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Assistance to the Development of the Mykolaiv Masterplan

Water and District Heating Affordability in Mykolaiv

Final

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List of Abbreviations

CPI	Consumer Price Index
EBRD	European Bank for Reconstruction and Development
GCal	Gigacalorie
GDP	Gross Domestic Product
MOTE	Mykolaiv Oblast Teploenergo
UAH	Ukrainian hryvnia
VAT	Value added tax

1 Introduction

This report analyses the water and district heating affordability in the municipality of Mykolaiv in Ukraine. We use data from the European Bank for Reconstruction and Development (EBRD), and the municipality of Mykolaiv, to conclude that households in the 1st income decile have a water affordability problem in the future and that there is a heat affordability problem for income decile 1-8. These findings call for policy implications. There are two major options on how to support the poor households' heat and water affordability: 1) direct household assistance and 2) subsidising the utility companies. We suggest implementing direct household assistance to support the households on their water and heat affordability problems.

The report is structured as follows. Section 2 includes a brief introduction to the principles of affordability and affordability analyses. Section 3 explains the general data in the two affordability analyses. Section 4 includes the affordability analysis for water as well as a brief explanation of the water data and assumptions. Section 4 includes the affordability analysis for district heating as well as a brief explanation of the heat data and assumptions. Finally, Section 5 discusses the results and policy implications.

2 Principles of affordability

Affordability is defined as a share of monthly household income/expenditure, which is spent on utility bills. It is the actual financial ability of households to pay for utility services. Household affordability is often confused with willingness to pay which refers to the perception of households of the utilities costs they need to pay. We only focus on affordability.

Affordability analyses studies the impact of tariff policies on household tariff affordability. Tariff policies play an important role in infrastructure reforms. Often as part of project requirements, tariffs are adjusted to reach cost recovery levels. It is important to analyse the impact of such tariff reform on poor households and vulnerable groups.

Affordability analysis can:

- assess financial well-being of households with lowest income and those that are most vulnerable to tariff increases,
- forecast future impact of tariffs on poor households and vulnerable groups,
- assess household needs in utilities sector.

Several variables are considered in determining affordability of tariffs. Among them are the income of households, level of consumption, tariffs, collection rates, inflation as well as income growth. Affordability ratios are calculated by dividing household utility expenditure by the total household expenditure (or by total income where data is unavailable).

Utility bills are ‘unaffordable’ when they exceed the preset threshold. EBRD’s affordability thresholds are the following:

- 10% for district heating,
- 5% for water and wastewater.

We calculate affordability ratios for households in all 10 income deciles to uncover the tariff affordability of the households of Mykolaiv.

3 General data in affordability the analyses

The water and heat affordability analyses are based on many of the same data inputs. These data inputs will be presented in this section.

The main data used in the two affordability analyses is:

- macroeconomic data forecast for Ukraine from 2022-2032,
- household income and expenditure data in Mykolaiv for each of 10 income deciles in UAH for 2018-2021,
- average household size in Mykolaiv for 2018-2022,

The macroeconomic data for 2022-2032 is provided by European Bank for Reconstruction and Development (EBRD) whereas the other data is provided by the municipality of Mykolaiv.

Macroeconomic data

The macroeconomic forecast for real Gross Domestic Product (GDP) growth rate and Consumer Price Index (CPI) rate forecast for Ukraine from EBRD includes data for a base case and a pessimistic case for 2022-2032. We use data for the base case.

The GDP growth rate and CPI rate is presented in Table 3-1.

Table 3-1 Yearly real GDP growth rate and average annual change in CPI 2022-2032 (pct.)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Real GDP growth	-29.1%	1.0%	3.0%	6.0%	8.0%	10.0%	10.0%	8.0%	8.0%	6.0%	6.0%
CPI	26.6%	14.7%	7.0%	6.0	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

Source: European Bank for Reconstruction and Development (EBRD)

In the analyses the nominal income growth rate is calculated using the CPI rate and GDP growth rate:

$$Nominal\ income\ growth\ rate = (1 + GDP\ growth) * (1 + CPI) - 1$$

The calculated nominal income growth rate is presented in Table 3-2.

Table 3-2 Nominal income growth 2022-2032 (pct.)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Nominal income growth	-10.2%	15.8%	10.2%	12.4%	13.4%	15.5%	15.5%	13.4%	13.4%	11.3%	11.3%

Source: Affordability model calculations

In the analyses the nominal income growth rate projects the households' nominal expenditure for the years from 2022-2032.

Household income

For household nominal income we have data for 2018-2021 for each of 10 deciles. For 2022-2032 the data is projected for each decile using the nominal income growth rate.

The average household income for each decile is given in

Table 3-3.

The table shows that the income is not consistently increasing for every increase in the income decile. This is because the household incomes are based on average incomes per capita, and that the average household size differs between the deciles. The average household size tends to be larger for smaller income deciles than for higher income deciles.

Table 3-3 Average household income per decile (1,000 UAH/month)

UAH	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Average household	8.8	10.4	10.6	11.9	10.7	12.4	13.7	15.4	17.4	20.1	23.2	26.3	29.9	33.3	37.0
1st decile	6.0	5.2	5.2	6.7	6.0	7.0	7.7	8.6	9.8	11.3	13.0	14.8	16.8	18.6	20.8
2nd decile	5.5	6.8	6.4	7.9	7.1	8.2	9.0	10.2	11.5	13.3	15.4	17.4	19.8	22.0	24.5
3rd decile	6.3	7.8	9.3	9.6	8.7	10.0	11.1	12.4	14.1	16.3	18.8	21.3	24.2	26.9	29.9
4th decile	7.3	8.3	8.6	9.0	8.0	9.3	10.3	11.5	13.1	15.1	17.4	19.8	22.4	25.0	27.8
5th decile	8.8	9.2	10.3	10.8	9.7	11.2	12.4	13.9	15.8	18.2	21.1	23.9	27.1	30.1	33.5
6th decile	8.1	9.7	11.0	9.9	8.9	10.3	11.4	12.8	14.5	16.8	19.4	22.0	24.9	27.7	30.8
7th decile	8.3	11.3	10.4	14.3	12.8	14.8	16.3	18.4	20.8	24.0	27.8	31.5	35.7	39.8	44.2
8th decile	9.2	14.1	11.8	14.0	12.6	14.6	16.1	18.1	20.5	23.7	27.3	31.0	35.2	39.1	43.6
9th decile	13.0	14.1	17.5	15.6	14.0	16.3	17.9	20.1	22.8	26.4	30.5	34.5	39.2	43.6	48.5
10th decile	15.9	17.5	15.5	21.6	19.4	22.4	24.7	27.8	31.5	36.4	42.0	47.6	54.0	60.1	66.9

Source: The municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

Average household size

The average household size is assumed to be 2.53 for all years in the analyses. This is the average household size in 2022.

4 Water affordability

The water affordability analysis covers 14 years from 2018 to 2032. The year 2032 is the last year in the analysis due to the data availability.

4.1 Data and assumptions

The main data used in the affordability analysis for water is:

- Ukrainian tariffs for water consumption and wastewater discharge in UAH/m³ for 2018-2023 (in current prices)[1],
- water consumption and wastewater discharge in Mykolaiv in litre per capita per day from 2018-2023,
- Ukrainian VAT rates for water tariffs.

The VAT rates are based on publicly available data.[2] The water consumption data as well as the water tariffs are provided by the municipality of Mykolaiv.

Tariffs on water consumption and wastewater discharge

The tariff data only includes data for 2018-2023. To get data from 2024-2032, we project the tariff rates based on the compounded annual growth rate[3] from 2018 to 2023. The compounded annual growth rate is calculated to be 15% for water consumption tariffs and 19% for wastewater discharge tariffs. Therefore, we assume that the tariffs for water consumption and wastewater discharge will have a yearly increase of 15% and 19%, respectively, towards 2032.

The tariffs for water consumption and wastewater discharge are presented in Table 4-1.

Table 4-1 Tariffs on water consumption and wastewater discharge (UAH/m³)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Water tariff	7.27	9.06	11.58	13.99	14.61	14.61	16.80	19.32	22.21	25.54	29.36	33.76	38.82	44.63	51.32
Waste-water tariff	5.70	7.19	9.91	12.92	13.76	13.76	16.41	19.58	23.35	27.85	33.22	39.62	47.26	56.36	67.23

Source: The Municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

VAT Rates

We assume that 20% VAT applies to water tariffs.

To calculate the tariffs including the VAT we multiply the tariff data from the municipality of Mykolaiv with 1.20. These tariffs are presented in Table 4-2.

[1] Current prices are prices including inflation.

[2] https://taxsummaries.pwc.com/ukraine/corporate/other-taxes

[3] The compounded annual growth rate (CAGR) is the average annual growth rate over a given period. CAGR is calculated using the following formula: $CAGR = \left(\frac{Ending\ value}{Beginning\ value}\right)^{\frac{1}{number\ of\ year}} - 1$.

Table 4-2 Tariffs on water consumption and wastewater discharge incl. VAT (UAH/ m³)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Water tariff	8.72	10.87	13.90	16.79	17.53	17.53	20.16	23.18	26.65	30.64	35.23	40.51	46.58	53.56	61.58
Wastewater tariff	6.84	8.63	11.89	15.50	16.51	16.51	19.69	23.49	28.02	33.42	39.86	47.54	56.71	67.64	80.67

Source: Affordability model calculations

Water consumption and wastewater discharge

In the data for water consumption and wastewater discharge there is a large decrease in consumption and discharge in 2022 and 2023. This due to the war in Ukraine and is not a realistic picture of the water consumption and discharge in the future. In the analysis we assume that the consumption for 2022-2032 is the same as for the year of 2021.

The water consumption and wastewater discharge are presented in Table 4-3.

Table 4-3 Water consumption and wastewater discharge (litre/day/capita)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Water consumption	121	109	112	107	107	107	107	107	107	107	107	107	107	107	107
Waste-water discharge	119	107	110	106	106	106	106	106	106	106	106	106	106	106	106

Source: The Municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

In the analysis we convert the water consumption and -discharge in litres/day/capita into consumption and discharge in m³/day/capita by dividing the consumption and discharge data with 1,000. To convert it into monthly data we multiply the water consumption and discharge in m³/day/capita with 30.42 (average number of days in a month). To convert the water consumption and discharge in m³/month/capita into m³/month/household we multiply with the average household size of 2.53.

Table 4-4 Water consumption and wastewater discharge (m³/month/household)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Water consumption	9.31	8.39	8.62	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23
Waste-water discharge	9.16	8.23	8.46	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16

Source: The Municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

To calculate the average monthly household expenditure on water consumption we multiply the water consumption tariff incl. VAT with the average monthly household water consumption in m³. To calculate the average monthly household expenditure on wastewater discharge we multiply the water discharge tariff incl. VAT with the average monthly household wastewater discharge in m³.

The average monthly household expenditure on water consumption and wastewater discharge is presented in Table 4-5.

Table 4-5 Average expenditure on water consumption and wastewater discharge (UAH/month)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Water consumption	81	91	120	138	144	144	166	191	219	252	290	334	384	441	507
Waste-water discharge	63	71	101	126	135	135	161	192	229	273	325	388	463	552	658

Source: Affordability model calculations

4.2 Results

The results of the water affordability analysis in Mykolaiv are presented in

Table 4-6.

The results show that the 2nd and 3rd income decile will not have any water affordability problems towards 2032 assuming an affordability threshold of 5%. The 1st income decile will have an affordability problem from 2030 to 2032 as the affordability ratio exceed the threshold of 5%.

Table 4-6 Water affordability in Mykolaiv (pct.)

UAH	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Average household	1.6%	1.6%	2.1%	2.2%	2.6%	2.3%	2.4%	2.5%	2.6%	2.6%	2.6%	2.7%	2.8%	3.0%	3.1%
1st decile	2.4%	3.1%	4.3%	4.0%	4.6%	4.0%	4.3%	4.4%	4.6%	4.7%	4.7%	4.9%	5.0%	5.3%	5.6%
2nd decile	2.6%	2.4%	3.4%	3.4%	3.9%	3.4%	3.6%	3.8%	3.9%	3.9%	4.0%	4.1%	4.3%	4.5%	4.8%
3rd decile	2.3%	2.1%	2.4%	2.7%	3.2%	2.8%	3.0%	3.1%	3.2%	3.2%	3.3%	3.4%	3.5%	3.7%	3.9%

Source: Affordability model calculations

5 District heating affordability

The district heating affordability analysis covers 14 years from 2018 to 2032. The year 2032 is the last year in the analysis due to the data availability.

The district heating affordability analysis focuses solely on heat consumption and does not consider hot water consumption. The exclusion of hot water is due to the absence of hot water supply in Mykolaiv in recent years. The decision to discontinue hot water consumption in Mykolaiv was made due to substantial heat losses, which rendered hot water consumption during summer periods highly inefficient. Consequently, this led to unaffordable hot water tariffs for the population. Presently, the population has electrical water heaters instead of getting supplied by a centralized hot water supply.

5.1 Data and assumptions

The main data used in the affordability analysis for heat is:

- Ukrainian tariffs on heat consumption in UAH/Gcal for 2018-2023 (in current prices),[4]
- Heat consumption in Mykolaiv in Gcal per month per capita from 2018-2023,
- Ukrainian VAT rate for heat tariffs.

The VAT rates are based on publicly available data.[5] The heat consumption data as well as the heat tariff rates are provided by the municipality of Mykolaiv.

Tariffs on heat consumption

The tariff data only includes data for 2018-2023. To get data from 2024-2032, we project the tariff rate based on the compounded annual growth rate[6] from 2018 to 2023. The compounded annual growth rate is calculated to be 6% for heat consumption tariffs. Therefore, we assume that the tariffs for heat consumption will have a yearly increase of 6% towards 2032.

The tariffs for heat consumptions are presented in Table 5-1.

Table 5-1 Tariffs on heat consumption (UAH/Gcal)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Heat tariff	1,235	1,235	1,235	1,235	1,666	1,666	1,769	1,878	1,993	2,116	2,246	2,385	2,532	2,688	2,853

Source: The Municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

[4] Current prices are prices including inflation.

[5] https://taxsummaries.pwc.com/ukraine/corporate/other-taxes

[6] The compounded annual growth rate (CAGR) is the average annual growth rate over a given period. CAGR is calculated using the following formula: $CAGR = \left(\frac{Ending\ value}{Beginning\ value}\right)^{\frac{1}{number\ of\ year}} - 1$.

VAT Rates

We assume that 20% VAT applies to heat tariffs.

To calculate the tariffs including the VAT we multiply the tariff data from the municipality of Mykolaiv with 1.20. These are presented in

Table 5-2.

Table 5-2 Tariffs on heat incl. VAT (UAH/Gcal)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Heat tariff	1,483	1,483	1,483	1,483	1,999	1,999	2,122	2,253	2,392	2,539	2,696	2,862	3,038	3,225	3,424

Source: Affordability model calculations

Heat consumption

We only have data for heat consumption for 2018-2022. In the analysis we assume that heat consumption for 2023-2032 is the average monthly consumption for 2018-2022.

The heat consumption is presented in Table 5-3.

Table 5-3 Heat consumption (Gcal/month/capita)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Heat consumption	0.34	0.30	0.31	0.35	0.30	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32

Source: The Municipality of Mykolaiv (2018-2021) and affordability model calculations (2022-2032)

In the analysis we convert the heat consumption in Gcal/month/capita into Gcal/month/household by multiplying the data with the average household size of 2.53.

Table 5-4 Heat consumption (Gcal/month/household)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Heat consumption	0.86	0.77	0.80	0.87	0.75	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81

Source: Affordability model calculations

To calculate the average monthly household expenditure on heat consumption we multiply the heat consumption tariff incl. VAT with the average monthly household heat consumption.

The average expenditure on heat consumption is presented in

Table 5-5.

Table 5-5 Average expenditure on heat consumption (UAH/household)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Heat consumption	1276	1139	1180	1295	1506	1620	1720	1826	1938	2058	2184	2319	2462	2614	2775

Source: Affordability model calculations

5.2 Results

The results of the heat affordability analysis for Mykolaiv are presented in Table 5-6.

The results suggest that all income deciles except income decile 10 will experience affordability problems at some point throughout the period from 2018 to 2032 when we assume an affordability threshold of 10 pct. for heat consumption. Income decile 1 and 2 will have an affordability problem throughout the whole period.

Table 5-6 Heat affordability (pct.)

UAH	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Average household	14.5 %	11.0 %	11.1 %	10.9 %	14.1 %	13.1 %	12.6 %	11.9 %	11.1 %	10.2 %	9.4 %	8.8 %	8.2 %	7.9 %	7.5 %
1st decile	21.4 %	22.1 %	22.9 %	19.4 %	25.1 %	23.3 %	22.4 %	21.2 %	19.8 %	18.2 %	16.8 %	15.7 %	14.7 %	14.0 %	13.4 %
2nd decile	23.1 %	16.7 %	18.5 %	16.4 %	21.2 %	19.7 %	19.0 %	18.0 %	16.8 %	15.4 %	14.2 %	13.3 %	12.4 %	11.9 %	11.3 %
3rd decile	20.4 %	14.6 %	12.7 %	13.4 %	17.4 %	16.1 %	15.6 %	14.7 %	13.8 %	12.6 %	11.6 %	10.9 %	10.2 %	9.7 %	9.3 %
4th decile	17.5 %	13.6 %	13.7 %	14.5 %	18.7 %	17.4 %	16.8 %	15.8 %	14.8 %	13.6 %	12.5 %	11.7 %	11.0 %	10.5 %	10.0 %
5th decile	14.5 %	12.4 %	11.5 %	12.0 %	15.5 %	14.4 %	13.9 %	13.1 %	12.3 %	11.3 %	10.4 %	9.7 %	9.1 %	8.7 %	8.3 %
6th decile	15.8 %	11.7 %	10.7 %	13.0 %	16.9 %	15.7 %	15.1 %	14.3 %	13.4 %	12.3 %	11.3 %	10.6 %	9.9 %	9.4 %	9.0 %
7th decile	15.4 %	10.1 %	11.4 %	9.1 %	11.8 %	10.9 %	10.5 %	9.9 %	9.3 %	8.6 %	7.9 %	7.4 %	6.9 %	6.6 %	6.3 %
8th decile	13.9 %	8.1 %	10.0 %	9.2 %	11.9 %	11.1 %	10.7 %	10.1 %	9.5 %	8.7 %	8.0 %	7.5 %	7.0 %	6.7 %	6.4 %
9th decile	9.8 %	8.1 %	6.8 %	8.3 %	10.7 %	10.0 %	9.6 %	9.1 %	8.5 %	7.8 %	7.2 %	6.7 %	6.3 %	6.0 %	5.7 %
10th decile	8.0 %	6.5 %	7.6 %	6.0 %	7.8 %	7.2 %	7.0 %	6.6 %	6.2 %	5.7 %	5.2 %	4.9 %	4.6 %	4.3 %	4.1 %

Source: Affordability model calculations

6 Discussion and policy implications

The analysis finds that the households in the 1st income decile in Mykolaiv will have a water affordability problem in the future from 2030-2032.

Furthermore, the average household as well as households in income decile 1-8 will experience a heat affordability problem today and in the future. The general affordability problem is due to low incomes for the population. In fact, heat affordability is a problem even for larger cities in Ukraine, including Kiev. In Kiev the average salary is around 20,000 UAH/month while the heating bill in cold months for an average apartment is 2,000-3,000 UAH/month. Thus, on average the population in Kiev also experience a heat affordability problem as their heat bills exceeds the threshold of 10% of their income.[7]

Heat tariffs have been legislatively frozen since the beginning of the state of emergency in Ukraine, starting on the 24th of February 2022, and will be frozen until six months after the end of the state of emergency. Consequently, the current heat tariffs are insufficient to cover the enterprise's costs and only 55% of the costs are covered. At present, the government is not fulfilling its responsibility of covering the difference between the tariffs and the costs. Therefore, the state owes MOTE 495 million UAH as of third quarter of 2023. Based on this information, we can assume that once the state of emergency ends, heating tariffs will increase by at least 50%.[7]

In the analysis we assume that the heat tariffs increase yearly by 6% from 2023-2032. This means that the heat tariffs have increased by 50% by 2030 compared to the tariffs in 2023. If the 50% increase in heat tariffs happens before 2030 the affordability problem will be even larger than suggested by the results in Table 5-6.

Meanwhile the heat tariffs have been frozen the tariffs for other energy sources have not been subject to freezes and are consistently rising.[7]

The affordability results call for policy implications. There are two major types of policy implications when supporting poor households on their heat and water bill:

1 Direct household assistance, and

2 Subsidising the utility companies.

Direct household assistance involves providing cash transfers directly to households which are facing difficulties with affording heat and water. The amount of assistance should be substantial enough for households to achieve affordability ratios below 5% for water and 10% for heat.

In contrast, when utility companies are subsidised, it is the utility companies themselves who receive financial support from the municipality. In these situations, it becomes the responsibility of the utility companies to charge lower tariffs from the households with affordability problems.

To address the issues of water and heat affordability, we propose the implementation of direct household assistance. We do not believe that it is beneficial to have the utility companies

[7] Phone interview with representative of MOTE and consultant's own assessment

distinguishing between households. Additionally, we aim to avoid subsidies, as they often yield unfavourable outcomes.

On November 8th, 2023, the Ukrainian Parliament supported Bill No. 10037 which redirects the income tax of military personnel[8] from the municipality budget to the state budget. From October 1 to December 31, 2023, 50% of the income tax of military personnel will support State Special Communications for drones and 50% will support the Ministry of Defense for the purchase of artillery systems. From January 1 to December 31 in the year that the martial law will be suspended the income tax of military personnel will be distributed as follows: 45% to State Special Communications for drones, 45% to the Ministry of Strategic Industries of Ukraine to produce ammunition and weapons, and 10% to military units on the ground.[9]

The income tax of military personnel was a significant source of money for the local municipality budget. Therefore, the redirection of the tax income will have a large impact on the municipality budget in the future. This can affect the Municipality of Mykolaiv's ability to make substantial and effective direct household assistance to address the affordability problems.

[8] Military personnel include military personnel, police officers and persons of ordinary and commanding staff.

[9] https://babel.ua/en/news/100373-the-parliament-supported-the-redirection-of-the-military-personal-income-tax-the-main-points