SUMMARY OF THE RESEARCH ON HEATING PRACTICES IN THE RESIDENTIAL SECTOR OF NORTH MACEDONIA

Single family houses, which include residential houses and buildings with up to 2 separate apartments constitute large majority (81%) of the housing stock in North Macedonia; the remaining are mostly **collective housing buildings**, i.e. buildings with 3 or more apartments (18%). Almost two thirds of respondents have noted to live in buildings built between 1961 and 1990 (63%). Most buildings were built between 1981-1990 (23%) and 1971-1980 (22%). In buildings built since 1991, lives 24% of the respondents, which is an evident decrease. In houses older than 1961 lives another 7%. The remaining 7% of the respondents were unable to provide an adequate assessment regarding the age of their house and therefore, the share of older buildings is likely to be greater. **Average living area** of households in North Macedonia is 84m^2. **Thermal insulation (facade)** is missing on 18% of the households. The facade is missing more frequently from single-family houses (20%) compared to apartments in collective housing buildings (6%). In terms of statistical regions, households in Northeast region (33%) more often do not have a finished facade, while in Polog (9%) and especially Pelagonia (4%) regions households without facade are rare. Interestingly, 29% of newer buildings, built after 2013[1], do not have a finished facade, which is considerably more frequent than in buildings built in previous decades.

Households in North Macedonia mainly have **PVC joinery** (47%), which is followed by wooden (32%) and aluminum (11%) joinery. Multiple types of joinery can be found on 9% of households, while the remaining 2% households have no joinery. Among the households who have wooden joinery, older wooden joinery accounts for 56%. Although citizens of North Macedonia are generally satisfied (72%) with the quality of their joinery, with 32% being very satisfied and 40% being mostly satisfied, 15% **remains dissatisfied** and 13% neither satisfied nor dissatisfied. However, there are some important exceptions. First of all, significant majority (62%) of users of older wooden joinery are unsatisfied with the quality of their joinery. On the other hand, users of newer wooden joinery (12%), and especially PVC (2%) and aluminum joinery (4%), are far less often dissatisfied with its quality. It should then come as no surprise that dissatisfaction with the quality of joinery is highest in Northeast region (38%), where almost half (48%) of the households have older wooden joinery. In addition, members of single parent households (42%), single households (36%) and socially vulnerable[2] (35%) are in general far more often dissatisfied with the quality of their joinery than citizens on average.

Wood and coal stove is used as the main heating device in the households in North Macedonia more frequently than any other device. More than a third of the households (38%) in the country use these devices as their primary source of heat. **Air-conditioning**, used by 19% of the households, comes second. Room wood or coal heaters (9%), district heating via heating plant (8%), wood and coal boilers (7%), pellet boilers (6%), room pellet heaters (5%) and storage heaters (5%) are also some of the devices/systems which often serve as the main source of heat. Other devices such as electric energy boilers, quartz heaters and heat pumps, are used by the remaining 4% of the households. Solid fuels, which include wood, coal and pellet are being used for heating considerably more, than the other energy

[1] In newer buildings, built after 2013, 6% of the respondents have noted to live in.

[2] "Socially vulnerable" are referred to as citizens who thinking about their household's total income find it "very difficult" or difficult" to make ends meet, namely, to pay for its usual necessary expenses. This is 27% of all respondents.

sources such as electricity and gas. In fact, two thirds of households (66%), use **devices which burn solid fuels** as their main heating device. Citizens who live in single family houses, tend to use wood and coal stoves (44%) and devices which burn solid fuels in general (76%) much more often compared to citizens living in collective housing buildings, who are mostly reliant on district heating (38%) and air-conditioning (31%) for heat. Wood and coal stoves are most often used in the East region (62%), followed by Polog (55%) and Vardar region (54%). Compared to other regions, room wood or coal heaters are most widely used in Southeast region (30%), as well as devices which burn solid fuels (83%) in general. In terms of their share, devices on solid fuels are also very present in regions of Northeast (82%), East (81%), Polog (81%) and Vardar (79%). The usage of wood and coal stoves (15%) and devices on solid fuels (36%) is by far the lowest in Skopje, where citizens most often use air-conditioning (30%) and district heating (26%) as their primary sources of heat. Lastly, socially vulnerable tend to use wood and coal stoves (55%) and devices which burn solid fuels (72%) much more than the average. Majority of the **main heating devices (58%) in households are newer**, meaning not older than 10 years. Between 11 and 20 years of age are 28% of the main heating appliances, while 8% is between 21 and 30 years of age. The remaining 6% percent are older than that. A considerable 41% of households in North Macedonia, **uses more than a single appliance for heating**. The users of district heating via heating plant required additional heating devices (14%) much less compared to users of other devices, especially the ones burning solid fuels. Despite **air-conditioning** being a very popular device for heating in North Macedonia, 45% households do not have them at all. On the other hand, it is used both for cooling and heating by 34% of households, while additional 17% use it only for cooling and 5% only for heating. Single family households (50%) and households in rural areas (56%) do not own air-conditioning devices much more often than apartments in collective housing buildings (19%) and households in city areas (37%). In addition, socially vulnerable (64%) and members of single households (58%) and single parent households (51%) much more often do not have these devices.

In regard to **cooking**, almost a third of households (31%) in the country use the same appliance both for heating and cooking. These are mainly users of stoves on coal and wood, 62% percent of whom, aside from heating, use these devices for cooking as well.

In North Macedonia, 39% of the respondents stated that they are able to **maintain equal levels of heating in several rooms of their household**. On the other hand, majority (52%) of the households heats only the rooms in which the residents spend most of their time, while 9% has a single room which is also the only one being heated. The remaining 0.5% of respondents have claimed not to be able to afford heating at all. The ability to maintain equal heating in several rooms in the household is lowest in single households (19%), single parent households (20%) and in the households of socially vulnerable (29%). It is also low in households which use room wood and coal heaters (18%) and wood and coal stoves (23%) as their main heating appliances. Users of district heating system (95%) and pellet boilers (79%) are much more successful in maintaining equal levels of warmth in several rooms in the household.

Despite heating only a part of the household, large majority of the respondents in North Macedonia are very (31%) and mostly (49%) **satisfied with quality of their heating**, while 7% are dissatisfied. The remaining 13% are neither satisfied nor dissatisfied. Members of single parent households (16%), single

parent (13%), socially vulnerable (13%) and respondents with lower levels of education[3] (10%) are dissatisfied with the quality of their heating far more often. This is also the case with members of households without a finished facade (16%) and with older wooden joinery (14%). **The quality of air** is perceived by respondents in North Macedonia as very (30%) and mostly (49%) satisfying, while for 8% it is dissatisfying. Again, 13% of the respondents are neither satisfied nor dissatisfied.

The most **affordable energy source for heating**, in opinion citizens of North Macedonia is wood (38%), followed by electricity (22%). Pellet and gas are seen as the most affordable by 14% of the respondents each, while another 3% see coal as the cheapest alternative. Other energy sources were selected by 2% of the respondents, while 8% could not provide an assessment. **Wood is widely used in North Macedonia**, with 60% of households consuming it for heating. Households in rural areas (73%) use it much more frequently than households in city areas (49%). The regions in which wood is consumed by the highest percentage of households includes East (82%), Vardar (76%), Southeast (75%) and Northeast (72%). In Skopje, on the other hand, only 34% of households consume wood. Despite wide consumption, large majority of wood burned is inadequately dried, which leads to greater air-pollution, worsening public health and decreased thermal comfort. Among the households which use firewood, a third (34%) **has not acquired it for the upcoming heating season** by the end of August 2021. In addition, 44% of the respondents with experience of burning wood have shown **insufficient knowledge in regard to what type of firewood should be used**. When asked about the best type of firewood for consumption, these citizens stated that it is wood dried for 2-3 months after cutting (22%), dried for 2-3 weeks after cutting (6%), fresh (4%) or that they do not know (12%). The correct answers, given by prevailing 56% of the respondents, were wood dried for more than 6 months (32%) and dry wood, which was dried for more than a year (24%).

When it comes to **willingness to replace their current heating appliance**, most of the respondents (53%) in North Macedonia are opposed to such idea. The main reasons they stated are that their current appliance heats well (41%), that they already have a new and modern device (36%), that they have that appliance for a long time (20%) and that they could not afford replacement (17%). On the other hand, **40% of the respondents would be interested in replacing their main heating appliance**. The most frequent reasons mentioned by these respondents were that the appliance in use requires too much work to operate (53%), that it is outdated (34%), that the cost of operating the current device is too big (23%), and that it does not provide adequate heat (18%). Out of citizens interested in replacing their device, 74% would **pursue replacement only if they were to receive financial assistance**. It should be noted that 7% of respondents were unable to provide an answer on whether they would change their device. The respondents whose main heating appliance is wood and coal stove (54%) or a room wood and coal heater (53%) are especially interested in replacing their device. On the other hand, citizens who use air-conditioning (28%) and especially pellet boilers (10%) and district heating (10%) are far less interested in a potential replacement.

If there was an option to take out **a loan in order to replace the heating device** in the household, large majority of the citizens in North Macedonia (78%) would not be interested in it. While 64% would

[3] Respondents with lower levels of education are the ones who only have completed elementary education or lower than that. This is 17% of total respondents covered through the survey.

oppose to taking out this loan in general, 14% would not want because they see their appliances as efficient enough. Only 13% of respondents would be interested in such a loan. In addition, 9% of respondents were unable to provide an answer on the spot.

When choosing their heating device, citizens of North Macedonia remain very constrained by **inadequate financial resources**. In fact, if they were forced to change their heating appliance, almost a third (31%) would not be able to afford a new one at all. The most frequently stated price ranges are also the lowest ones: up to 300 Euros (16%), from 301 to 500 Euros (19%) and from 501 to 1000 Euros (13%). The devices in the price range of 1001 to 1500 Euros could afford 4% of the respondents, while additional 2% could afford devices in the price range of 1501 to 3000 Euros. Devices more expensive than 3001 Euros, would be affordable to only 0.6% of the respondents. The remaining 15% of the respondents could not provide an assessment. The groups which are at the biggest risk in this regard are members of single parent (53%) and single (52%) households, as well as socially vulnerable in general (50%), as they are much more often unable to afford new heating devices. More vulnerable in this regard are also households in rural communities (36%) compared to ones in city areas (26%), as well as residents of regions of Pelagonia (40%), Polog (39%), Northeast (38%) and Southwest (36%) compared to other ones.

If a system of support were to be established, it should mainly target users of devices which burn solid fuels such as wood and coal in order to alleviate the negative effects of their consumption, but also because the energy poor tend to use these devices more frequently. For such a supporting schemes to function, **obsolete devices need to be effectively removed from use and eventually from the market**. This would entail that households which would receive financial assistance in purchasing a new device, would have to give up on their old device. This measure would not pose a problem to the successful implementation of the replacement scheme as only 24% of respondents who burns solid fuels for heating, would oppose handing out their old device. On the other hand, 57% would say yes to the replacement under this condition, while 18% of the potential beneficiaries were unable to provide an answer on the spot.

In regard to their **familiarity with some advanced heating technologies**, citizens of North Macedonia are very well aware of **inverter-air conditioning**. Only 16% of the respondents stated that they had little to no knowledge[4] about them. On the other hand, large majority of the public has not been acquainted with **heat pumps**. In fact, 67% of the respondents, meaning two thirds, stated that they had little to no knowledge about them. Less familiar with both inverter air-conditioning and heat pumps are on average citizens with lower levels of education (40% and 81%), older citizens, especially the ones over 65 years (32% and 82%) and socially vulnerable (28% and 80%) in general. In addition, women (20% and 75%) stated more frequently they are not familiar with these technologies compared to men (12% and 59%).

Among the citizens interested in replacing their main heating devices, there are **two types of devices/heating systems which are the most popular alternatives** for citizens of North Macedonia. These include the previously mentioned inverter air-conditioning (37%) and district heating systems

[4] This included responses “does not know, cannot assess”, “not at all” and “little”. Respondents who stated “moderately”, “well” and “excellent” were not included in the count.

(29%). Very popular are also gas heating systems (21%) and heat pumps (17%). Pellet boilers (16%), pellet stoves (12%) and modern wood and coal stoves (12%) follow. Less popular alternatives among citizens interested in replacing their heating devices include electricity heating (10%) and modern wood and coal boilers (6%). When respondents interested in replacement were asked to **select only one device which they would agree to replace their current main heating device with, regardless of the cost**, district heating system (24%) came first, followed by inverter air-conditioning (22%). Heat pumps (11%), pellet boilers (9%), gas heating (8%) were also stated often.

The greatest amount of **trust, when it comes to influencing their decision about potential appliance replacement**, citizens have in word of mouth, i.e. family and friends (56%). Appliance manufacturers and vendors (24%), doctors (15%), neighbors (13%) and representatives of public institutions (10%) follow. Local energy managers (9%), media (8%), professors and academic community and (3%) other stakeholder groups such as politicians and non-governmental organizations are seen as less influential.

No other information illustrates better the need for subsidizing the replacement scheme than the fact that almost a quarter (23%) of households **has never changed their main heating device**. On the other hand, households which did introduce a new device, in most cases kept the old device (28%) or sold or gave it to another person (19%). Of those who kept them, 22% continues to use them occasionally. This entails that even when households in North Macedonia change their main heating device, they often do not remove the old ones from use, which highlights the need to confiscate them when implementing replacement schemes. Other respondents sold their device to scrap metal (15%), took them for recycling (3%) and saved money through purchase of new devices by replacing the old ones (1%). It should be noted that 10% of respondents could not remember what they did with the previous device.

Exposure to different forms of air pollution in households and in the open can have adverse health effects. Large contributor to air pollution, but mainly particulate matter in the region are individual heating devices which burn solid fuels. While the whole society is exposed to harmful effects of ambient air pollution, the members of households which burn solid fuels are even more vulnerable due to indoor pollution. **Average time spent daily by members of households which burn solid fuels in a room with the heating device** is approximately 8 hours and 40 minutes. At the same time, members of almost half of the households (49%) spends more than 8 hours in a room with such a heater. Additional 39% spends between 4 and 8 hours per day. Members of 9% of the households which burn solid fuels, spend between 1 and 4 hours, while up to one hour 3%. In 47% of households which use solid fuels for heating, family members **sleep in a room with these heaters**. This is a more often practice in households of socially vulnerable (74%), single households (65%) and single parent households (63%). Small percentage of respondents (2%) who use solid fuels for heating does not **ventilate their rooms orderly**, compared to 73% which does so often.

Almost two thirds (65%) of respondents do not believe that their **heating practices can harm their health and health of their family members** and another 20% believes it has only a negligible impact. Moderate and severe impacts on health are recognized by 12% and 3% of respondents respectively. Especially worrisome is that 61% of users room wood and coal stoves and heaters, who are especially exposed to indoor air-pollution denounce completely their negative effects. In terms of advice received, only 5% of respondents have claimed to have gotten some sort of **warning from their doctor** about

possible adverse effects of their heating practices to their health. Majority of respondents (94%) have never been in a situation to **burn plastic, rubber and fabric** for heating purposes. Most (92%) of them are also **aware of the severe consequences** on health, associated with exposure to their burning.

Lastly, citizens of North Macedonia perceive coal (48%) to be the **greatest polluter among different energy sources**. Liquid fuels, namely, diesel (22%) and gasoline (9%) follow. Gas (5%), wood (5%) and pellet (2%) are seen as greatest polluters, by a much small percentage of respondents. The remaining 9% could not provide an assessment.