

Heating. Panasonic Air Heat Pumps Practical Operation, Season 2013/2014



PR Photo

Over the last years in Latvia and all over the world rapidly increase in price energy supplies. Runs up cost of oil and gas, diesel fuel, electricity. Even price of fire wood is increasing. It is reflected on Figure 1, showing change of cost for heat, produced by means of different energy supplies over 11 recent years. (1 st = 1,4 € cent)

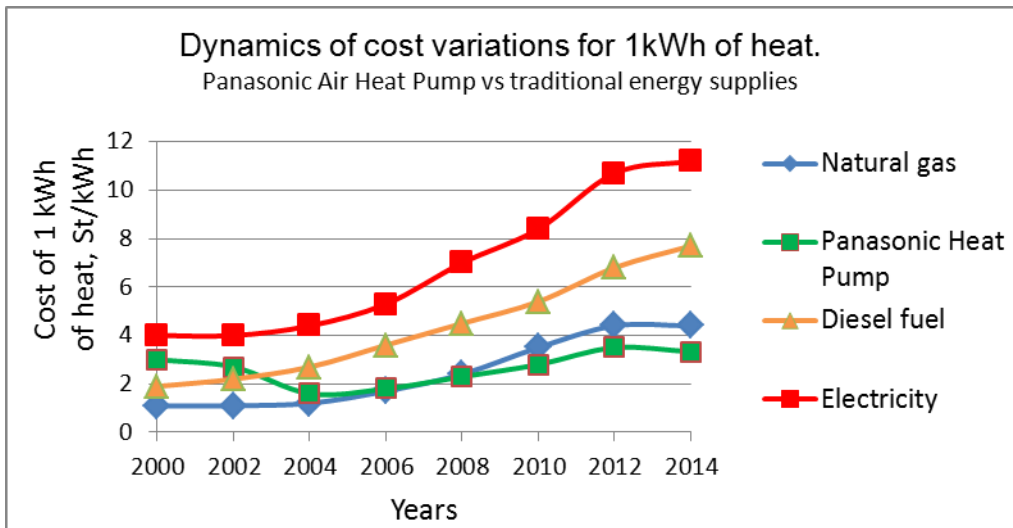


Figure 1

This situation experienced almost every Latvian family. Cost of heating makes significant share of family budget.

This is the reason why many Latvian people use cost efficient *Panasonic* Heat Pump as the main heating system.

Some Background

Highly efficient Panasonic NORDIC Inverter Heat Pumps air-to-air were introduced in 2000-2002. Immediately they become very popular in countries of Scandinavia – Norway, Sweden and Finland.

The point is – traditionally in these countries was accepted electrical heating. But installation of Panasonic NORDIC Heat Pump allowed cut cost of heating (which with rise of tariffs is increasing continuously) by 2,5 – 3 times.

As the result, thrifty Scandinavian people during 10 recent years purchase 100 000 pieces of Panasonic NORDIC per year.

In 2010, based on deep experience (Panasonic sell air-to-water heat pumps in Japan from 1973!), the company offered European customers conceptually new heat pumps of air-to-water type AQUAREA: more than 60 models of output from 7 to 16 kW with efficiency coefficient COP reaching even 4.67. The year around these heat pumps provide hot water for household as well as shower/bath. It should be underlined - such heat pumps efficiently and reliably operate at outdoor air temperature -20°C . For such severe conditions Panasonic provide heat pumps with 5 years warranty.

In autumn 2010 “RIKON AC” Company installed the first Panasonic AQUAREA Heat Pump with output of 9 kW (Engure). In addition installation was equipped with heat and electric meters for evaluation of efficiency of heat pump operation in real winter conditions. The same time there was started another long-time test in Jaunsishi settlement, where were installed 70 houses of the same type (manufacturer SUPER BEBRIS Ltd.) (86 m²) provided with electrical heating system. In one of the houses there was installed Panasonic NE12 NORDIC Heat Pump. The aim was comparison of real heating costs at heating by means of Panasonic NORDIC Heat Pump and electrical heating system in Season 2010/2011.

We would like to indicate: for efficiency evaluation of heat pumps there are used two coefficients:

- COP (ratio of heat gained to consumed electric power at fixed outdoor temperature);
- SPF (ratio of heat gained during season (Or set time period) to consumed electric power per set period).

As outdoor temperature vary continuously, more realistic indication of heat pump efficiency per season (period) provides SPF coefficient.

On the basis of the test results for the first time in Latvia there was determined average coefficient of efficiency for heat pump (SPF, air-to-air and air-to-water) in real conditions of operation (Winter 2010/2011). (And next year in Jaunsishi settlement there were installed more than 30 Panasonic NORDIC Heat Pumps).

The test results are provided in article [“Air-thermal Heat Pump – Optimal Heating System Theory and practice of system method”](#). (DELFI; 10.10.2011.).

There was found, that real SPF values of Panasonic Heat Pumps may reach 2.9 – 3.2. At that moment (2011) this provided saving of 10 – 15% in comparison with gas heating, and is by 1.9 times cheaper than diesel fuel heating (and by 2.9 – 3.2 times cheaper than electrical heating!).

Conclusion: after Season 2010/2011 – Air-thermal (air) Panasonic Heat Pump – ambitious heating system for conditions of Latvia.

During summer 2011 there were installed more than 30 models of Panasonic AQUAREA air-to-water in houses with area of 70 to 400 m². For every installation there were measured:

- Electricity consumption (Power).
- Consumption of heating media by heating system.
- Produced heat power.

Every installed heat pump was equipped with electric meter. Several houses were equipped with heat meters. Results are provided in article of „RIKON AC” Company [„Practical Operation of air-to-water Panasonic Heat Pumps, Season 2011/2012”](#) (DELFI; 15.10.2012.). In Figure 2 there are shown real variations of COP depending on outdoor temperature for air-to-water Panasonic AQUAREA Heat Pumps.

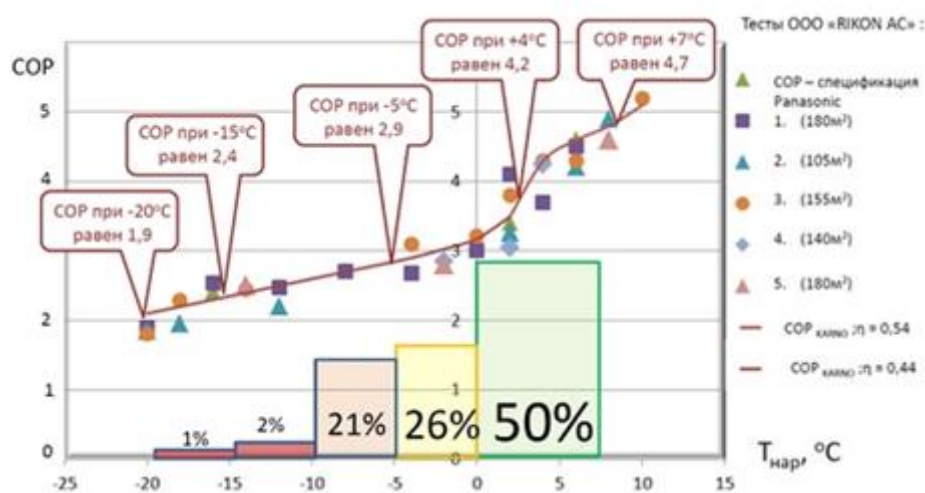


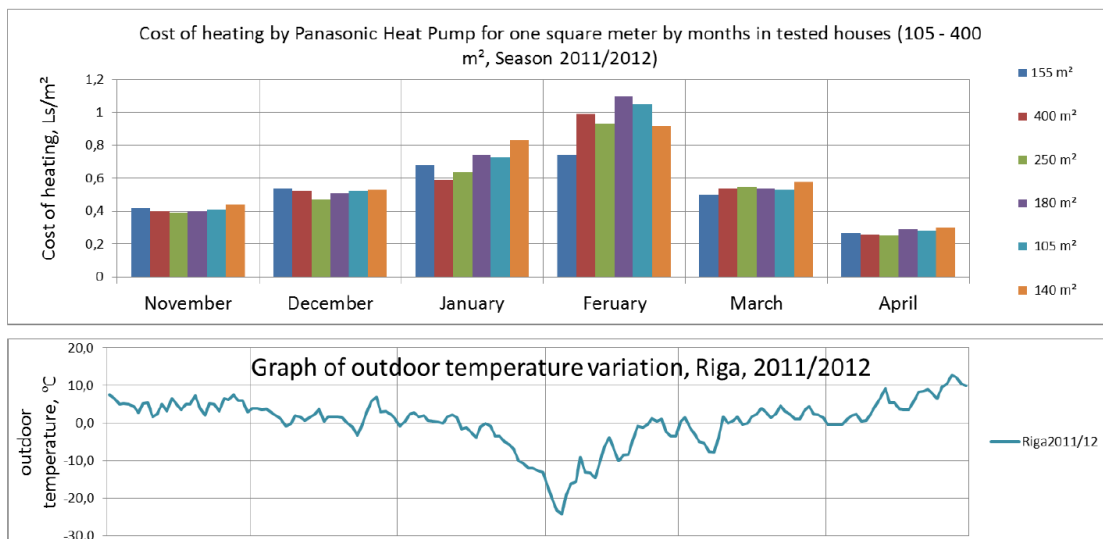
Figure 2 – Tests of “RIKON AC” Company

On the basis of gained practical results there was made a number of conclusions supporting feasibility of application of Panasonic Heat Pumps as heating systems.

1. Really confirmed high values of COP = 4.2 – 5.0 in temperature range +4 - +10°C (temperature of heating media 28°C - 35°C), indicating high engineering level of Panasonic AQUAREA air pumps (total efficiency factor in relation to for Carnot cycle – up to 54%!), Fig. 2.
2. At -15°C real value of COP = 2.4 – 2.5 is in accordance with Panasonic specification (temperature of heating media 40°C - 45°C).
3. There were gained real values of COP at -20°C! (First week of February 2012). There was found, that at -20°C really measured COP = 1.9 – 2.0 (!). So, even at temperature of -20°C Panasonic AQUAREA Heat Pump still by two times is more efficient than electrical heating and for 10% more economical than diesel fuel heating.

As well, in Season 2011/2012 there was accomplished complex research on optimization of AQUAREA Heat Pumps agreement with heating systems of different type and different pipe-fitting patterns of boiler house. As the result of this research there were developed bivalent configurations of Panasonic AQUAREA connecting, allowing efficient application of heat pump taking in to account features of certain house and Latvian climate.

There was made comparison of real operation costs (on every Panasonic AQUAREA unit was installed electric meter) and cost of district heating provided by AS “Rīgas Siltums” for standard apartment in Riga (Purvciems) (Figure.3a). There was confirmed real saving of 35 – 40%.

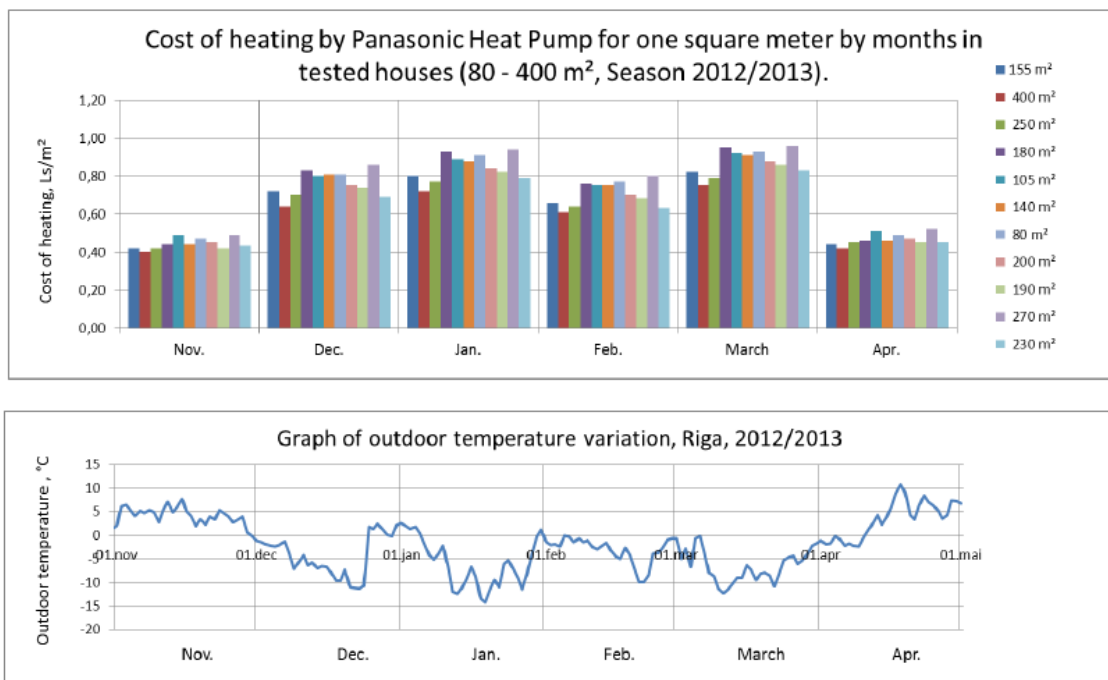


Season 2011/2012	November	December	January	February	Martc	April	Total	Monthly average
Average cost of heating, LVL/m ²	0,4	0,5	0,7	0,95	0,55	0,25	3,35	0,56 Ls/m² (5,3KW/m2)

For compare:

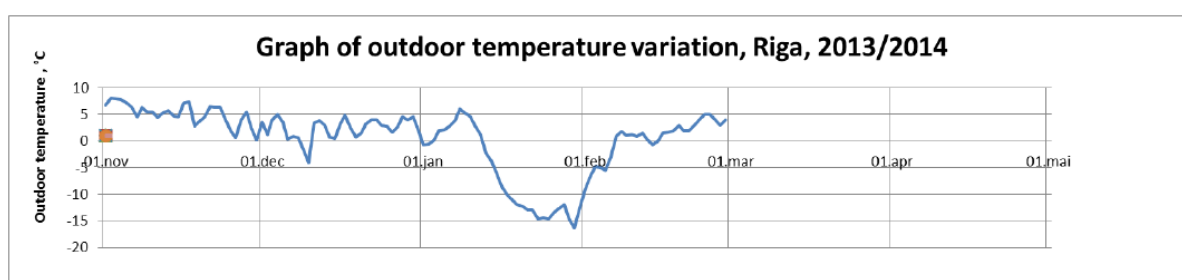
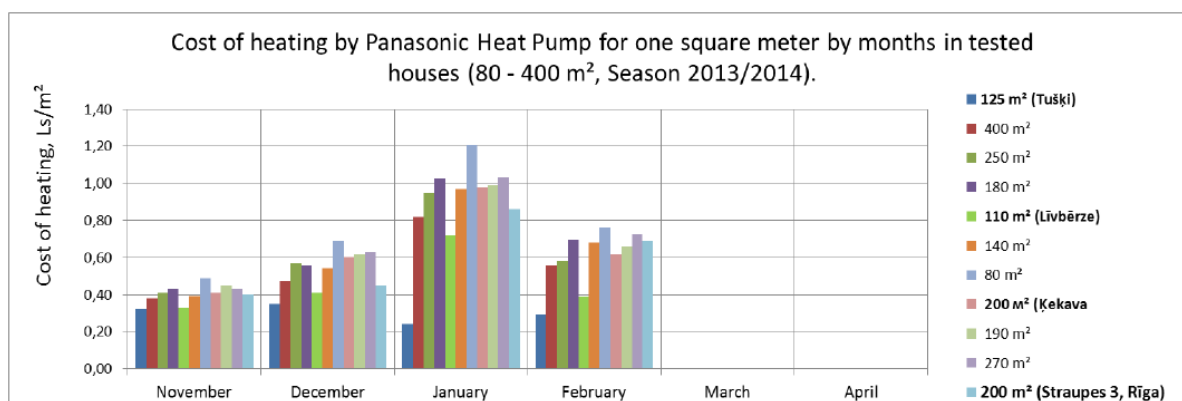
Season 2011/2012	November	December	January	February	Martc	April	Total	Monthly average
Cost of district heating provided by AS "Rigas siltums", Zolitude, LVL/m ²	0,67	0,86	1,23	1,36	0,81	0,38	5,31	0,88 Ls/m² (8,3KW/m2)

Figure 3a



Season 2011/2012	November	December	January	February	March	Aplir	Total	Monthly average
Average cost of heating, Ls/m ²	0,44	0,76	0,84	0,70	0,87	0,47	0,68	0,68 Ls/m²(6,4kw/m²)

Figure 3b



Season 2013/2014	November	December	January	February	March	Aplir	Total	Monthly average
Average cost of heating, LVL/m ²	0,40	0,54	0,89	0,60				0,61 Ls/m ² (5,89 kW/m ²)

Figure 3c

On the basis of operation of more than 30 installations there was made important conclusion on reliability and efficiency of Panasonic AQUAREA operation, including operation at very low outdoor temperatures of -20°C.

In 2012 Panasonic, on the basis of deep experience in development of NORDIC heat pumps for Scandinavia, introduced new models of air-to water heat pumps AQUAREA T-CAP (Total capacity) – especially designed models for cold climate.

In these models was implemented a number of innovations for improvement of operation efficiency at low temperatures:

1. Highly efficient twin-rotor compressors with increased power and compression rate at low temperatures.
2. Microprocessor system of compressor speed control Inverter+, allowing significantly increase power at lowered temperatures.
3. Sub-cooler with electronic control system for improvement of efficiency of thermodynamic cycle at low temperatures.
4. Intelligent defrost system (on condition), taking into account outdoor temperature and humidity of environment air, optimizing loss for defrost at low temperatures.
5. And, of course, traditional quality and reliability of Panasonic products.

Thanks to these innovations AQUAREA T-CAP Heat Pumps maintain maximum heat power up to -15°, but range of efficient operation expanded up to -28°!

In article of [“RIKON AC” Company „Heating. Panasonic Air Heat Pumps — Proper Option for Latvian Winter”](#) (DELFI; 14.10.2013.) there are described advantages of these models. It is shown - for Latvia it is reasonable to choose air heat pump designed for operation at low temperatures.

Respectfully, for customer of heat pump in Latvia it is not interesting a heat pump output at +7°C, then the house needs not so much heat, but at least at -15°C (and at this temperature compare characteristics and prices of models from different manufacturers!).

Of course, if manufacturer provide data on operation at low temperatures. If there is no such data most probably this model of heat pump made for South Europe or even for warming up water in pool in summer time, but in climate of Latvia it cannot operate efficiently!

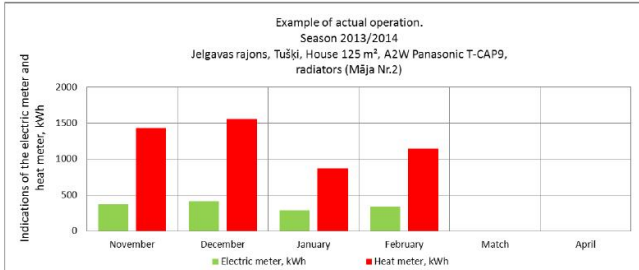
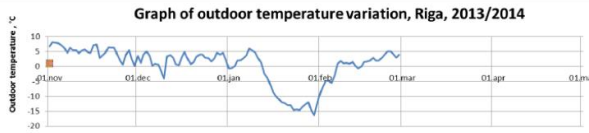
Results of operation of new models in Season 2013/2014 are presented on Figure 4, Figure 5, and Figure 6.



Figure 4 .Home No.1.

Heat insulated house of light-frame construction (125 m²), Elgavas district, Tushki

- ✓ There are living four persons
- ✓ Elements of heating – radiators
- ✓ Heating system – Panasonic SXF09D3E5/UX09DE5 Heat Pump
- Bivalent component – integrated in the system solid-fired boiler



	November	Denember	January	February	March	April	Total	Monthly average
Electric meter, kWh	374	417	284	334			1409	352 kWh
Heat meter, kWh	1433	1561	870	1148			5012	1253 kWh
SPF	3,83	3,74	3,06	3,4			3,56*	* - average per season
EUR (Ls) / month	57 (40)	63 (44)	43 (30)	51 (36)			214 EUR (150 Ls)	54 EUR (38 Ls)

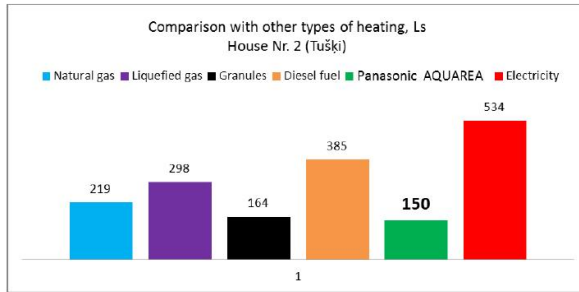
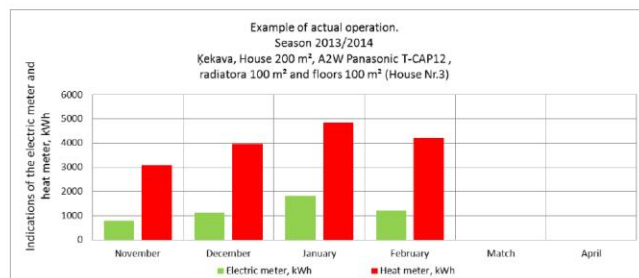


Figure 5.Home №.2.

New building (200 m²), Kekava

- ✓ There are living three persons
- ✓ Elements of heating – under floor heating + radiators
- ✓ Heating system – Panasonic SXF12D6E5/UX12DES Heat Pump
- Bivalent component – integrated in the system chimney with water jacket



	November	Denember	January	February	March	April	Total	Monthly average
Electric meter, kWh	798	1138	1831	1233			5000	1250 kWh
Heat meter, kWh	3094	3963	4852	4205			16114	4028 kWh
SPF	3,88	3,48	2,65	3,4			3,22*	* - average per season
EUR (Ls) / month	121 (85)	172 (121)	277 (195)	186 (131)			756 EUR (531 Ls)	189 EUR (133 Ls)

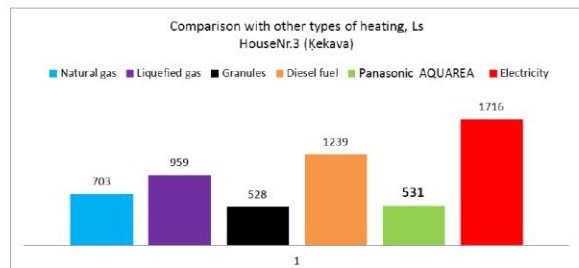


Figure 6.Home №.3.

There were selected 3 typical houses:

House No.1 (Livberze): New house of light-frame construction with very good heat insulation (110 m²), manufactured by Livas grupa Ltd.. Under floor heating - 100 m² (Figure 4).

There is installed Panasonic AQUAREA MDF06 Heat Pump (6 kW). Bivalent component – electric heat element (actually not used). There is living young family with two small children. So, it leads to increased consumption of hot water.

House No. 2 (Jelgavas district, Tushki): Renovated house (125 m²). Radiator hot-water heating (Figure. 5).

There is installed Panasonic AQUAREA SXF09 heat pump (9 kW). Bivalent component – integrated in the system solid-fired boiler. There are living 2 persons.

House No. 3 (Kekava): New building (200 m²). Ground floor – under floor heating, 1 floor – radiators (Figure. 6).

There is installed Panasonic AQUAREA SXF12 (12 kW) Heat Pump. Bivalent component – integrated in the system chimney with water jacket. There is leaving family with a small child.

Every heat pump was equipped with heat and electric meters.

Results of experiments speak for themselves: operation costs indeed are very small!

Some comments:

The House No. 1 (Figure 4). Not so high value of SPF = 2.9 (At the moment!) is due to increased consumption of hot water at low cost of heating (House of Livas grupa Ltd. is warm indeed). It is clear, that during 2 remaining months and summer SPF value will increase significantly.

However, even now average cost of heating and hot water is only of 50 LVL per winter month for house of 110 m² - it is really excellent!

The House No. 2 (Figure 5). Outstanding result SPF = 3.56, of course, not only due to usage of newest model AQUAREA T-CAP and small hot water consumption (There are leaving 1 – 2 adults). At coldest 2 weeks of January there was used integrated in the system fire-wood boiler and allowed to save at small additional expenditures. So, there is gained record average cost of 38 LVL per month.

And, by the end, full size house of 200 m² in Kekava (The House No. 3, Fig. 6). During four months already gained high coefficient SPF = 3.22, which by the end of the season will raise (And continues grown during whole summer: in summer air heat pump produces hot water at COP ≈ 4(!), result we will see in October!). Costs made 133 LVL per month or 531 LVL for four months. Would owner use gas, it should cost him 700 LVL. But at usage of granules – he would save 1 LVL per month! And for these 4 months it would be necessary to process more than 4 t of granules and several tons during remaining time. Plus evacuation and utilization of ash and not efficient granules usage in summer time.

But in case of Panasonic there were consumed about 100 kg of briquettes for chimney in cold January and, if required only (Output of T-CAP12 was sufficient for house even in coldest days), but chimney for fun and some saving!

Of course, this year winter was sufficiently warm, however, in January there was cold more than 2 weeks with temperature at night time down to -20; -22°.

All three houses successfully handled this cold by means of heat pumps only. Bivalent system was used in the House No. 2 and No. 3 for improvement of cost efficiency.

In general, average cost of heating per square meter of heated area in Season 2013/2014 (November – February) made 0.61 LVL/m². Season not ended now, there are remaining March and April, in total we are looking for 0.5 – 0.55 LVL/m² (See Fig. 3c).

This winter is similar to winter of 2011/2012, where cold was in February only and average monthly cost of heating made 0.56 LVL/m² (See Fig. 3a).

For comparison: last cold winter (snow covered the ground till the end of April) average cost of heating was 0.68 LVL/m² per month (See Fig.3b).

In total, data for three recent seasons is very similar, so there is confirmed high economic efficiency and reliability of Panasonic AQUAREA Heat Pumps for long period. Indeed, average cost of heating and hot water preparation (on the basis of data for three seasons) is of 0.5 – 0.68 LVL/m² per month, and depending on winter for typical house (with area, for example, 160 m²) makes 80 - 110 LVL for winter month, and is cheaper than main-line gas, diesel fuel and approximately equal to the cost granules heating (But without need of processing of 4.5 tons of granules for house of 160 m²!).

As we believe, it may be concluded: operation of Panasonic Air Heat Pumps in Latvia during recent 14 years completely proved their reliability, efficiency and economic effect in comparison with other types of heating!

Of course, it is necessary to take into account the fact, that these outstanding results become possible not only due to the best in industry Panasonic AQUAREA Heat Pumps, but also thanks to great research work of „RIKON AC” Company during last 12 years on improvement of air heat pumps operation in Latvia; and development by “RIKON AC” Company integral bivalent configurations of heat pump connection for optimal agreement of Panasonic AQUAREA with heating systems of different type for weather conditions of Latvia.

And finally, probably, significant is that this is made by people who before were involved in research in area of thermodynamics, gas dynamics, ecology, reliability and diagnosis of engines for airspace vehicles:

- Doctor of Science in Engineering Andrey Sipkevich;
- Doctor of Science in Engineering Andris Dancigs;
- Doctor of Science in Engineering Aleksandr Filipov.

More details on activities of “RIKON AC” Company one may find in article [“Enterprise „RIKON AC” – the Most Successful Pioneer of Alternative Heating in Latvia., In Latvian – “Uzņēmums „RIKON AC” – veiksmīgākais no alternatīvās apkures celmlaužiem Latvijā”](#) (DELFI; 26.11.2013), which was prepared by construction site [BUILDING.LV](#).

More detailed introduction of Panasonic NORDIC и AQUAREA T-CAP Heat Pumps model range and get any required consultation one may get on show-bench of "RIKON AC" Company on Exhibition "Māja I 2014"/"Home I 2014" (13.-16.03.2014), as well as in full-time operating Panasonic show-room at address: Riga, Straupes Street 3, phone 67310975 or on www.gaiss-udens.lv, www.siltumpumpis.lv.

Material was prepared by “RIKON AC” Company, official Panasonic dealer for heat pumps and air conditioners, as well as authorized service center in Latvia.