VALMIERA

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"Methods and measures to enhance resilience against electric power outage in urban vital societal functions"

MEREPUV

Summary of vulnerability assessment from Valmiera

Deliverable no: 4.1 Valmiera

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1. Introduction

This assessment was prepared for the project "Methods and measures to enhance resilience against electric power outage in urban vital societal functions"; MEREPUV; 783153 — MEREPUV — UCPM-2017-PP-AG and co-funded by European Union Civil Protection finance instrument.

The main goals of the project:

- Evaluate the main risks regarding the possible effects of power outage in the city as well as the direct and indirect consequences to the healthcare services
- Prepare city risk and vulnerability assessment

Achievements of the project:

- For the project. Final assessment about the impacts of power outage to the provision of healthcare services including the evaluation of the severe consequences that the local citizens will face in case of disturbed healthcare services.
- For the city. Identification of the vital methods and measures to enhance cities resilience and persistence against power outage in order to provide the essential city functions.

2. Methodology and data collection

Regarding the project partner agreement the final assessment is made in the form of so called bow tie model which is adapted and specialized regarding the project goals, research object and the main topical questions that are evaluated in the final assessment.

The final methodological model includes these risk evaluation elements:

- Probability
- Vulnerability
- Consequences
- Uncertainly

Additional evaluation:

- Management. To what extent and what methods are available that would lower the risk possibility and vulnerability in the chosen scenarios?
- Transferability. To what extent these methods, measures and assessment results are transferable to other cities?

The analytical object of this project is the vulnerability of the health care services.

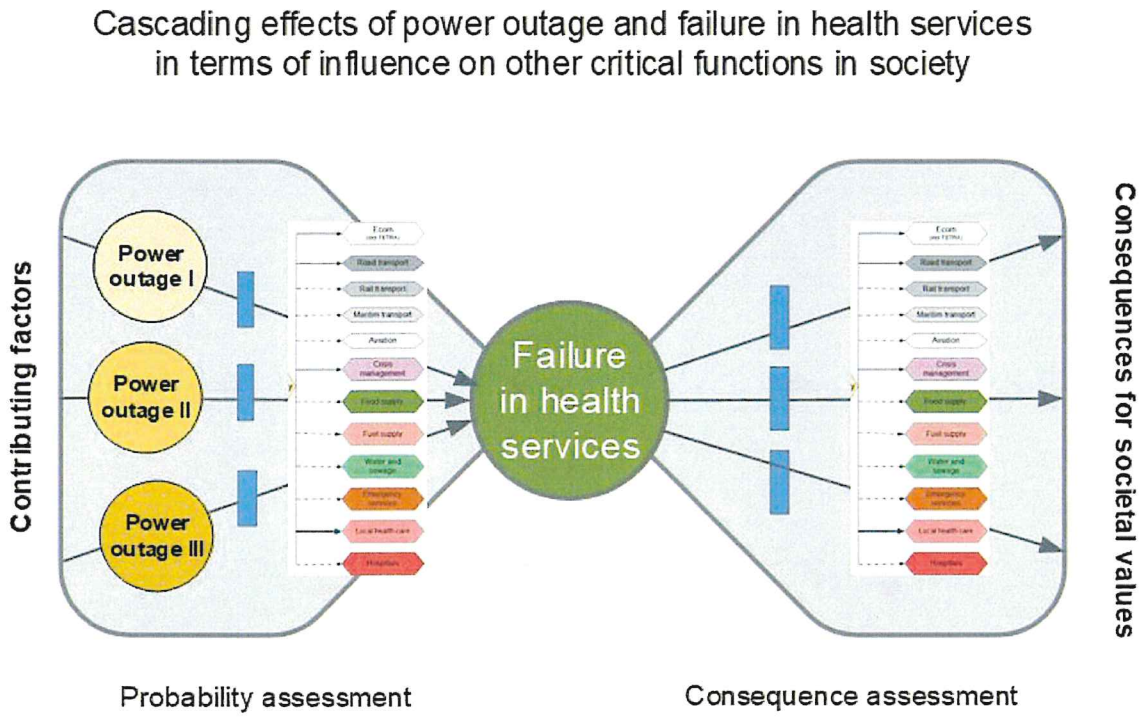

Figure 1. Impacts of power outage and related problems in health care system to other important functions of the society.

Development of the scenarios

Four scenarios were chosen in the project based on the duration of the power outage:

- Scenario 1: Electrical power outage 24 hours
- Scenario 2: Electrical power outage 74 hours
- Scenario 3: Electrical power outage 1 week
- Scenario 4: Electrical power outage 1 month

3. System description of the analytical object (health services)

Evaluation analysis object is the provision of healthcare services in Valmiera city.
Valmiera city healthcare service system consists of:

- Primary healthcare - general practitioners (GPs);
- Secondary healthcare – multi profile regional hospital «Vidzeme Hospital»;
- Emergency Medical Service - Emergency Medical Service provides the first emergency care and delivery to the regional hospital;
- Valmiera nursing home – daily care of seniors;
- Ambulatory (outpatient) care facilities – doctor, specialist private practitioners;

- Home care – medical manipulations done in patient's place of residence

Based on the importance of the elements included in our health care system as well as the emergency and ambulatory services provided, evaluation assessment about the power outage impacts to the healthcare system will be done for the main regional hospital "Vidzeme Hospital".

"Vidzeme Hospital" is multi profile regional hospital and Emergency Medical institution where the most important services of the whole region are concentrated. This includes both – the ambulatory or outpatient care (General practitioners, doctors – specialists) and stationary care (stationary, emergency medical services, operation facilities).

The assessment does not include the impacts of power outage to the medical home care manipulations because the kind of services is not very common in Valmiera.

"Vidzeme Hospital" as healthcare service works regarding the Latvian Medical Treatment Law second part of Section 54 - Medical treatment institutions may be outpatient institutions where patients, if placement in a hospital is not necessary, are provided with medical treatment services, and hospitals where patients who are under constant 24-hour care of medical practitioners are provided with emergency medical assistance, diagnosis and medical treatment services until a specific level of medical treatment is reached.

Regarding the 13.12.2011. Cabinet of Ministers requirements Nr. 948 "Organisational rules for catastrophe medicine system", "Vidzeme Hospital" as medical institution is included in the catastrophe medicine system with the commitment that in the case of situations of medical catastrophes or other emergency public health issues, it will provide the catastrophe medicine system with all their resources.

"Vidzeme Hospital" can provide healthcare services for the whole region with 240 000 inhabitants.

4. Results of the assessment of power outage

4.1. Scenario 1: Electrical power outage 24 hours

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as low: 10-40 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Water supply

Water supply system pipes are equipped with generators that are able to provide fully functioning water supply system for 24 hours. Water purification system has additional diesel generators that can provide its functioning. Water abstraction pumps are not supplied with additional power sources which results in the fact that drinkable water will only be available from the water container which could provide the city with drinkable water for 24 hours.

Heat production

In the case of power outage to the city, heat production would be interrupted because of the block of the pipe operation including boiler houses and circulating heat networks. In result of inertia, heat supplement would be available in the heat networks for two hours. In case the temperature would be less than -10 degrees Celsius, heat networks would freeze in 24 hours.

Provision of public transport. Fuel availability.

It is possible to provide the public transportation system with the available fuel. There are no additional emergency situation fuel reserves available for the city. Fuel tanks are equipped with generators to provide the functioning of the pumps. In addition it is possible to connect the generator from the technical help truck.

Provision of public order.

Valmiera Municipal police is responsible for the functioning of Operative Information centre, public order and, if necessary, informative function for the local inhabitants. In the

case of power outage the functioning of Valmiera Municipal police will be interrupted by the outage of fuel for the operative transportation, the limited communication opportunities (phones and walkie-talkies will be available only till the end of current charge) and disruption of the video surveillance system.

Impact on health services

"Vidzeme Hospital" is equipped with two power input lines (total power supplement 2400 kW) that can replace each other. In the case of one local power disruption, all the necessary power can be supplied from the other power input line. In case of more immense power supplement emergency – electro energy is not provided to the hospital.

The existing uninterruptible power supply blocks (UPS systems) would be able to provide the functioning of the most necessary medical equipment with the necessary power only up till two hours.

"Vidzeme Hospital" is equipped with diesel generator (300 kW) with 12 hours working time taking into account the available fuel reserves. This generator would provide the functioning of intensive care department, resuscitation department and children care department. The fact that these departments have experienced several important reconstructions must be taken into account because the diesel generators have not been tested since their installation so it is not that reliable source. The testing process of these diesel generators is almost impossible because of the fact that the hospital is treating patients 24/7.

The generator could provide the necessary light equipment in selected departments of the hospital as well as the functioning of some of the medical appliances. It must be taken into account that full light equipment will not be provided in all the hospital as well as the functioning of elevators and operating of inner water and heat supplement system.

In the case of power outage there are some additional diesel generators available at Valmiera city for example at Power Distribution network or SFRS. It would be necessary to provide "Vidzeme Hospital" with additional generator connection points as well as to install a separate power wiring.

Power outage would have a significant impact not only to the medical appliances but also to other critically important fields:

- Catering. Food reserves are strategically made for a week (Food is supplied to hospital once in a week). It is stored in freezers which would stop working after the case of power outage. The cooking processes wouldn't be possible because the main source of energy for most of the technological appliances in the kitchen is electricity. Critically important will be necessity for the hot water.

- Communication. Inner communication at "Vidzeme Hospital" would be provided using the fixed inner phone networks. Mobile and other communication would depend on the national mobile network activities.
- Heat. The outside heat supplement system in case of lower temperature then -10 Celsius will freeze in 24 hours. The inner circulation will not be provided. In winter, if the power supply is not restored within 24 hours, the hospital will need to be evacuated.
- Autonomous heating system is not installed.
- Transportation. The provision of transport services are related to the inner fuel reserves. Of course, the availability of communications to coordinate transport will also be important. It is possible to involve the recourses of army and National Guard in order of evacuation. Evacuation of the critical patients would be done organised in cooperation and would depend on other hospital availability as well as the availability of the transport.

In case of power outage up to 24 hours "Vidzeme Hospital" can provide:

- Emergency medical care for critical patients
- Availability of the doctors

Ambulatory and unurgent specialist availability and consultations will be limited. The standard of patients recovering in the stationary care won't be available, because it will not be able to provide the necessary conditions including catering, heat and water supply.

Cascading effects and impact on other vital societal functions

Evaluating the results and impacts of power outage on health care services and other vital societal functions, no significant impact was found. Limited first aid services or other health care services will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions were these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage. In the scenario of 24 hour power outage this possibility is evaluated as very low.

Consequences for societal values

Results of power outage in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 24 hours it is assessed that it will not lead to additional deaths that are related with the health care and emergency services because all the important medical services including medical appliances will be provided. In the case of a 24 hour power outage, communication and transport facilities will be able to ensure public access to health

services. The provision of health care services will not be provided in full amount, but by focusing on providing assistance in the most critical cases.

- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. No significant increase in the demand for health services is expected.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.

The following measures have been identified that could effectively reduce vulnerability to power outages:

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;

4.2. Scenario 2: Electrical power outage 72 hours

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable. This will make it impossible to communicate with the public (cannot call, get information, etc.)

Impact on health services

Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed. Evacuation of patients will be required.

If additional fuel reserves would be provided ,the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food wont be available for the patients as well as there will be no water and heat supply. As a result, the hospital will have to stop and start evacuation.

Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals.

Cascading effects and impact on other vital societal functions

Limited first aid services or other health care services for 72 hours will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions were these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage.

Consequences for societal values

Results of power outage for 72 hours in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 72 hours it is assessed that some problem situations might arise that are related with the health care and emergency services because the provision of the important medical services including medical appliances will not be possible. The city of Valmiera will not be able to provide a full range of health care services without external assistance
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. 72 hour power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
  In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.
- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.

The following measures have been identified that could effectively reduce vulnerability to power outages

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.

4.3. Scenario 3: Electrical power outage 1 week

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves only for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable. This will make it impossible to communicate with the public (cannot call, get information, etc.)

Impact on critical input factors for health services

Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed. Evacuation of patients will be required.

If additional fuel reserves would be provided ,the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food wont be available for the patients as well as there will be no water and heat supply.

Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals.

Cascading effects and impact on other vital societal functions

Limited first aid services or other health care services for 1 week will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions were these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage.

Consequences for societal values

Results of power outage for 1 week in health care system would have major consequences on societal values like:

- Life and health of local inhabitants. The interruption of the weekly electricity supply will make it more difficult to provide emergency care or to provide daily care, and the public will feel the need for water and food. The possibility of freezing should also be considered.
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their

relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. 1 week power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.
- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.
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The following measures have been identified that could effectively reduce vulnerability to power outages;

- Fuel reserves for diesel generators;
- Testing of the available alternative power systems;
- Development of an alternative power supply system for the provision of inner heat supply.

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.
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4.4. Scenario 4: Electrical power outage 1 month

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable.

Impact on health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Power outage or one month will reduce the demand for health care services, as some part of the population will choose other cities where healthcare is available. The city will need emergency care and care for patients who are not transportable.

Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed.

If additional fuel reserves would be provided, the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food wont be available for the patients as well as there will be no water and heat supply. Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals provided that functioning communication channels are available.

Cascading effects and impact on other vital societal functions

Power outage for one month will encourage all the population to evacuate to other nearby regions and leave the city.

Consequences for societal values

Results of power outage for 1 month in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 1 month it is assessed that it will make impossible to provide emergency care or to provide daily care, and the public will feel the need for water and food. The possibility of freezing should also be considered.
- bring many lethal cases that are related with the health care and emergency services because as well as with lack of food, water and risk of frostbite.
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. 1 month power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.
- Due to the water and heat supply interruption deterioration of sanitary and hygienic conditions are expected, it may result in the outbrake of infection cases and diseases e.g. diarrhea. The outbreak of such cases may overload already existing health services.
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Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.
- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.

The following measures have been identified that could effectively reduce vulnerability to power outages

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating a detailed plan for full evacuation of hospital patients
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.

5. Way forward

Uncertainty and transferability

ASSESSING UNCERTAINTY	
Indicators for evaluation of quality in knowledge	**Explanation**
To what degree is this type of incident a well-known phenomenon?	Taking into account the fact that power outages in the city have not happened before on such a big scale, citizens do not have the knowledge and experience to know how to deal with a one-month electricity supply interruption.
To what degree do we have access to relevant data and experience from equivalent scenarios?	The previous severe power outage of up to 4 hours in the city was 14 years ago. The situation in the city was perceived as an emergency situation. Aggregation of data and experience was not made.
To what degree does the available knowledge provide high degree of consensus?	Taking into account the lack of experience and knowledge of how to deal with these particular situations, the actions and reactions of inhabitants are not entirely predictable.
Sensitivity in results	
To what degree do small changes in preconditions affect the assessment of probability and consequences?	Taking into account the lack of experience in similar circumstances, the impact assessment has been carried out theoretically, as a result of which changes in the prerequisites may have a significant impact on the actual situation and consequences.
Overall assessment of uncertainty	

Transferability

Evaluation, facts and the findings of our assessment as well as possible proposals for measures to improve the prevention of harmful effects are transferable and usable in other cities adjusting parameters of certain areas of impacts. For example, in other cities, water extraction pumps may already be equipped with additional generators to provide full water supply, so there is no need to look for additional ones.

Steering ability

ASSESSMENT OF STEERING ABILITY	
Indicators on steering ability	**Explanation**
To what degree can new effective measures be implemented?	As a result of this evaluation, real proposals were made for urgent actions that would reduce the potential consequences and can be implemented in practice.
To what degree are areas of responsibility clear between other sectors and private actors?	Areas of responsibility are mainly within the field of state or municipal institutions and organizations.
To what degree do the responsible sector authority have the possibility to decide and implement new measures?	The field institution has the opportunity to decide on the implementation of new measures. The financial aspects must be taken into account when implementing new measures.
Overall assessment of steering ability	

As a result of this evaluation, it is clearly concluded that in a case of power outage for 72 hours, it will have significant consequences not only for the provision of health services but also for other important functions for the city and its population.

If the power outage is longer than 24 hours, both the evacuation of the hospital and the transfer of individual population groups (children, seniors) to other nearby regions where water, heat and food are provided should be encouraged. Healthcare services in these situations can only be provided to a very limited extent, focusing on the provision of first-aid medical care and the possibilities to transfer the patients directly to other regional health facilities.

Water and heat supply issues, which in Valmiera city can be provided for up to 24 hours after power outage, were identified as with the most significant importance in the assessment. In a further period of time, the topical issue would be the provision of fuel for the operation of diesel generators, the provision of transport, which, at one point would be critical to the supply of food.

It should be noted that the disruption of water supply and heating would lead to a deterioration of public health in general. This indicates the need to improve the capacity of the municipality to ensure the sustainability of water and heat supply.

Possible improvements to reduce the probable consequences were identified:

- Creation of additional alternative energy-generating equipment (generators) or their connection point system to ensure continuous supply of water and heat in case of power outage;
- Formation of fuel reserves as well as detailed regulations for its distribution in crisis situations.
- Developing new evacuation plans for hospital patients to ease the porcess of transferring patients to hospitals in nearby regions, in that way saving valid resources for emergency medical assistance.