, 2010, 2014, 2017 per district & Sector

			Annual Electricity Consumption				
Year			2006	2008	2010	2014	2017
JEPCO (middle District) Climate Zones 1+2	Domestic & Government Buildings	Gwh	2308.5	3057.9	3555.6	4376.2	5298.2
	Industrial	Gwh	1222.9	1561.7	1734.1	1968.1	2073.7
	Commercial & Hotel	Gwh	1166.6	1465.1	1645.3	1742.9	1746.2
	Agriculture & Water Pumping	Gwh	368.6	462.8	454.8	533.1	625.1
	Street Lighting	Gwh	130.4	145.4	155.5	138.8	178.6
	Total	Gwh	5393	6692.9	7559.5	8759.1	9921.8
		%	13%	11%	8%	3%	5.0%
IDECO (North District) Climate Zones 2	Domestic & Government Buildings	Gwh	678	832.4	986.3	1368.2	1673.3
	Industrial	Gwh	150	157	269.1	262.6	294.2
	Commercial & Hotel	Gwh	123.2	153.5	187.4	238	297.6
	Agriculture & Water Pumping	Gwh	296.2	370.8	443	545.1	651.3
	Street Lighting	Gwh	74.3	83.2	98	106.8	134.7
	Total	Gwh	1326.5	1596.9	1983.8	2520.7	3051.1
		%	10%	9%	12%	9%	5.7%
EDCO (South district) Climate Zones 2+3+4	Domestic & Government Buildings	Gwh	448.2	569.1	677.8	839	937
	Industrial	Gwh	130.5	175.4	297.7	353	365
	Commercial & Hotel	Gwh	177.9	249.7	288.1	309	342
	Agriculture & Water Pumping	Gwh	731.5	879.4	969.1	1206	1406
	Street Lighting	Gwh	56.7	54.9	61.1	70	89
	Total	Gwh	1560.3	1928.5	2293.8	2777	3139
		%	9%	9%	12%	6%	2.9%
Total	Domestic & Government Buildings	Gwh	3651	4459	5225	6583.4	8038
	Industrial	Gwh	2757	3128	3262	3878.3	3877
	Commercial & Hotel	Gwh	1528	1925	2187	2357.7	2507
	Agriculture & Water Pumping	Gwh	1396	1713	1868	2284.2	2706
	Street Lighting	Gwh	261	284	315	315.6	404
	Total	Gwh	9593.4	11509	12857.4	15419.2	17503.8
		%	10%	9%	8%	6%	4.8%

(1): NEPCO, 2017

27/11/2019

Presentation two, Tala Awadallah, ESCWA, 2019

12

2- Overall Energy Consumption in the Residential Sector:

2.2: Electricity Use per sector for 2006, 2008, 2010, 2014, 2017, 2018 , (1),(2),(3)

		Household	Industrial	Commercial	Water Pumping	Governmental	Street Lighting	Others	Total
2006	No. of consumers (000)	987	15	161	5	15	-	12	1195
	Consumed Percentage %	30.4	29.6	15.2	14.5	4.3	2.7	3.2	100
	Elec. Consumed GWh	2918	2839	1457	1392	416	263	310	9595
2008	No. of consumers (000)	1134	15	176	6	13	-	7	1352
	Consumed Percentage %	31.4	28	15.9	14.7	6.9	2.5	0.7	100
	Elec. Consumed GWh	3630	3231	1841	1695	797	284	77	11555
2010	No. of consumers (000)	1264	16	189	7	13	-	8	1498
	Consumed Percentage %	33	26.3	16.1	14.3	7.1	2.4	0.8	100
	Elec. Consumed GWh	4260	3398	2084	1844	915	315	105	12921
2014	No. of consumers (000)	1,594	17	200	1	23	10	16	1,862
	Consumed Percentage %	35.6	25.2	15.9	10.2	6.9	2.1	5.3	100
	Elec. Consumed GWh	5,473	3,886	2,267	1,565	1,063	316	821	15,391
2017	No. of consumers (000)	1879.5*	19.6	236.5	10.2	*	12.2	-	2158
	Consumed Percentage %	45.7*	22.3	14.3	15.3	*	2.3	-	100
	Elec. Consumed GWh	7998.8*	3909.7	2509.8	2683.2	*	402.3	-	17503.8
2018	No. of consumers (000)	1934.916*	18.731	247.433	10.364	*	13.987	-	2237.8
	Consumed Percentage %	45.4*	22.4	14.3	15.5	*	2.4	-	100
	Elec. Consumed GWh	7963.8*	3929.3	2508.4	2718.9	*	421	-	17,541.4

* Governmental electricity consumption for the years 2017 and 2018 are included within the household consumption.

(1): NEPCO, 2017,
27/11/2019

(2): Electricity Regulatory Commission, 2010,2015

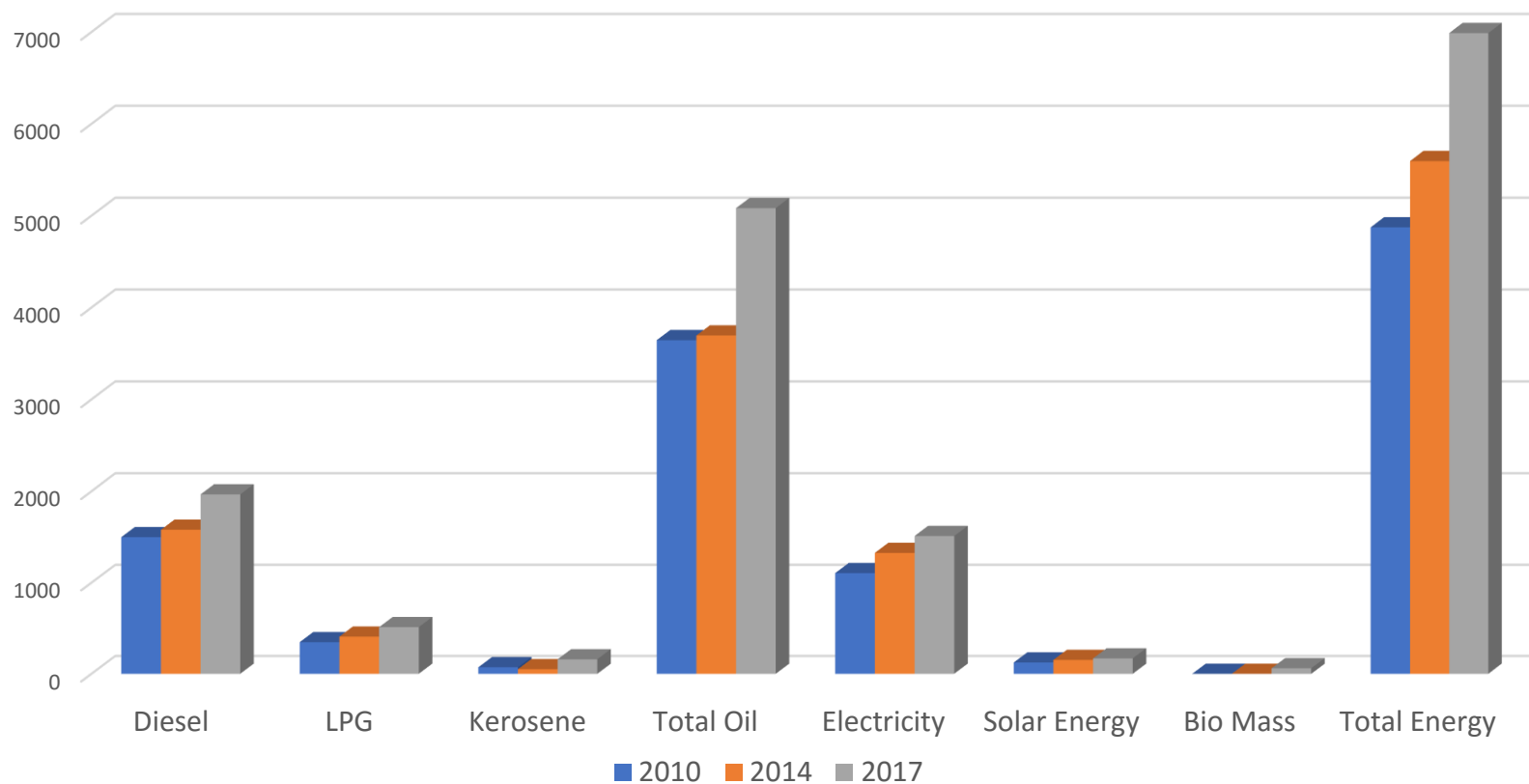
(3): EMRC, 2018

Presentation two, Tala Awadallah, ESCWA, 2019

2- Overall Energy Consumption in the Residential Sector:

2.3: Housing Energy Consumption for 2010, 2014, 2017

Housing Energy Consumption (000 toe) 2010, 2014, 2017



2- Overall Energy Consumption in the Residential Sector:

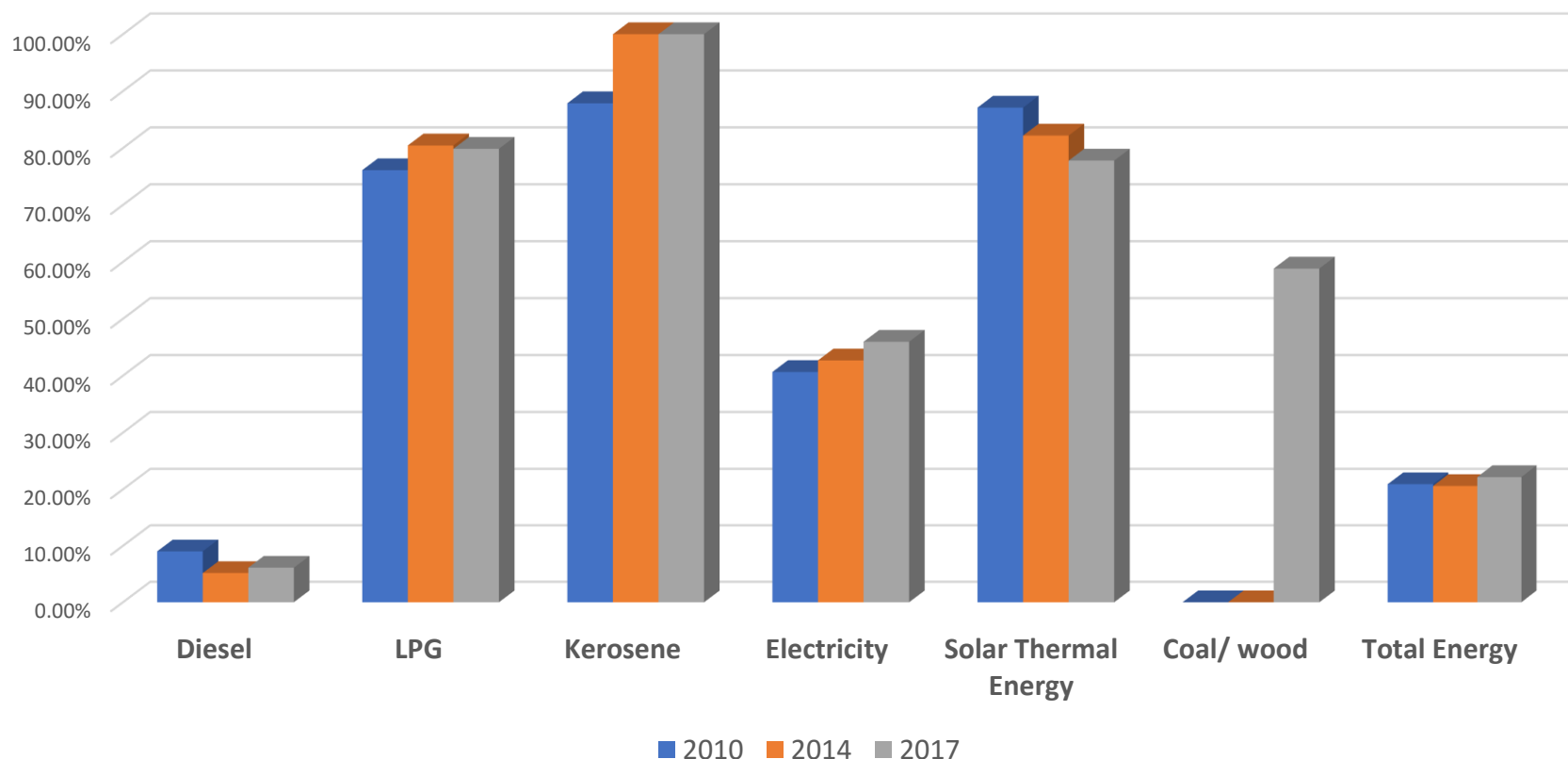
2.4: Percentage of type of energy consumption in relation to the housing sector and in relation to the total Jordan energy consumption

	Diesel	LPG	Kerosene	Total Oil	Electricity	Solar Energy	Bio Mass	Total Energy	%of Total Energy	primary
2010	1498.2	346.9	71.7	3644.2	1104.5	124	0	4872.7		-1137.8
Housing (000 toe)	135	264	63	462	448.9	108	0	1018.9	20.91%	
%of Total energy	9.01%	76.10%	87.87%	12.68%	40.64%	87.10%	0.00%	20.91%		
energy use (%) of housing	13.25%	25.91%	6.18%	45.34%	44.06%	10.60%	0.00%	100.00%		
2014	1579.5	408.1	50.6	3695.5	1325.9	152.1	0	5594		-1469.1
Housing (000 toe)	81.8	328.3	50.6	460.7	565.9	125	0	1151.7	20.59%	
%of Total energy	5.18%	80.45%	100.00%	12.47%	42.68%	82.18%	0.00%	20.59%		
energy use (%) of housing	7.10%	28.51%	4.39%	40.00%	49.14%	10.85%	0.00%	100%		
2017	1965.1	511.4	158.8	5081.8	1511.3	168.4	60.7	6987.1		-1356.6
Housing (000 toe)	120.3	408.4	158.8	687.4	694.5	131	35.7	1548.6	22.16%	
%of Total energy	6.12%	79.86%	100.00%	13.53%	45.95%	77.79%	58.81%	22.16%		
energy use (%) of housing	7.77%	26.37%	10.25%	44.39%	44.85%	8.46%	2.31%	100.00%		

2- Overall Energy Consumption in the Residential Sector:

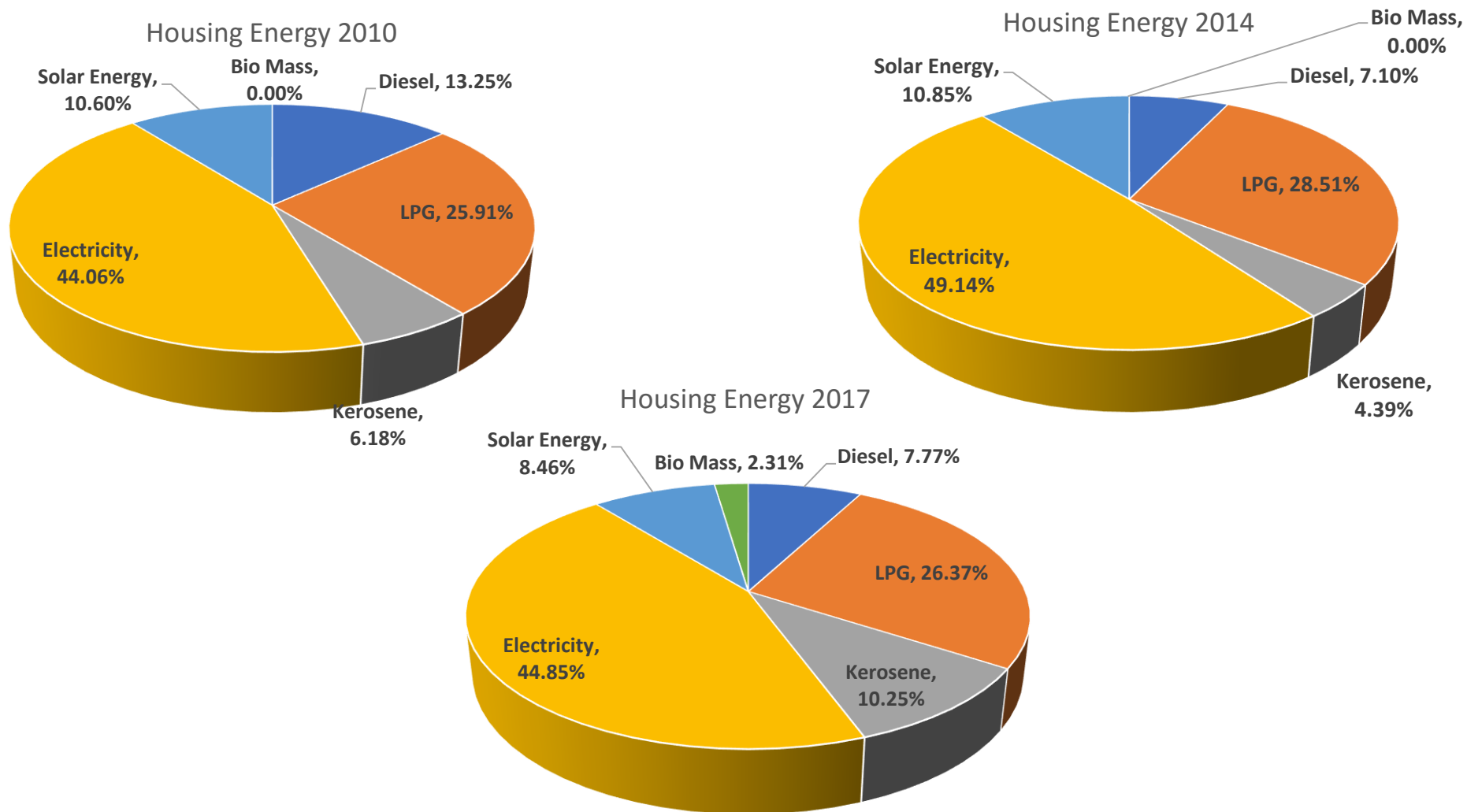
2.5: percentage of residential energy consumption in relation to the total energy consumption of Jordan for year 2010, 2014, 2017

(%) of Housing Total Energy from National Energy, by Energy Sources



2- Overall Energy Consumption in the Residential Sector:

2.6: residential energy consumption (TOE 000) for year 2010, 2014, 2017



3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

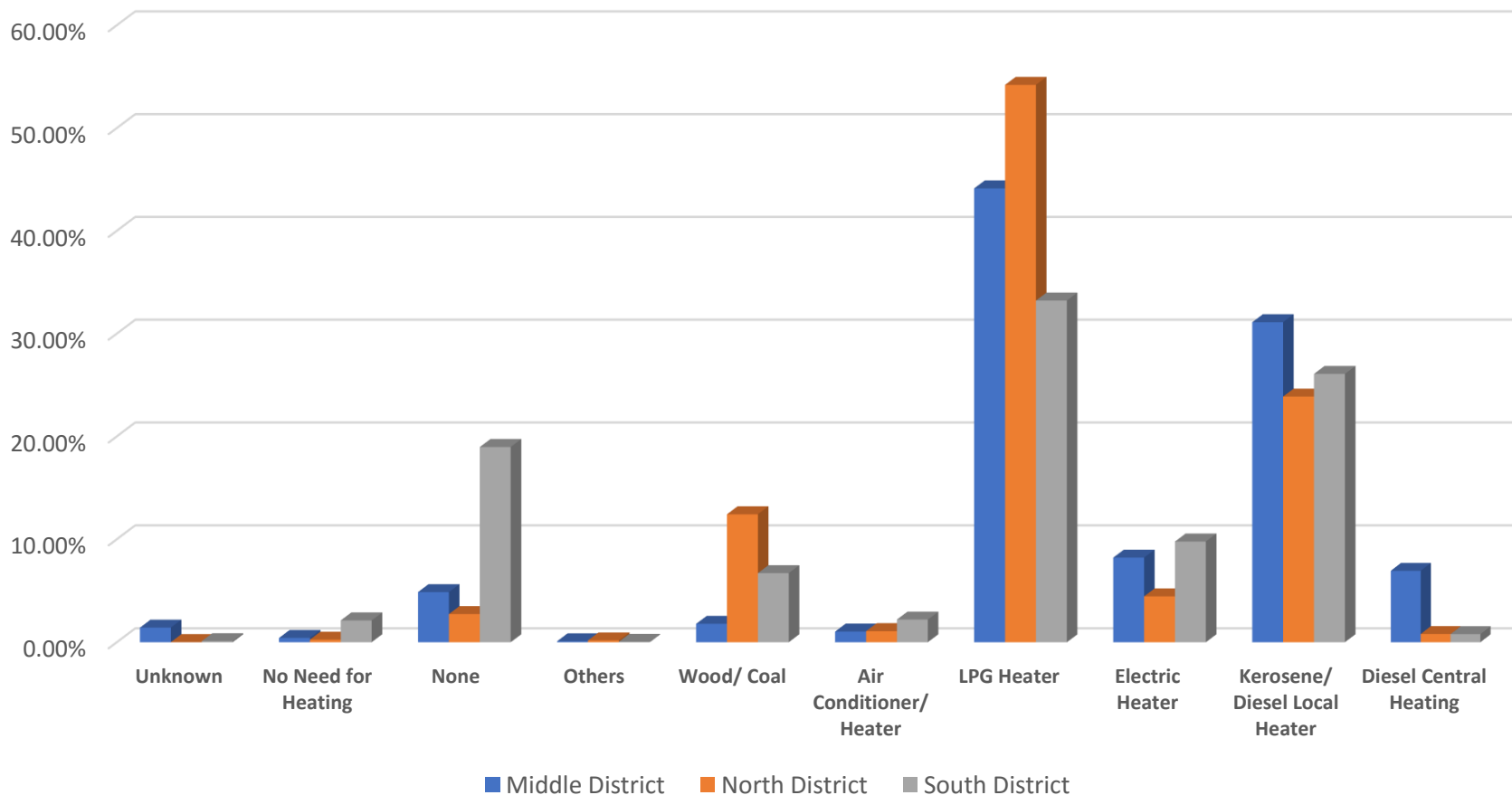
This part covers the following topics:

- 3.1: Heating Types per district:
- 3.2: Kerosene Consumption
- 3.3: Diesel Consumption
- 3.4: LPG Consumption
- 3.5 Electricity Consumption

3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

3.1: Heating Types per district:

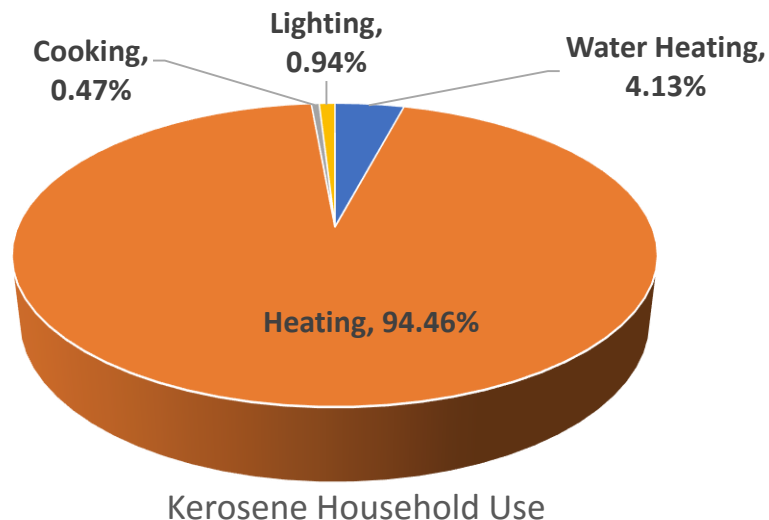
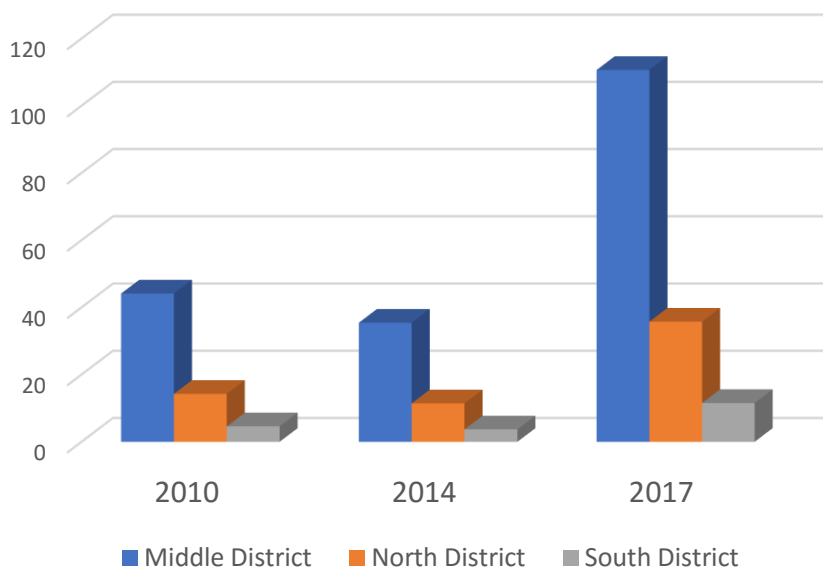
Type of heating per District



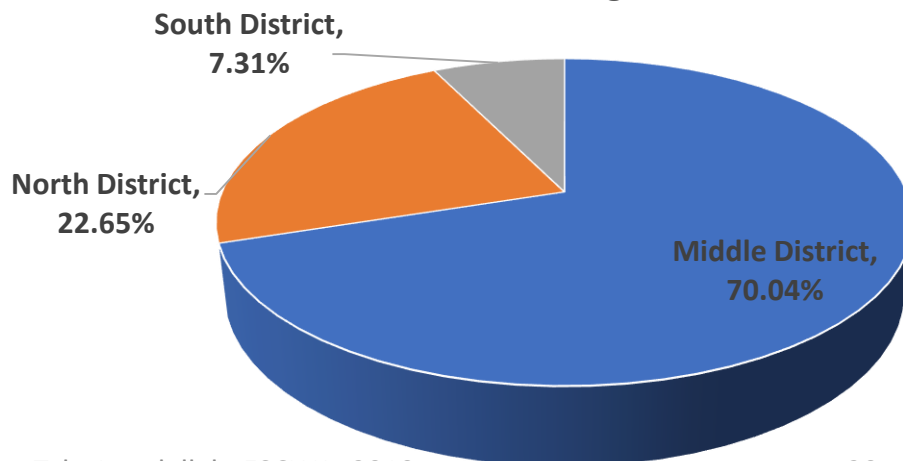
3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

3.2: Kerosene Consumption

Kerosene for Heating in Housing, TOE



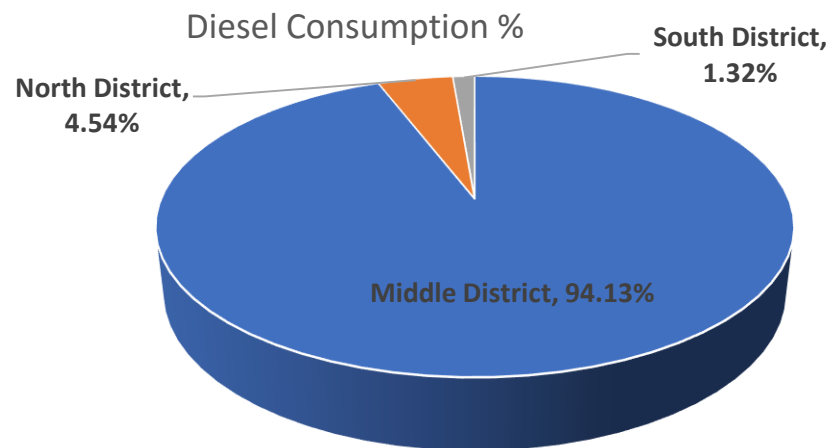
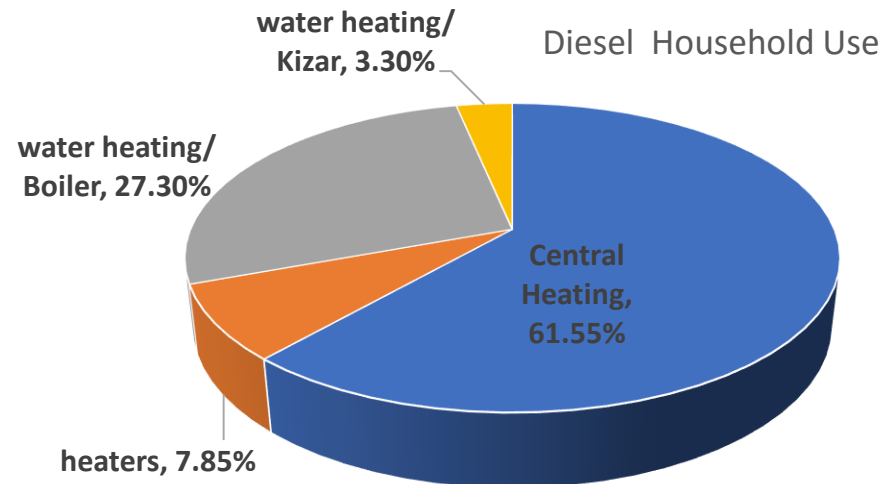
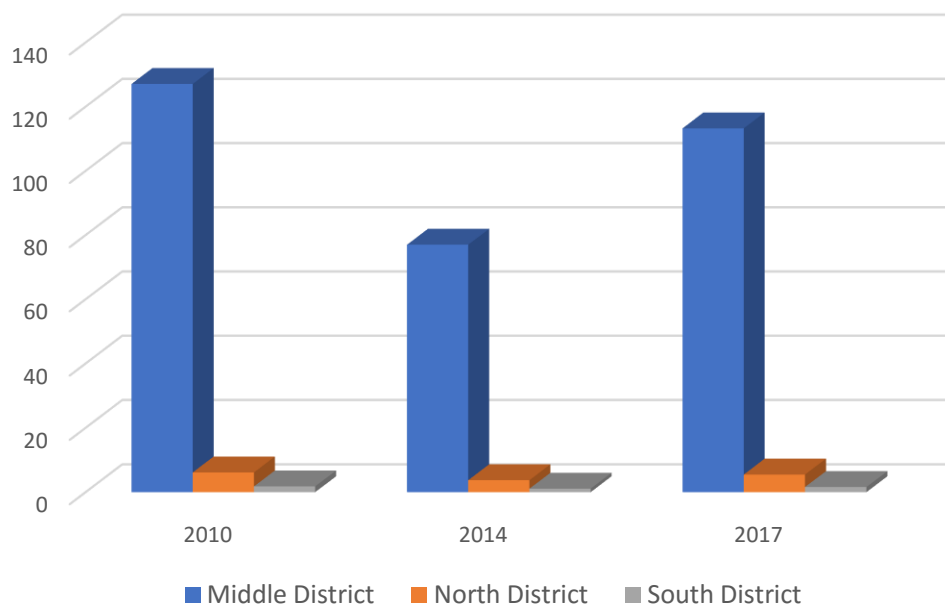
Kerosene consumption percentage, for heating In Housing Sector %



3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

3.3: Diesel Consumption

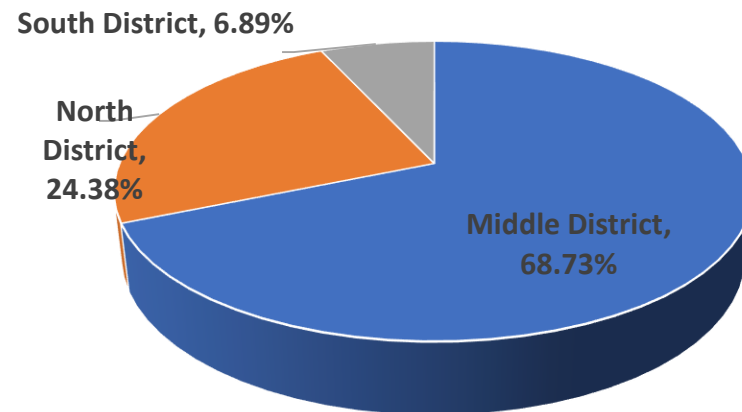
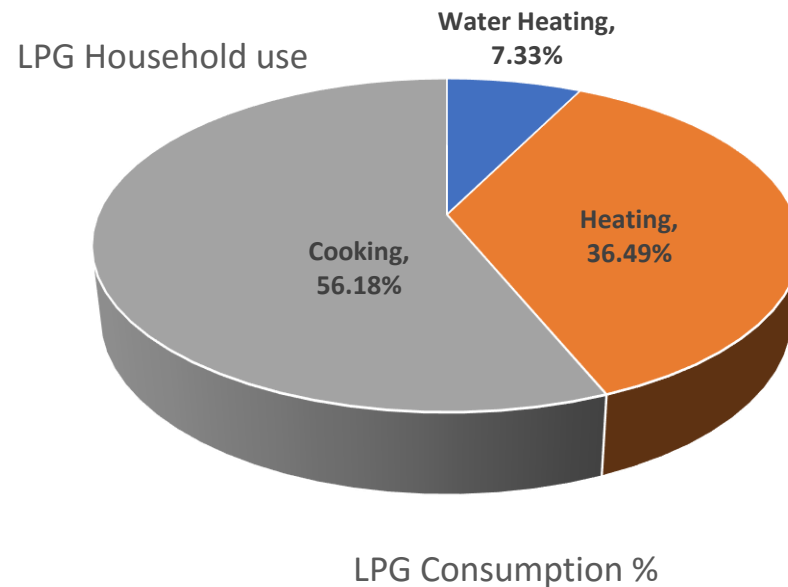
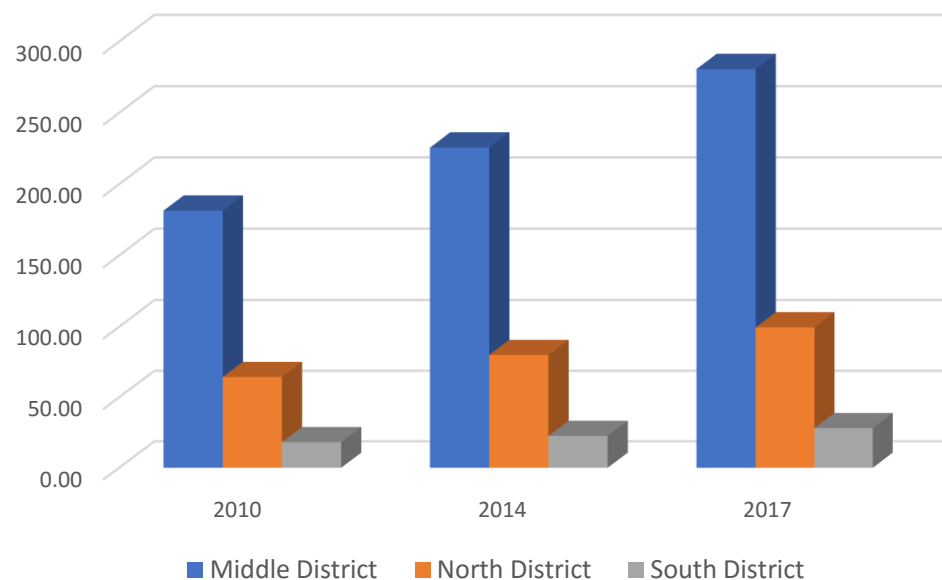
Diesel Consumption in Housing (TOE)



3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

3.4: LPG Consumption

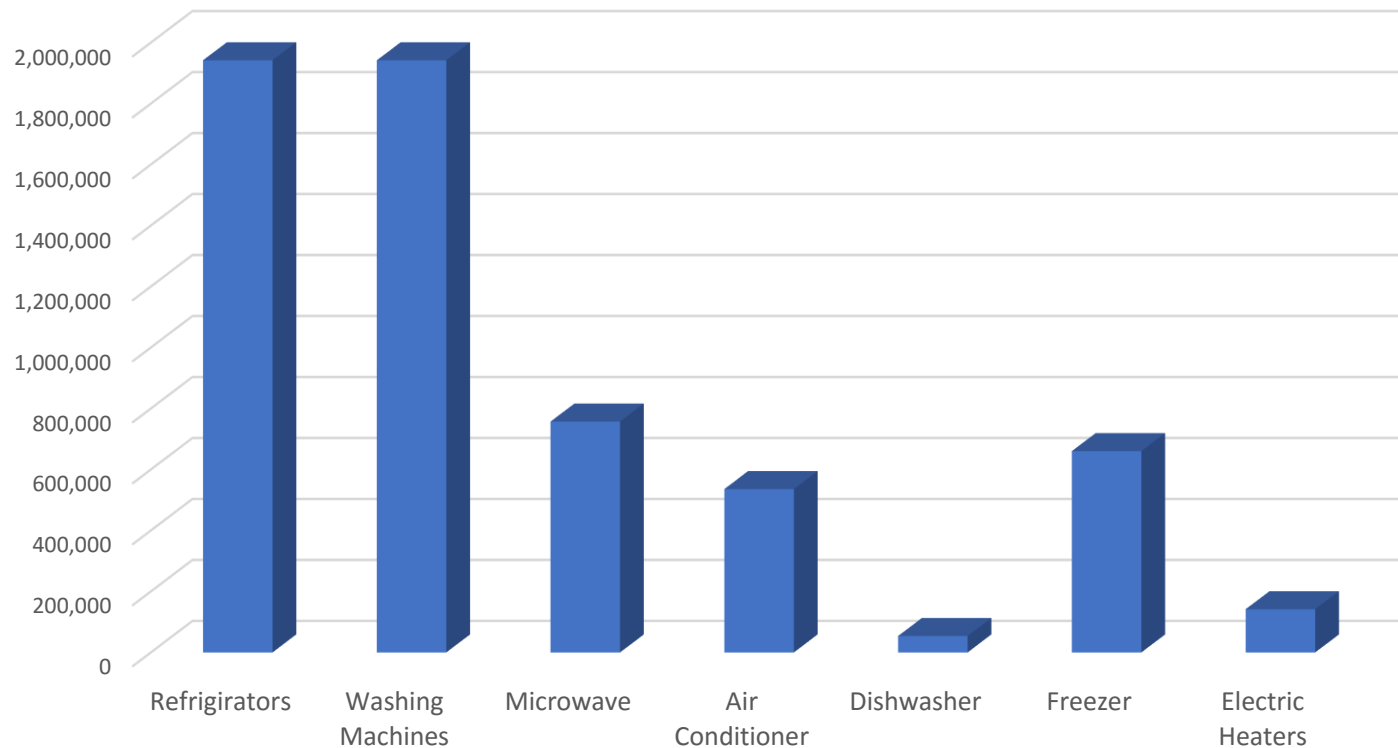
LPG Consumption in Household



3- End-Use Energy Consumption in the Existing Residential Sector in Jordan :

3.5: Electricity Consumption

Number of total Appliances on the national Scale 2017



Conclusions and Remarks:

- The building Envelope materials differ between districts, not because of the climate but because of the regulations and income.
- The Residential sector consumes an average of 20-22% of the total energy consumption of Jordan.
- The Residential sector consumes an average of 40-45% of the total electricity consumption of Jordan.
- Solar heaters are only available in 14% of the Residential buildings.
- LPG, Kerosene, and Diesel consumption structure is defined based on detailed surveys, making the structure of energy consumption closer to the actual consumption.
- Electricity consumption categorization is mostly based on estimations and averages, not measured and surveyed actual detailed consumption. All data are estimated using findings of scientific research not total surveys.

REFERENCES

- Greater Amman Municipality (**GAM**), regulations & Law 2005.
- Ministry of Energy and Mineral Resources (**MEMR**), Surveys Of 2013 & 2014, Annual Reports 2010,2014 & 2017.
- National Electric Power Company (**NEPCO**) Annual Report 2010. 2014, & 2017.
- National Energy Research Center (**NERC**), research reports 2012 & 2017.
- Ministry of Public Works & Housing (**MPWH**), building codes & guides 2008 & 2013
- Central Bank of Jordan (**CBJ**), Annual Report 2017.
- Department of Statistics (**DOS**), Population and Housing Census 2015, 2010, 2014, & 2017.
- Energy and mineral Resources Commission (**EMRC**), Significant Figures for Energy & Minerals Sector 2010, 2014, & 2017

Economic And Social Commission For Western Asia



UNITED NATIONS

الاسفوا

ESCWA

THANK YOU FOR YOUR ATTENTION