5. Tier 1: Subsystem Requirements

1. Control System

1. Functional Requirements

Id	Requirement
1	The system shall process data
2	The system shall manage heat distribution

2. Interface Requirements

Id	Requirement
1	The system shall provide data interface with the photovoltaic system
2	The system shall provide data interface with the energy storage system
3	The system shall provide data interface with the geothermal system
4	The system shall provide user interface to customers
5	The system shall provide user interface to developers
6	The system shall interface with the internet

3. Temporal Performance Requirements

Id	Requirement
1	The system shall not sell more than 100KWh per hour
2	The system shall sell minimum 80% of total power sales during the peak power price window (08:00->09:00 & 17:00->18:00)
3	The system shall buy minimum 80% of total power purchase during the cheapest power price window (02:00->04:00)

4. Non-temporal Performance Requirements

Id	Requirement
1	
2	

5. Design Requirements

Id	Requirement
1	The system service shall cost no more than 30k NOK annually
2	The system shall cost no more than 50k

2. Photovoltaic System

1. Functional Requirements

Id	Requirement
1	The system shall convert sunlight to DC electricity
2	The system shall measure its current power production

2. Interface Requirements

Id	Requirement
1	The system shall provide metadata using RS-485
2	The system shall send DC electricity to the energy storage system

3	The system shall send AC electricity to the local power grid
4	The system shall send AC electricity to the external power grid
5	The system shall provide a heat exchanger interface with the geothermal cooling system

3. Temporal Performance Requirements

Id	Requirement
1	The MTTF of the solar panels shall be > 1 year
2	The MTTR of the solar panels shall be < 1 day

4. Non-temporal Performance Requirements

Id	Requirement
1	The solar panels shall have a Wp of minimum 160
2	The solar panels mounted on the roof shall be placed with a slope angle of 40°
3	The solar panels mounted on the roof shall be placed with an azimuth angle of 2°
4	
5	

5. Design Requirements

Id	Requirement
1	The system shall cost no more than 3MNOK

3. Energy Storage System

1. Functional Requirements

Id	Requirement
1	The system shall be able to store energy in the dynamic storage
2	The system shall be able to store energy in the static storage
3	The system shall be able to provide energy from the static storage
4	The system shall be able to provide energy from the dynamic storage

2. Interface Requirements

Id	Requirement
1	The system shall provide metadata using RS-485
2	The system shall receive data instructions using RS-485
3	The system shall be able to receive DC electricity from the photovoltaic system
4	The system shall be able to receive AC electricity from the external power grid
5	The system shall be able to send AC electricity to the building power grid
6	The system shall provide a heat exchanger interface with the geothermal cooling system

3. Temporal Performance Requirements

Id	Requirement
1	The MTTF of the static batteries shall be > 5 years
2	The MTTR the static batteries shall be < 1 day

3	The system shall not increase the battery cycles of the vehicles with more than 150 cycles per year.

4. Non-temporal Performance Requirements

Id	Requirement
1	The static batteries shall provide storage capacity of minimum 0.5 MWh
2	The V2B system shall provide storage capacity of minimum 5MWh
3	The V2B system shall provide a two-way DC charger with 200 A at up to 450 V per vehicle

5. Design Requirements

Id	Requirement
1	The static batteries shall cost no more than 1.8MNOK
2	The V2B system shall cost no more than 1.3MNOK
3	The system shall cost no more than 3.3MNOK

4. Geothermal System

1. Functional Requirements

Id	Requirement
1	The system shall produce heat
2	The system shall absorb heat

2. Interface Requirements

Id	Requirement
1	The system shall receive data instructions using RS-485
2	The system shall provide metadata using RS-485
3	The system shall provide a heat exchanger interface to the waterborne heating system
5	The system shall provide a heat exchanger interface to the energy storage cooling system
6	The system shall provide a heat exchanger interface to the ventilation system.
7	The system shall accept AC electricity with maximum 50A at 400V
8	The system shall provide a heat exchanger interface to the photovoltaic cooling system
9	The system shall provide a heat exchanger interface to the domestic hot water system

3. Temporal Performance Requirements

Id	Requirement
1	The system shall have a MTTF > 1 year
2	The system shall have a MTTR < 12 hours

4. Non-temporal Performance Requirements

Id	Requirement

1	The system shall have a rated heat output of >= 67 kW
2	The system shall have a rated heat removal output of >= 20 kW
3	The system shall produce heat with an energy ratio of at least 1:3.1 when the outdoor temperature is -7°C
4	The system shall produce heat with an energy ratio of at least 1:3.6 when the outdoor temperature is +2°C
5	The system shall produce heat with an energy ratio of at least 1:4 when the outdoor temperature is +7°C
6	The system shall produce heat with an energy ratio of at least 1:4.3 when the outdoor temperature is +12°C
7	The system shall produce cooling with an energy ration of at least 1:4 when the outdoor temperature is between +12°C and -7°C
8	The system operational temperature shall be > -10°C

5. Design Requirements

Id	Requirement
1	The system shall cost no more than 1.4MNOK