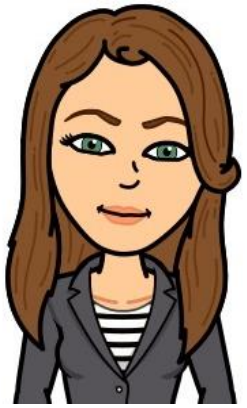
Virtual Design Review

Senior Design Team 523

Temperature Sensitive Medication Storage During Natural Disaster

Team Introductions



Zoe Dillehay
Systems Integration Engineer

Travis Amaral
Project Manager & Research Engineer

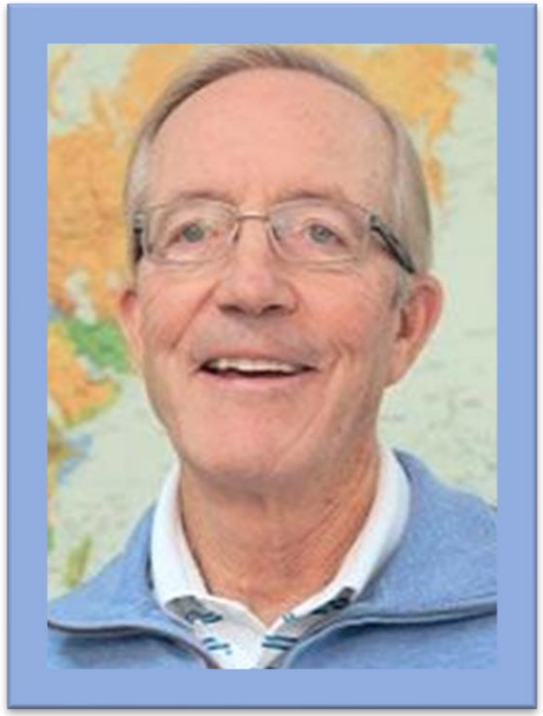
Nick Georgevich
Design Engineer

Keon Glass
Entrepreneurial Leader & Research Engineer

Diego Mendoza
Electrical Engineer

Andrew Sayers
Quality Control Engineer

Sponsors



Dr. Michael Devine

- Entrepreneur in Residence and an Adjunct Professor at FAMU-FSU College of Engineering
- Ph.D. in Mechanical Engineering (Operations Research)

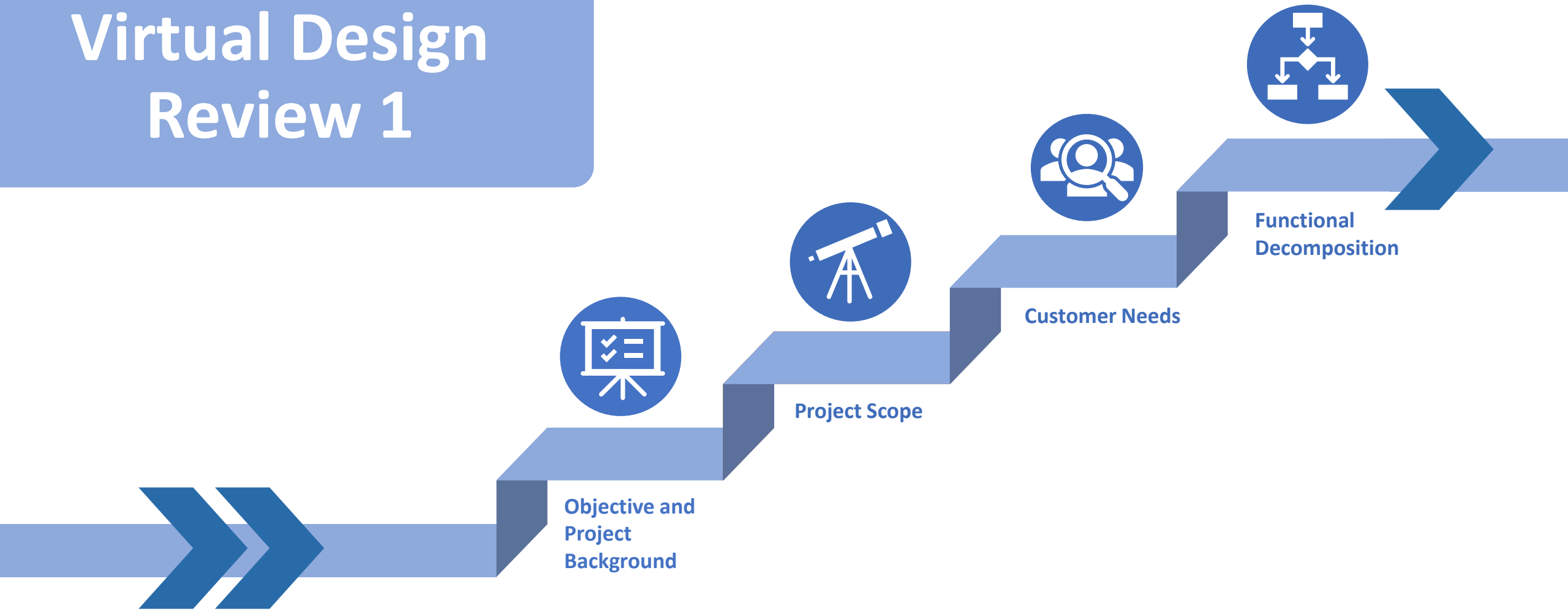
FAMU-FSU College of Engineering

Advisor

Dr. Shayne McConomy

- Teaching instructor at FAMU-FSU College of Engineering
- Ph.D. in Automotive Engineering

Virtual Design Review 1



Objective

The objective of the project is to develop a device that stores and maintains the quality of temperature sensitive medication in the event of a natural disaster that causes mass power outages

Motivation

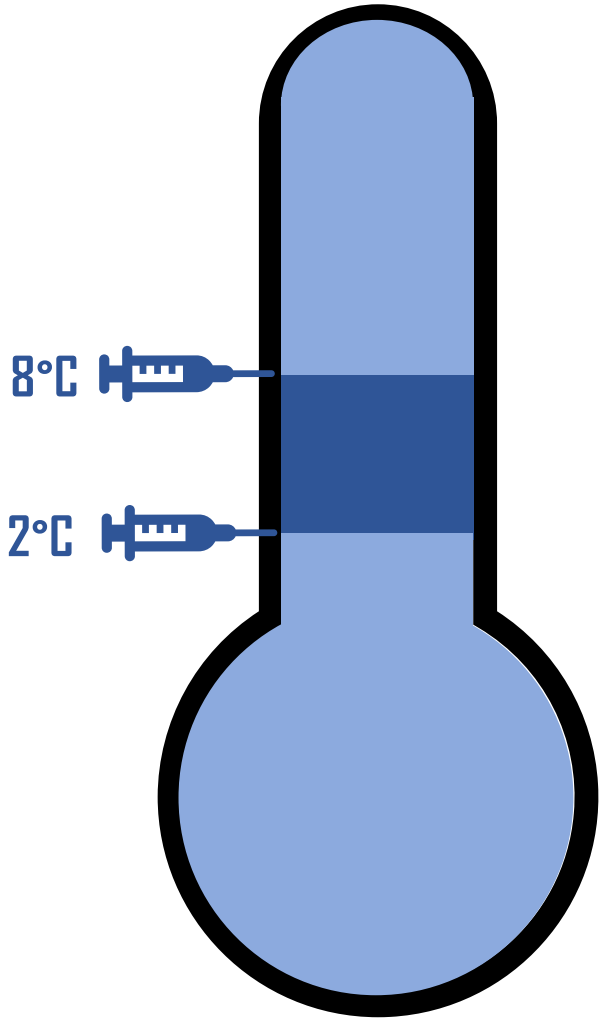
An estimated 425 million people globally are afflicted with Diabetes

Cases are rising, from 4.7% of the global adult population in 1980 to 9.3% in 2019

Diabetes is the 9th leading cause of death in the world

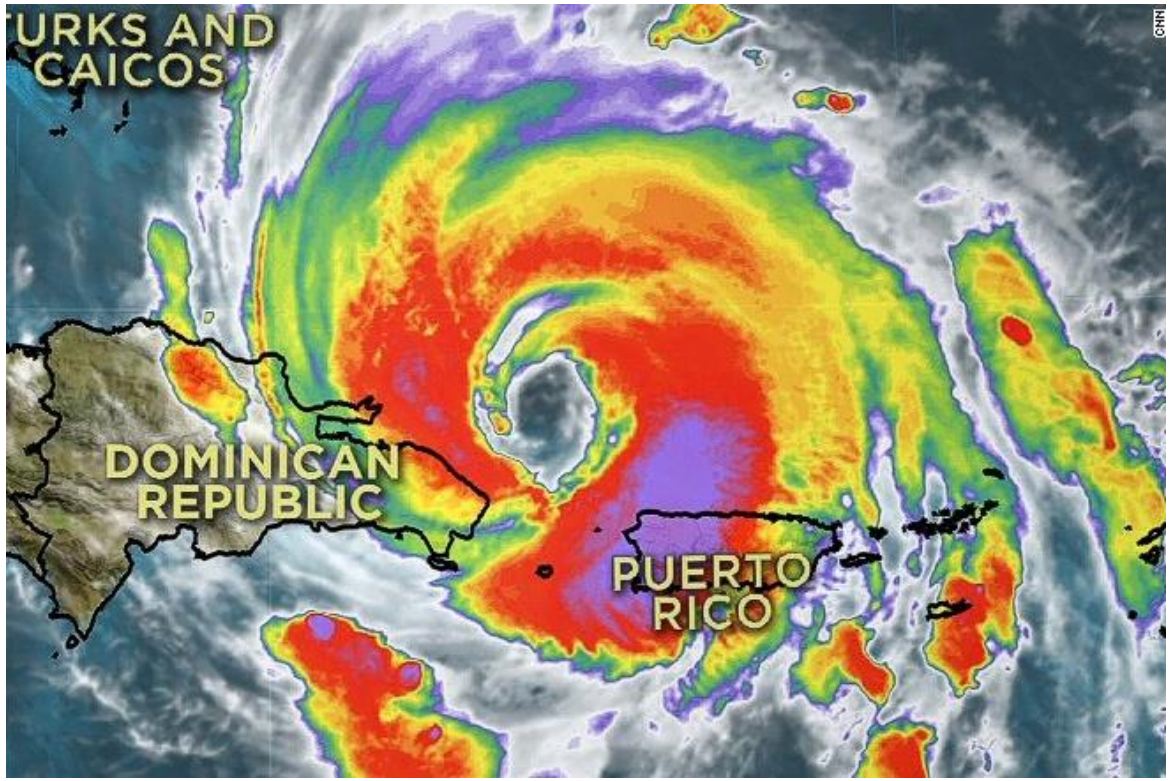
Motivation

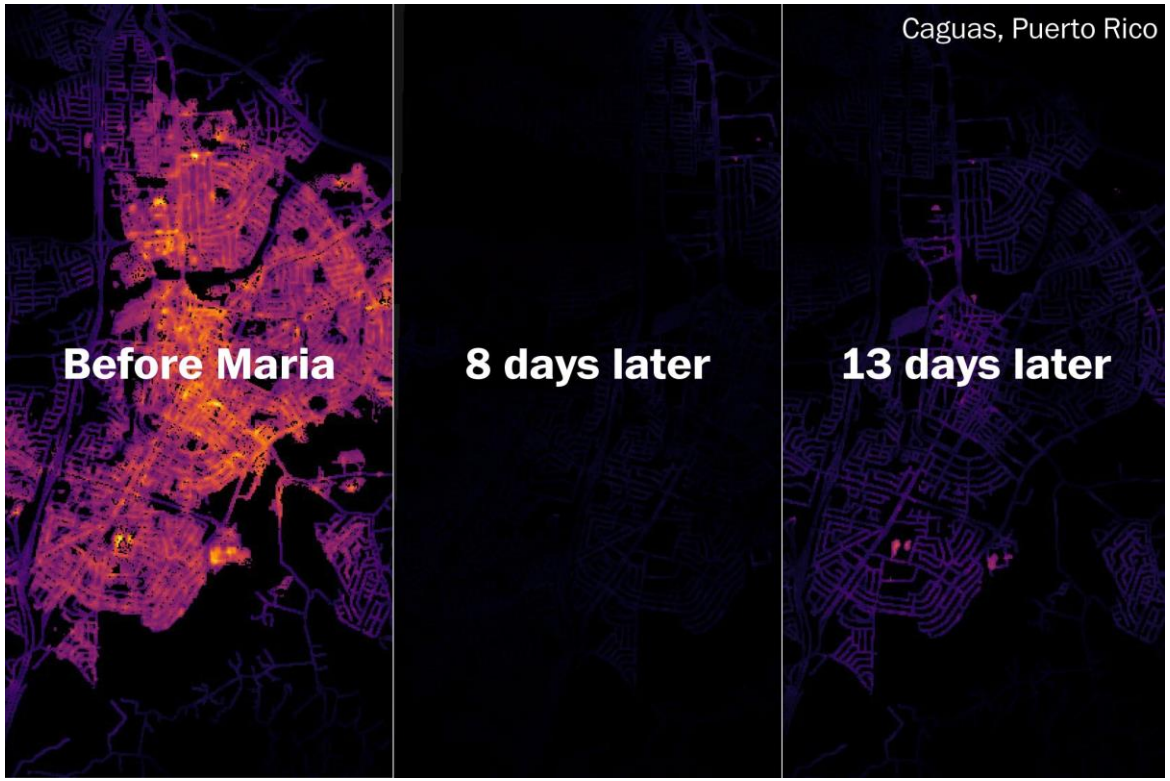
- Insulin can be kept at room temperature (15° - 30°C) for up to 28 days.
- If stored longer, it should be kept between 2° - 8°C



What is the problem?

Case Study: Puerto Rico





Case Study: Puerto Rico

Causes of death	Sept./ Oct. 2015	Sept./ Oct. 2016	Sept./ Oct. 2017	Pct. change
Essential hypertension and hypertensive renal disease	88	84	134	+56
Sepsis	138	117	197	+55
Suicide	31	35	49	+48
Alzheimer's and Parkinson's Diseases	370	343	524	+47
Diabetes	441	473	666	+46
Chronic Lower Respiratory Diseases	143	175	225	+42

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Case Study: Puerto Rico

Two months after landfall, only half of Puerto Rico had power restored

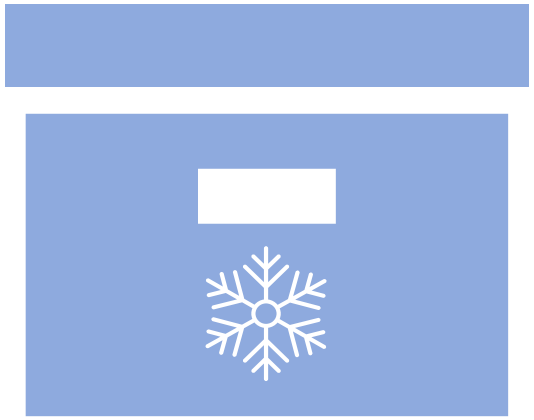
46% spike in diabetes related deaths compared to previous years

2nd highest identifiable cause of death from Maria

Lack of proper refrigeration for insulin to blame

What is the solution?

Temperature Sensitive Medication Storage Unit



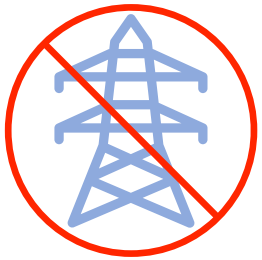
- These deaths are **preventable** by access to a temperature-controlled device
- The 2° - 8°C range is also accommodating for most common temperature sensitive medications

What does it need to do?

Key Goals

Maintain quality of medicine for 14 days minimum

Design device to have an external source of power attached



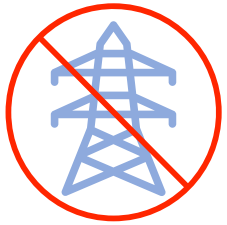
Design is packaged with a power system that can operate without access to main power grid

Ease of Operation

Durability

Cost Efficiency

Assumptions



Grid power will be inaccessible when device is needed

Device will operate at ambient conditions

Users have access to their own medication supply

Device will be used as a short-term solution until grid power is restored

Medication placed into device is at sufficient temperature and in good condition

How do we make the biggest impact?

Markets

Primary: Disaster Relief Organizations

- American Red Cross
- Federal Emergency Management Agency (FEMA)
- National Voluntary Organizations Active in Disaster (VOAD)

What does the user need?

Customer Needs

- Who is our customer?
- What is important to the customer in the product?
- How will the product be used?
- What are the design's most important functions?
- What do we need to think about as far as physical constraints?

The Customers

Responses from Rob McDaniels of FSU Emergency Management

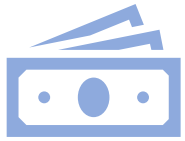
- Easy to operate to accommodate the elderly
- Important to keep contents sterilized and isolated from outside contaminates
- Ice is problematic with keeping things cold, gel packs work better
- Large potential market for third world countries that use drones for delivery
- Securing and separating different medications is important

The Customers

Responses from an Individual Insulin User

- Unprepared for major power outage and would rely on stores having generators
- Needs to be very affordable to convince the average insulin user its worth buying
- Be able to hold insulin vials, needles, and back-up test meter
- Would like product to hold a 30-day supply
- Wants device to be operational in a moment's notice

Our Takeaways



Affordable for typical insulin user

Lightweight enough to be portable

Maintain temperature without power grid for extended time

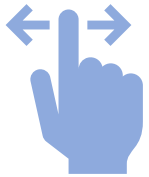
Room to hold medication and needed accessories

Protect contents from damage

How does it need to function?

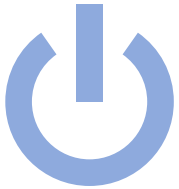
Functional Decomposition

From these interpreted needs, we were able to create 3 main functions for our design:



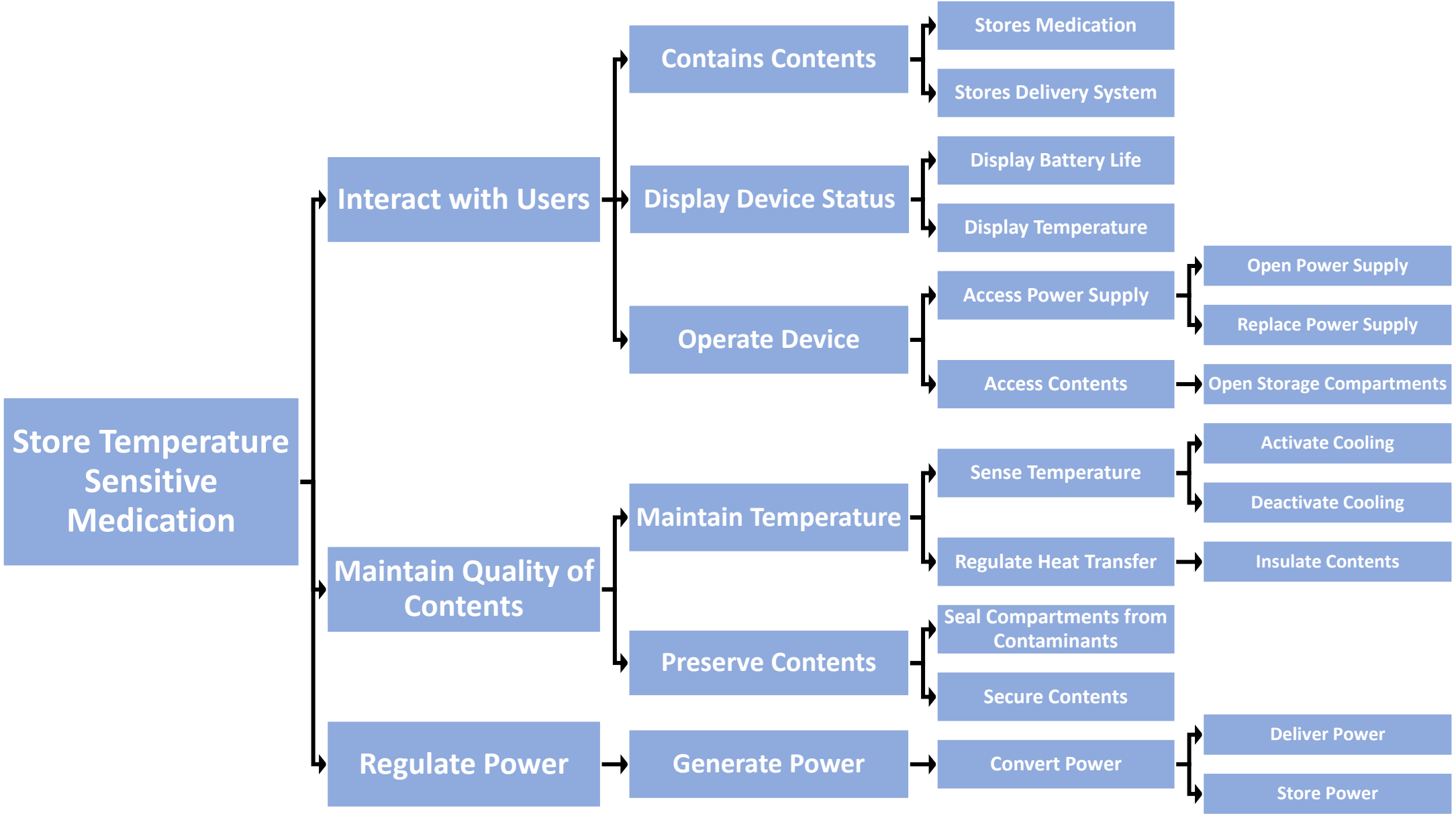
Interact with User

Maintain Quality of Contents



Regulate Power

These functions were broken down further via the hierarchy chart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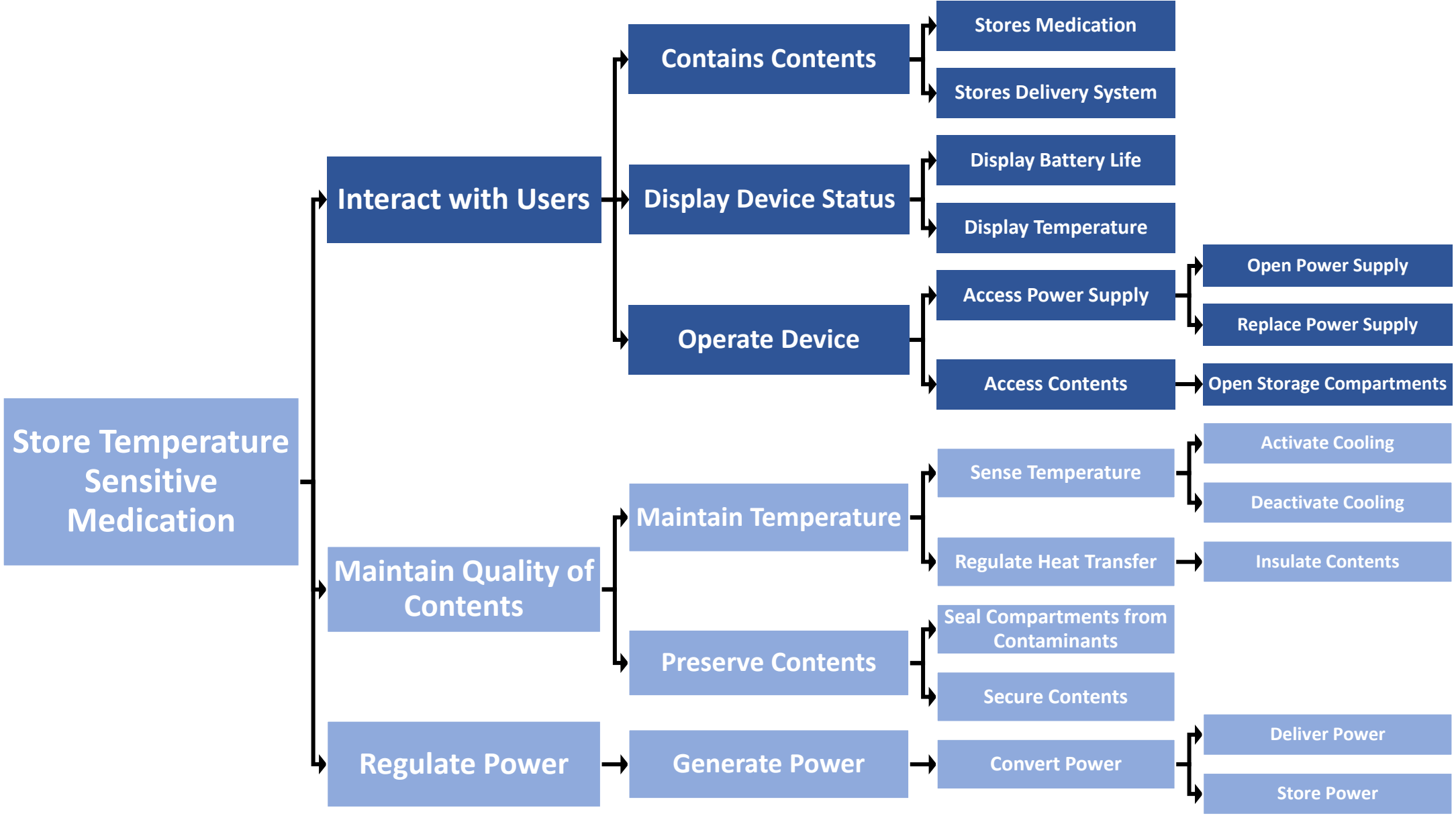
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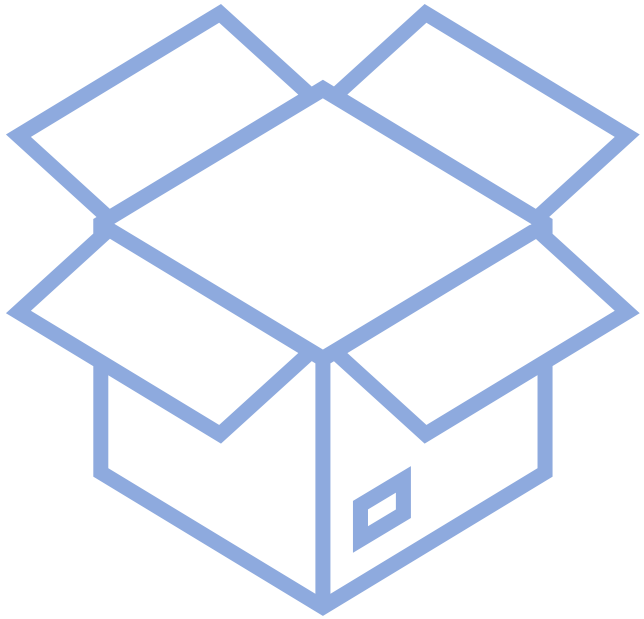

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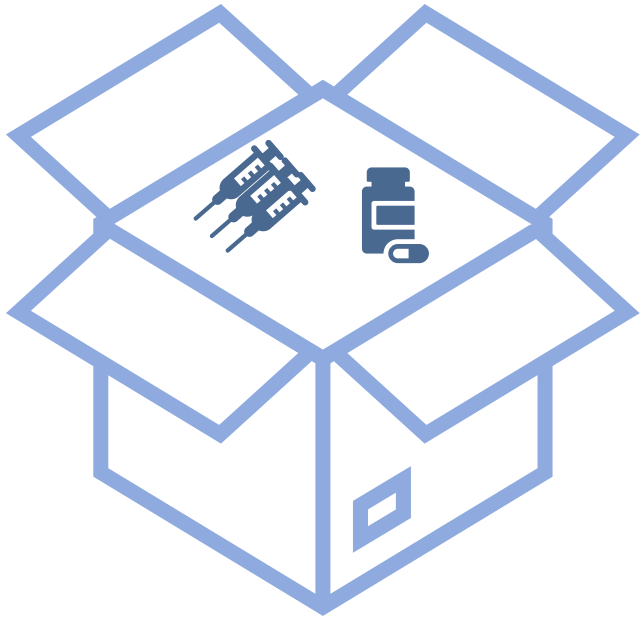

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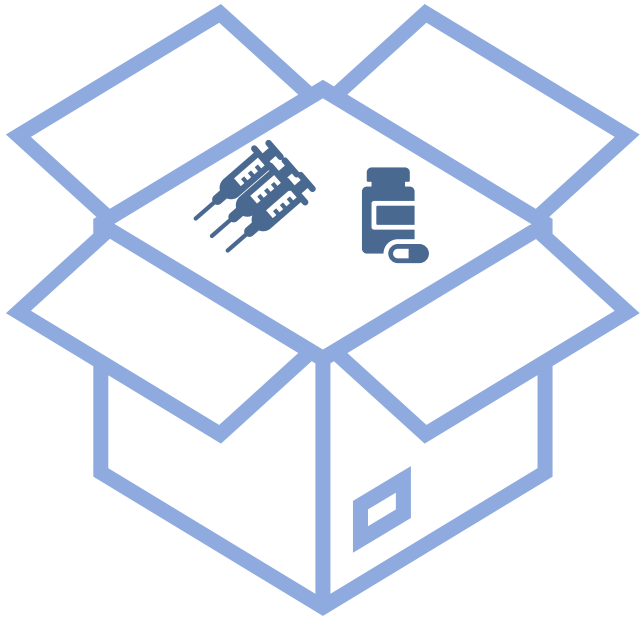

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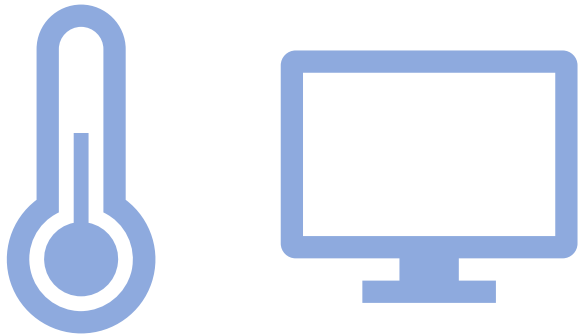

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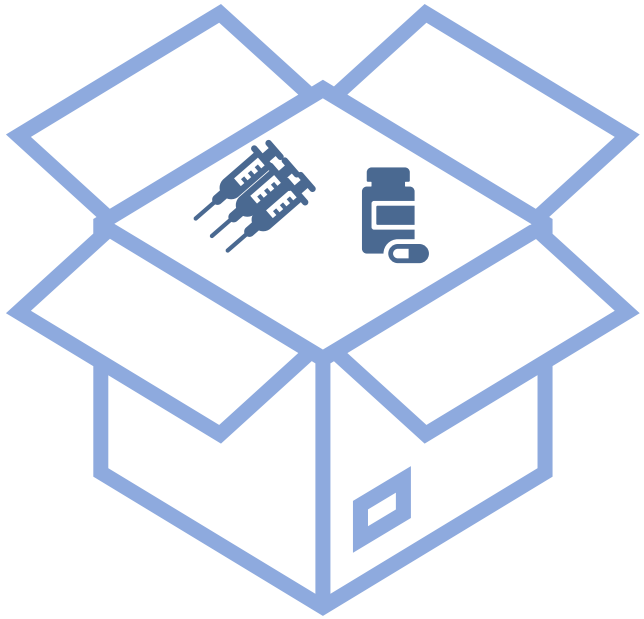

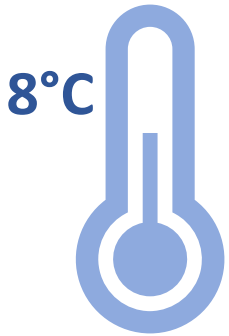

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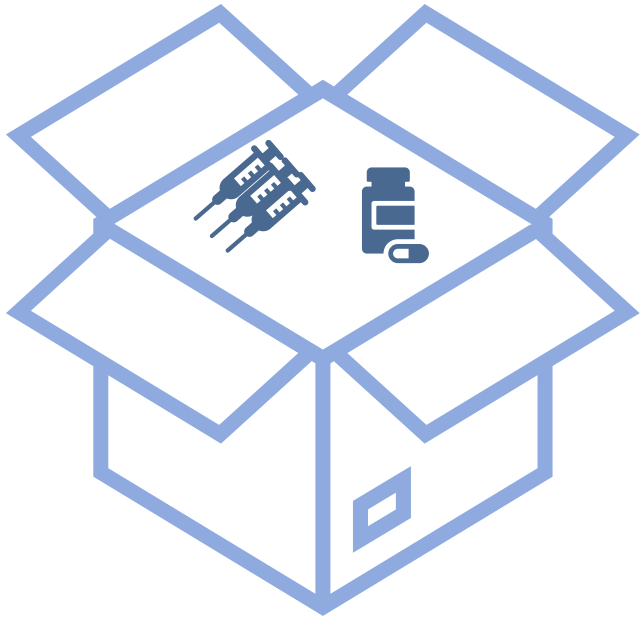

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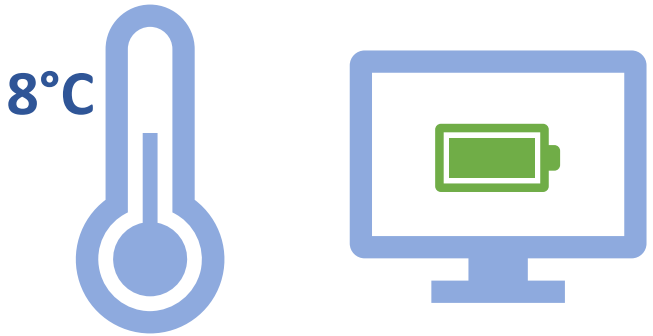

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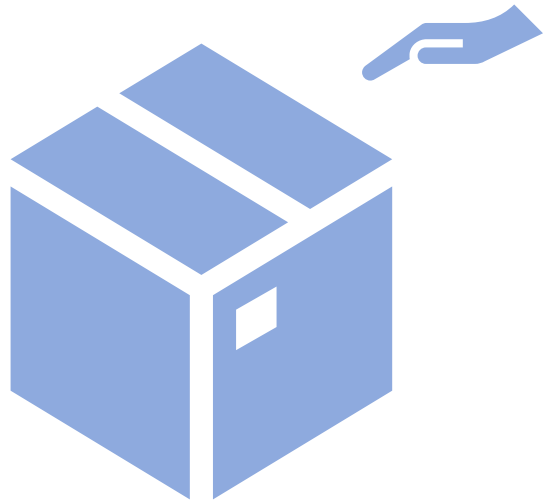

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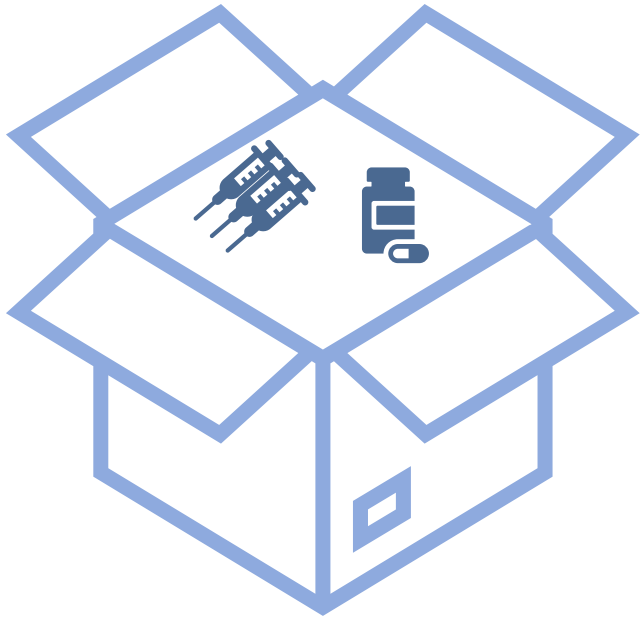

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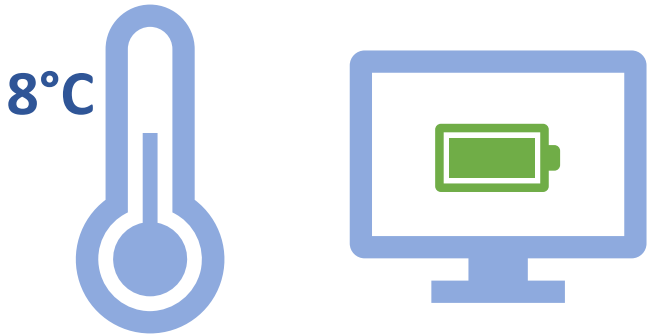

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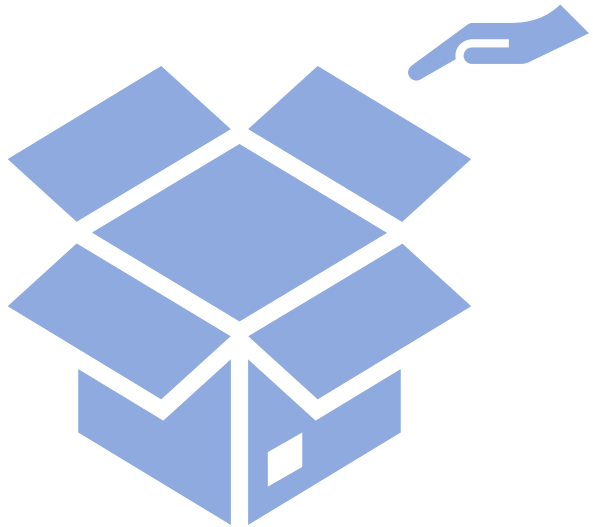

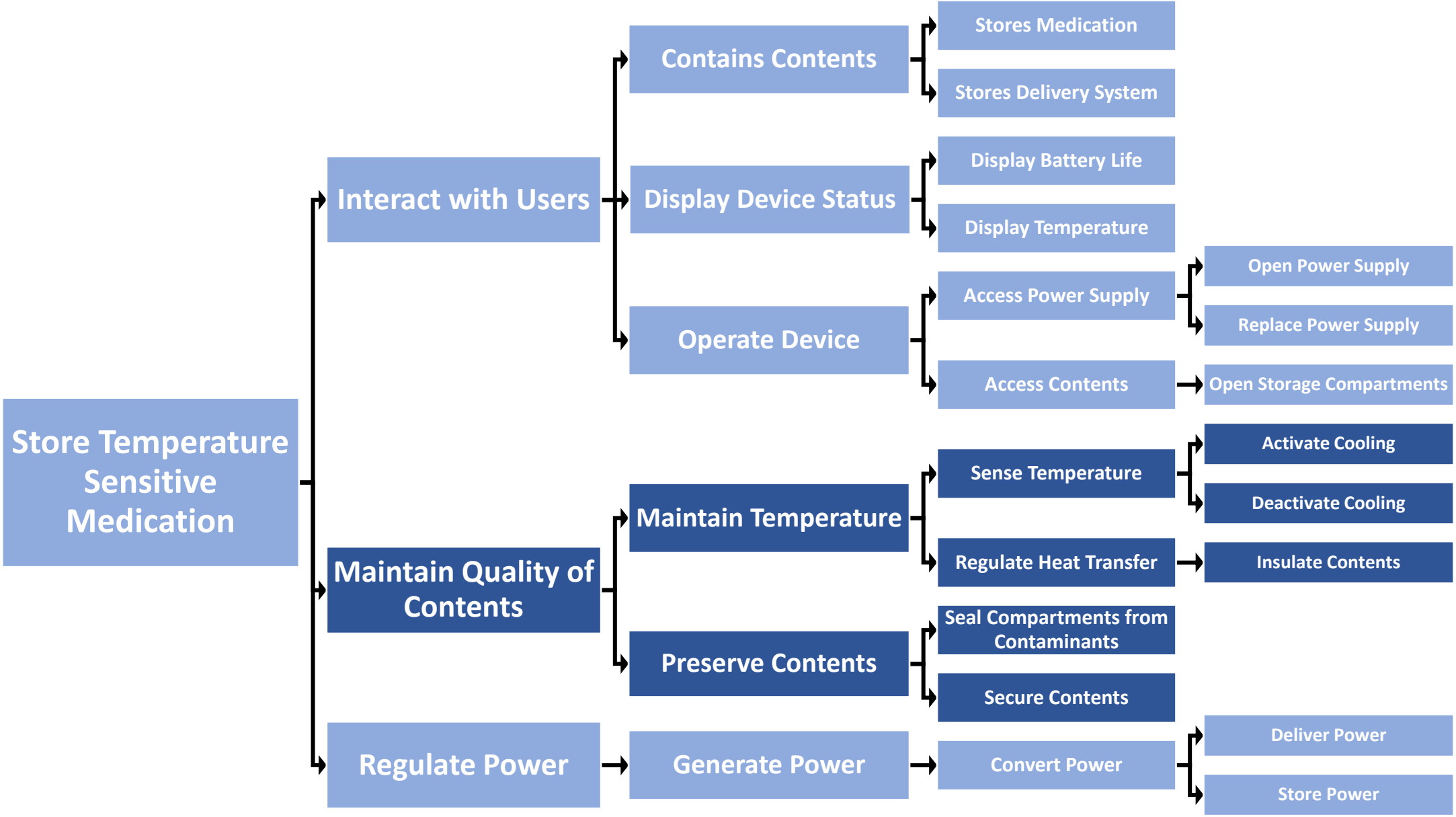
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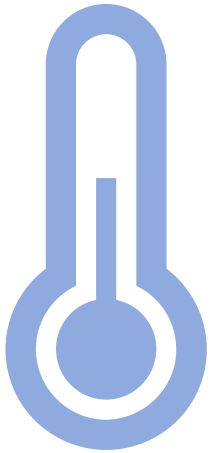

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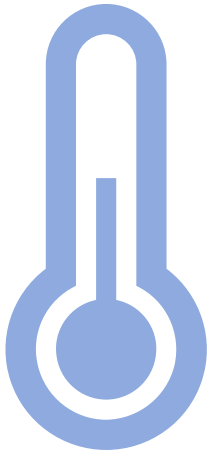

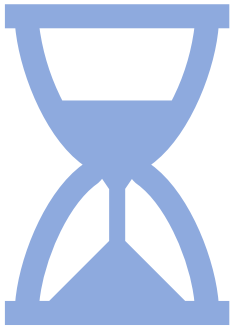

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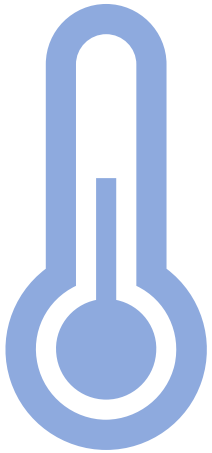

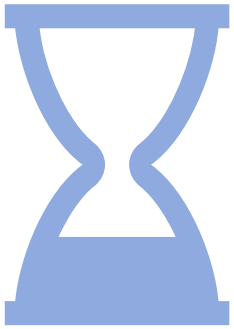

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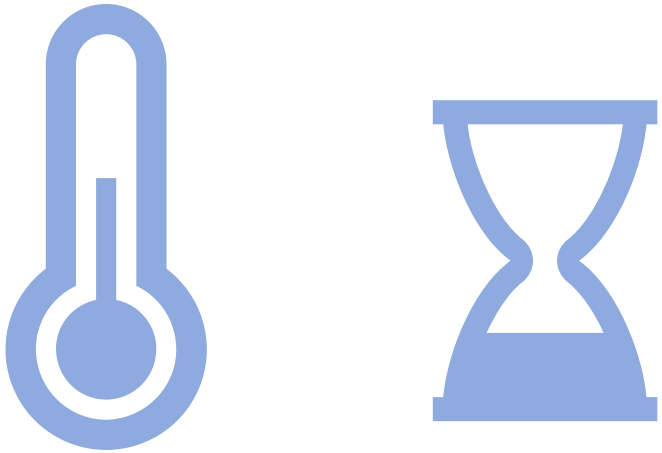

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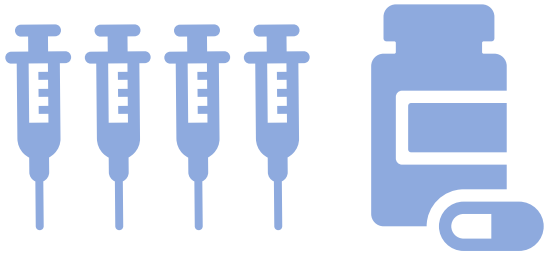

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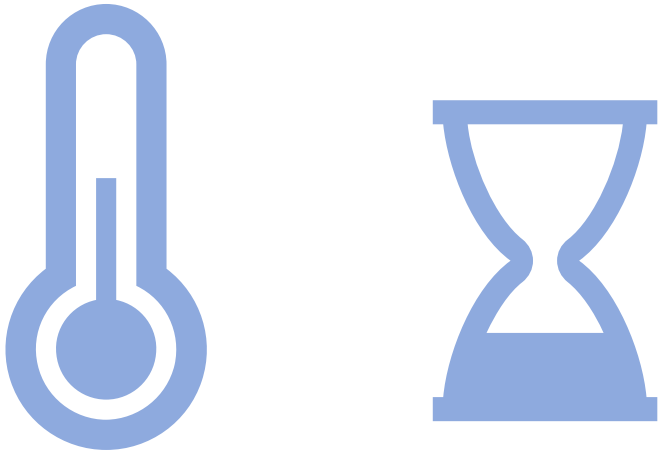

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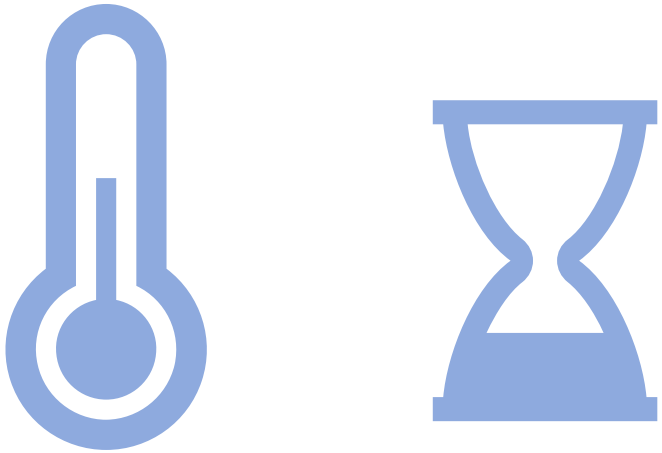

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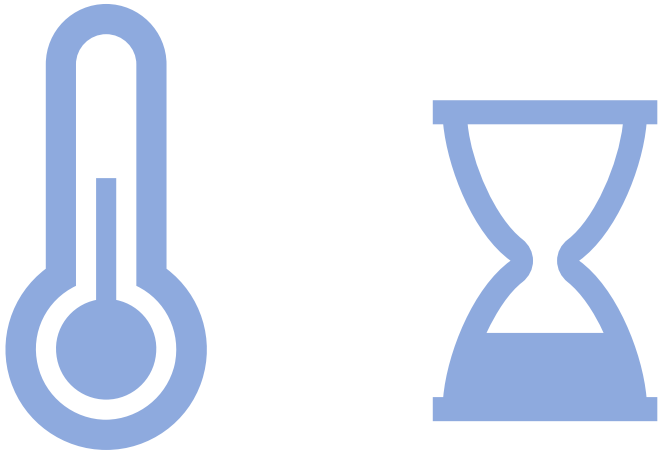

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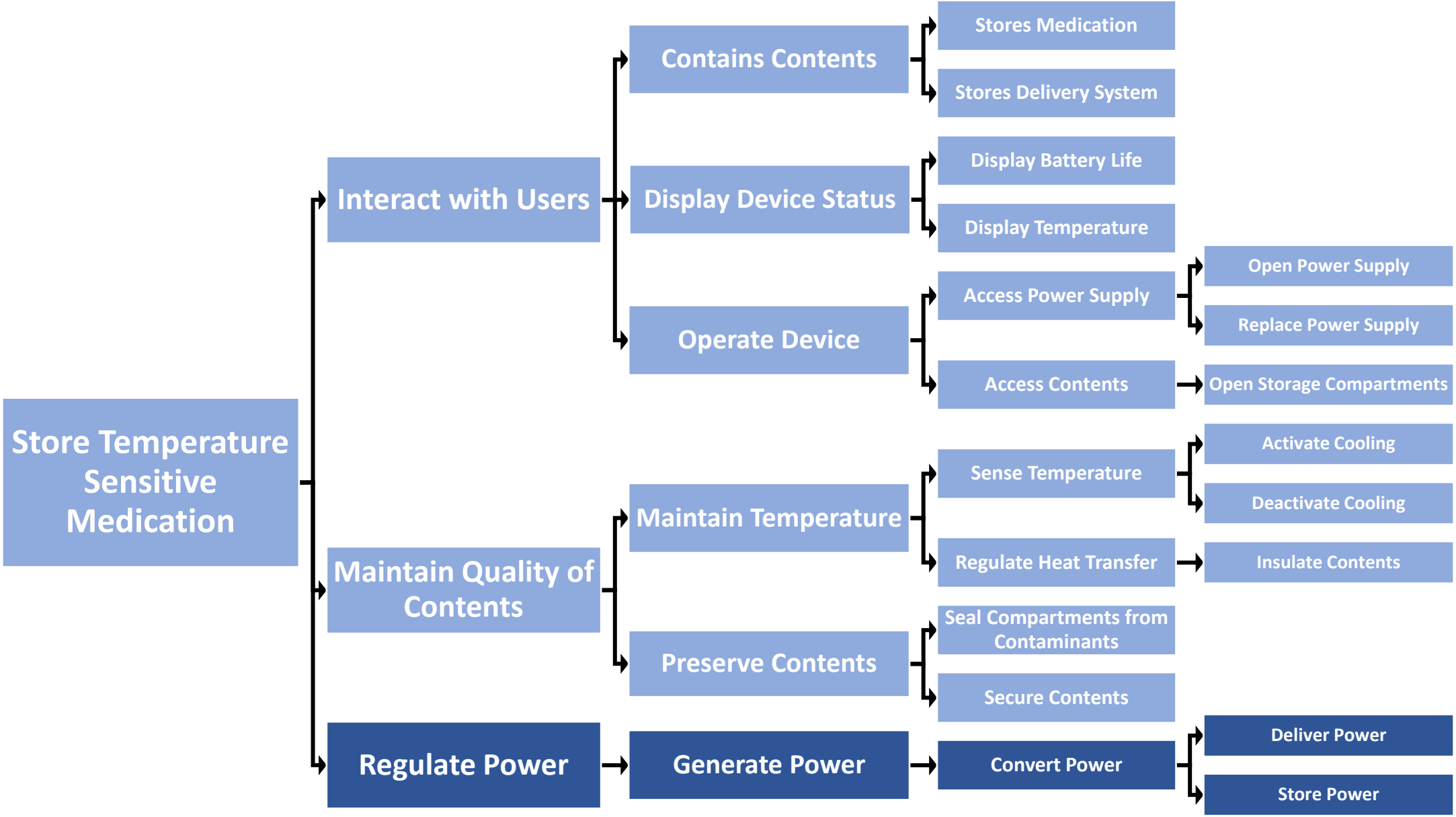
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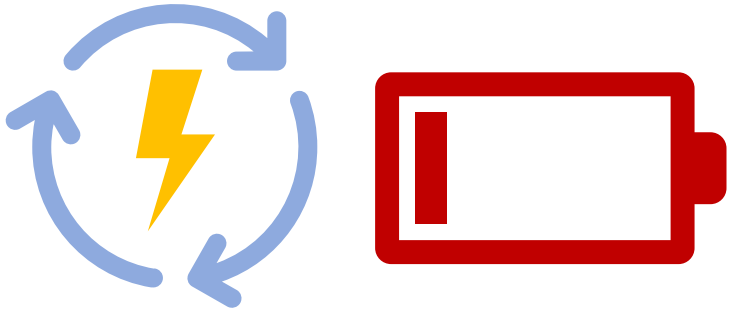
Regulate Power

Generate Power

Deliver and Store



Regulate Power

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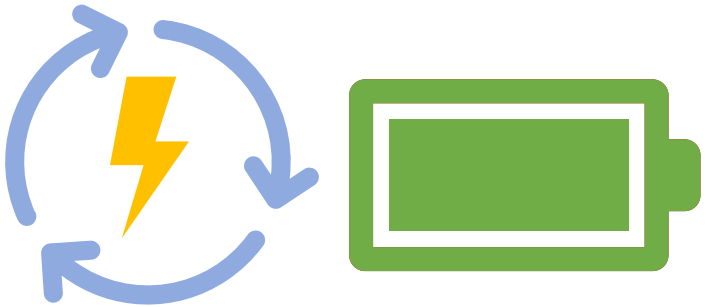
Deliver and Store



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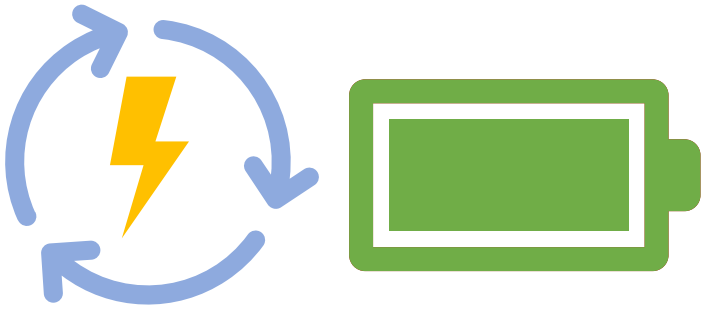

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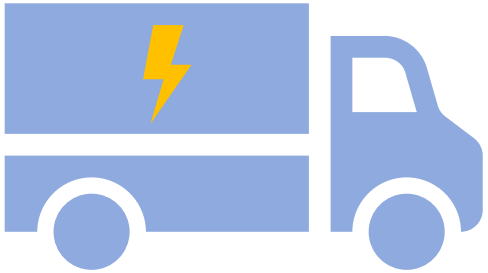

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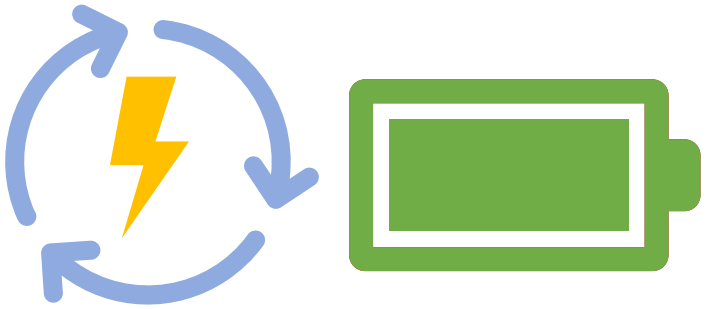

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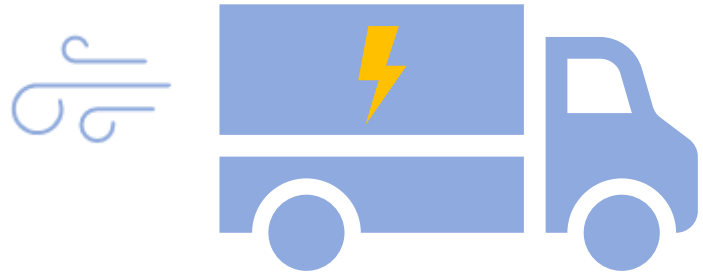
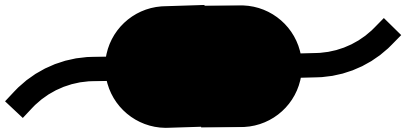
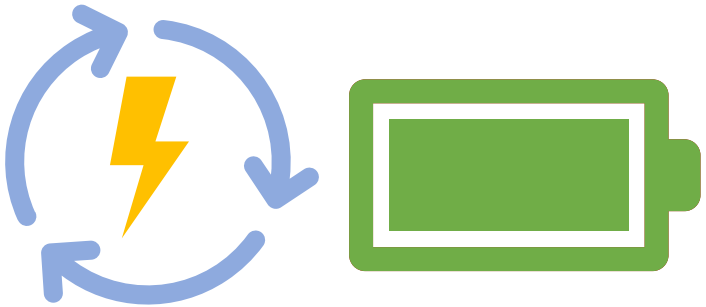




Regulate Power

Generate Power

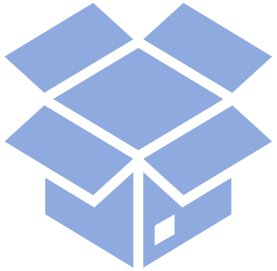


Deliver and Store

Functional Decomposition

From the hierarchy chart we create our three systems

Thermal System



Storage System

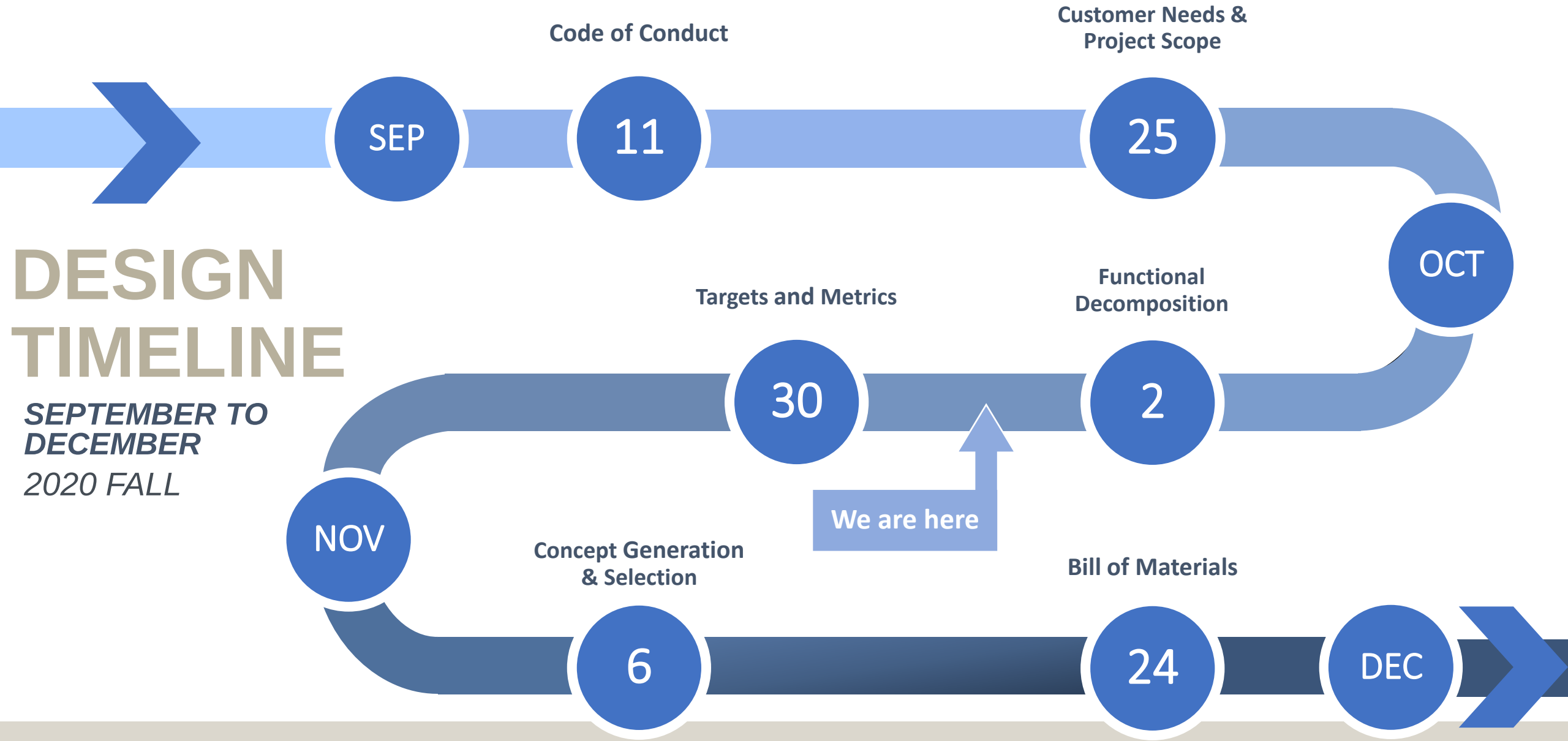
Power System

How do we get there?

DESIGN TIMELINE

SEPTEMBER TO DECEMBER

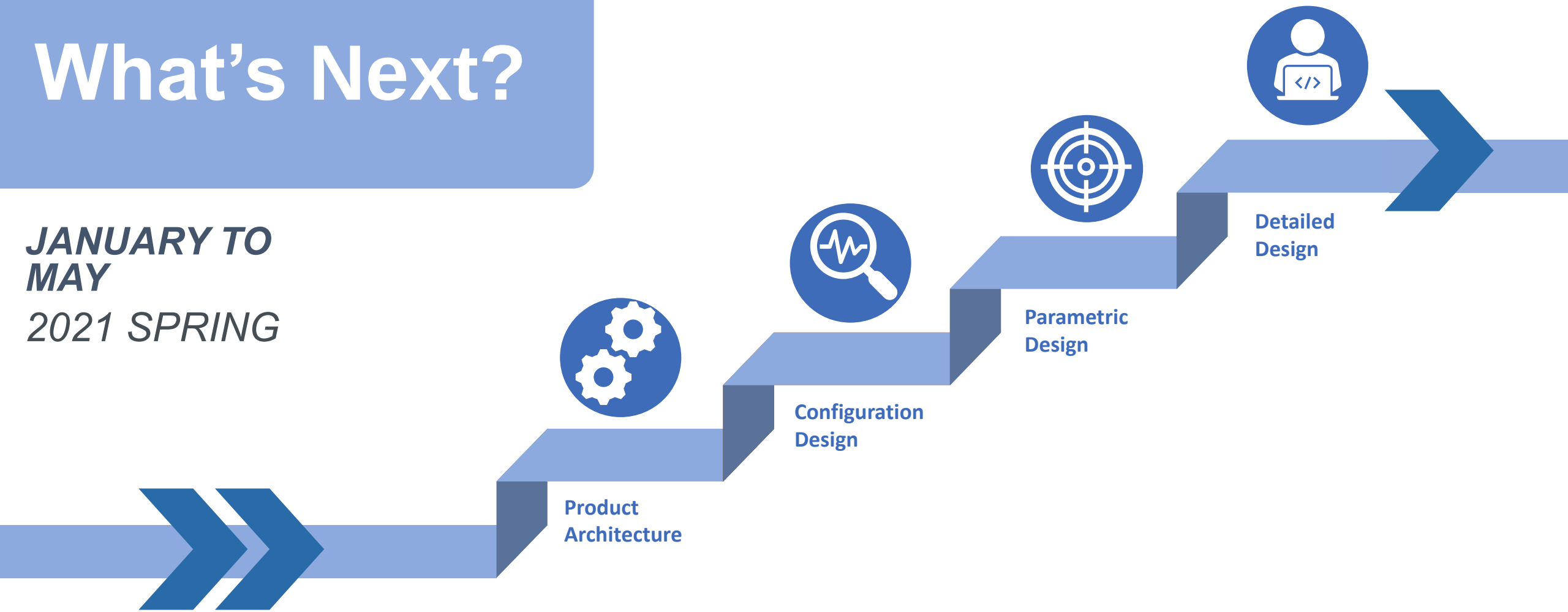
2020 FALL



What's Next?

JANUARY TO MAY

2021 SPRING



Questions?