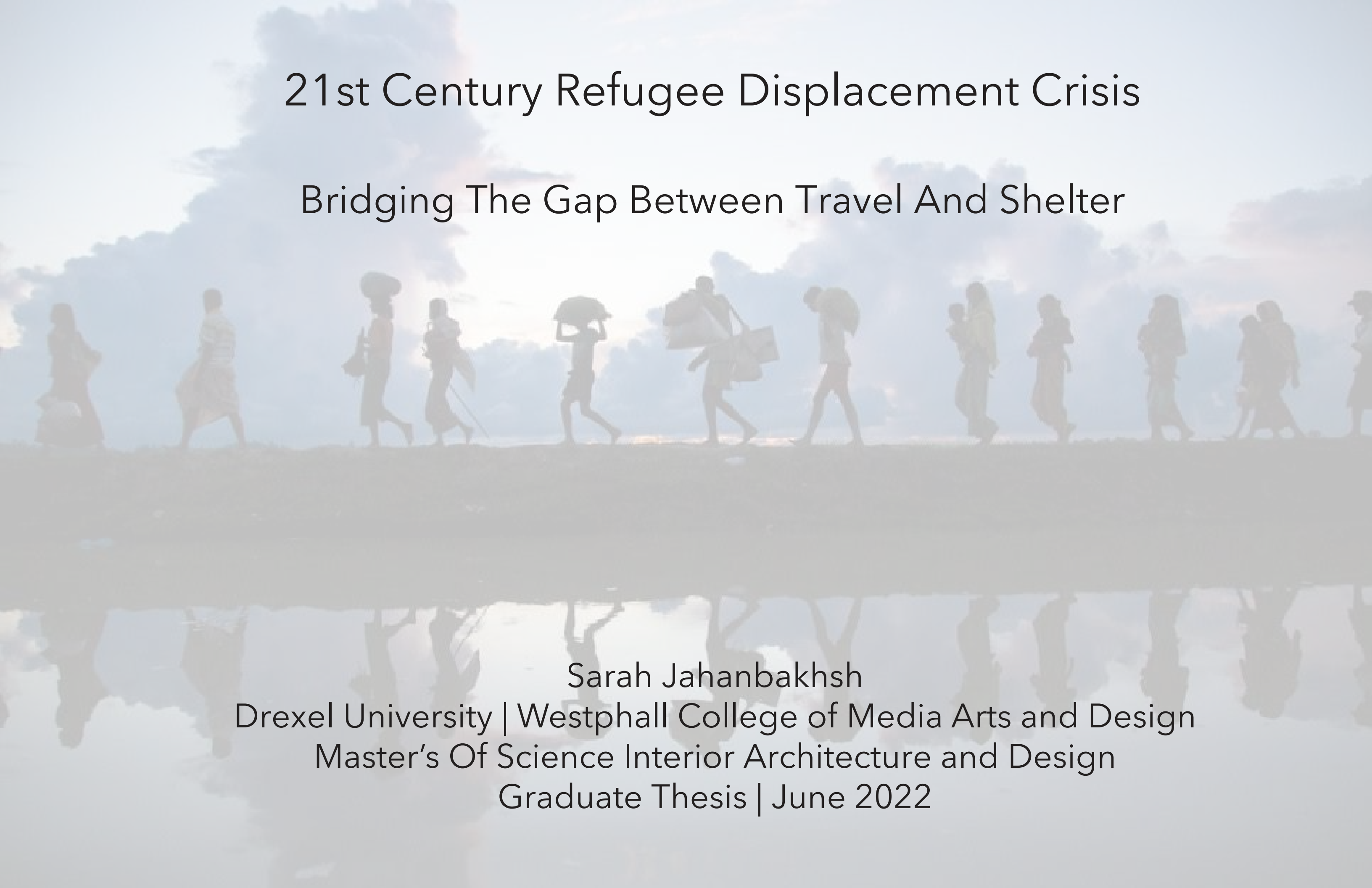


# 21st Century Refugee Displacement Crisis

## Bridging The Gap Between Travel And Shelter



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Master's Of Science Interior Architecture and Design

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I would also like to thank my Thesis Advisor, Rena Cumby, for your constant support and encouragement. Thank you for making my passion for design a reality.

# ***Introduction***



My name is Sarah Jahanbakhsh and I am a first-generation Iranian American. I never understand the feeling of being a refugee. Still, my father and grandparents experienced first hand the magnitude of the refugee and displacement crisis because of the Iranian revolution in 1978.

My father and grandparents and many other native Iranians were forced to flee their home country with only the clothes on their backs. Many fled to neighboring countries by foot while others, who were lucky enough, traveled to the US.

The Iranian revolution was over 40 years ago; today, there is an average of 82.4 Million forcibly displaced worldwide. The Iranian revolution holds similar characteristics to the trauma and magnitude of the humanitarian crisis Afghanistan faces today, which is my reason for honing in on Afghanistan refugees in particular.

There are 3.5 million Afghanistan refugees & asylum seekers forced to leave Afghanistan currently. War, violence, human rights violations, persecution, and natural hazards are just a few of the reasons Afghan Refugees are forced to leave their home country.

Resettling into another country is never an easy task; how can we designers make displacement and the refugee crisis a design solution? Temporary or permanent living conditions are the goals to identify a more robust, more sustainable solution.

Targeting areas of heavy foot travel will assist those in need of shelter by providing temporary community housing in those areas. By providing this, refugees can easily transition into becoming asylum seekers in a safer country of choice.

# *Literature Review*

# Literature Review

## Humanitarian Refugee Crisis:

## An Economic and Technological Advancement in Refugee Displacement

**Key Words:** Refugee, Superadobe, Displacement, Sand, Materials, Energy Efficient, Building System, Afghanistan.

### Introduction

The current Refugee crisis is rapidly growing every day in various countries worldwide. There are many reasons this has and will continue to occur. Some of the reasons are natural disasters, war, violence, human rights violations, and more. Technological advances can contribute to solutions for the refugee housing crisis. A new technology called Superadobe has the potential to provide a solution. "Superadobe was designed to be used as a human shelter that will give maximum safety with a low financial budget and minimum environmental impact with natural disaster resilience. A form of earth-bag construction using sandbag and barbed wire technology is an economic, time-efficient, energy-efficient and ecologically friendly system developed by Iranian-born architect Nader Khalili." 1 Many researchers find alternative uses for Superadobe, such as creating colorful communities, affordable housing, and building these homes with little materials. This literature review will discuss the development of Superadobe technology, and the different methods researchers use to address the housing crisis for Afghanistan Refugees in a temporary or permanent state.

### Refugee Crisis

The UN2 Refugee convention held in 1951 determined that a refugee is a person who flees their home country because of their fear of being persecuted because

of national origin, race, and religious or political affiliation. While Refugee is a generalized term, there are multiple types of refugees. Along with refugees, there are Asylum Seekers, Internally Displaced Persons, Stateless Persons, Returnees, Religious or Political Affiliation, Escaping War, Discrimination based on Gender/ Sexual Orientation, Hunger, and Climate Change. 82.4 million people are forcibly displaced worldwide. Within that statistic, 6.7 million are from Syria, 2.7 million are from Afghanistan, 2.3 million are from South Sudan, 1.1 million are from Myanmar, and 900,00 are from Somalia. Turkey houses the most refugees at 3.7 million mainly because of geographical proximity to neighboring countries at war and cultural and family ties. 3

### Issues in Afghanistan & Why A Solution is Needed

Afghanistan is a country in the Middle East nestled between Pakistan, Iran, and Turkey that has experienced worsening civil war conflicts since 1987 between anti-communist Islamic guerrillas4 and the Afghan communist government. After 2001 the United States invaded Afghanistan due to the 9.11 US terrorist attack. In August 2021, President Biden removed the remainder of American troops from Afghanistan, causing a mass panic. Afghanistan's government collapsed as the Taliban5 took over Kaul6. This panic caused Afghan natives to forcibly flee their living situations with little time as the Taliban invaded homes and enforced stricter rules. The United Nations has warned that up to half a million Afghans could flee the country by the end of the year and has called on neighboring countries to keep their borders open. 7

1. About CalEarth." CalEarth. Accessed October 27, 2021. <https://www.calearth.org/our-mission>

2. United Nations

3. What Is a Refugee? Definition and Meaning: USA for UNHCR." Definition and Meaning

4. A member of a small independent group taking part in irregular fighting, typically against larger regular forces.

5. A fundamentalist Islamic militia in Afghanistan

6. Capital of Afghanistan

7. The Visual Journalism Team "Afghanistan: How Many Refugees Are There and Where Will



## Current Refugee Housing Solutions

The current refugee housing solutions are not sustainable enough to accommodate the influx of refugees fleeing their countries. As a result, most refugees travel by foot to a safer location in a neighboring country, arriving in neutral territory. Image A shows Afghan refugees crossing to a refugee camp.



Image A

## Origins of SuperAdobe -Materiality - History

Iranian American architect Nader Khalili conceived of and designed Superadobe. At a proposed Nasa symposium in 1984, he presented using earth-bag construction as a visible solution for building in space, such as on the Moon and Mars. Since the cost of taking materials into space would be cost-prohibitive, using readily available materials makes the most sense. To build a SuperAdobe dome home, there is an in-depth list of steps required to make a home that has a central dome<sup>9</sup> and four niches. The Superadobe website claims only to need "ingredients found in nature."<sup>10</sup> These items are synthetic, low UV<sup>11</sup> resistant degradable sandbags, four-point, two-strand, galvanized<sup>12</sup> barbed wire, shovels, tampers<sup>13</sup>, soil, and water. It requires ten steps to create a Superadobe. The materials of Superadobe are almost all-natural and cost less than \$1,000 to build. Image B shows a group of men building a Superadobe home.



Image B

## Benefits

The main advantages of Superadobe are because of materiality. "The use of natural, reversible, and recyclable building materials, good acoustic parameters are essential to maintaining a strong core of the dome. Good thermal mass<sup>15</sup> materials, a wide range of use, harmonic and diverse, economical and environmentally friendly, low housekeeping costs, and anyone can learn this building technology."<sup>16</sup> The construction method doesn't require construction equipment and can be completed with just a few men. The advantages of the dome shape are based around Islamic traditional building methods and the benefits of ventilation which circulate from the top of the dome. Superadobe has the system's energy-sufficient characteristics: ventilation, lighting, and insulation.

"Since the interior space is floor to ceiling earth-bags, the height from roof windows to the floor certifies that the dome roof has accelerated the airflow better because it forms a stacks effect."<sup>17</sup> There are various ways to use ventilation systems for dome-roof ventilation, flat roof ventilation, and varying height ventilation. The R-value<sup>18</sup> of the insulation value proves the importance of extensive energy use; the R-value will yield a low U-value<sup>19</sup>. U-value measures a material's ability to store and transfer heat rather than resist its loss. Eastern walls function as an absorbent mass that can keep warmth and re-radiate<sup>20</sup> into the living spaces as the room cools. This temperature fluctuation is known as the thermal flywheel effect. This effect of the flywheel is a 12-hour delay in energy transfer from exterior to interior. The approximate filling rate is 300 bags per team of 2 per day. This is 150 bags per person per day.<sup>21</sup> "So we expect that the proposed technology is useful for the development of structures at a very low cost. This would provide thermal mass on the inside and barrier to that thermal mass losing its heat to the outside. On the other hand, for hot areas, specifically, the middle east, which the author has analyzed, this external insulation approach could create an environment that warm-up and is challenging to cool again, so building deeper in the group and eliminating insulation is a better approach."<sup>22</sup>

8. <https://www.vaticannews.va/en/church/news/2021-08/pakistan-caritas-afghan-refugees-aid-un-bishops-conferences.html>

9. Hemispherical structure evolved from the arch

10. Kamal, Razia, and Md. Saifur Rahman. A Study on Feasibility of Superadobe Technology

11. Ultraviolet - having a wavelength shorter than that of the violet end of the visible spectrum but longer than that of X-rays

12. Coated with a protective layer of zinc

13. Device used to compact or flatten an aggregate or another powdered or granular material

14. <https://www.calearth.org/tour>

15. property of the mass of a building which enables it to store heat, providing "inertia" against temperature fluctuations

16. Kamal, Razia, and Md. Saifur Rahman. A Study on Feasibility of Superadobe Technology

## Limitations

The disadvantages of SuperAdobe homes are as follows: “requires a lot of people to build a house by hands only, gets difficult after several hours of lifting heavy bags, it takes strength to lift and carry each bucket, and no mention of them in building codes.”<sup>23</sup> When listing the advantages, the author gives facts about the durability and weather resistance and backs these facts up with research and examples. In contrast, the disadvantages lack evidence to support the technologies disadvantages of “Takes a lot of people to build a house by hands only or takes strength to lift and carry each bucket.”<sup>24</sup>

Based on these facts, the author states that the issue with earth-bags is that they provide great thermal mass but truly are not great insulators. “The material does a great job of absorbing, storing, and releasing heat but lacks at preventing the loss of heat or the intrusion of sound.” However, the author continues to analyze the thermal lag<sup>25</sup> calculation and states that if the goal is to keep the heat in, “inhabiting the transfer of heat through walls can be very good”<sup>26</sup> Research shows Superadobe temporary homes can only last a few months, which is a benefit for temporary Refugee housing.

## Community & Family

The scope of application of Superadobe benefits a variety of sizes of families, individuals, and large communities and temporary or permanent solutions. An example of a Superadobe community in a warm climate is Iran’s Hormuz Island. This example houses a larger community of colorful domes to help residents revive their local economy. Interestingly, these domes were built by residents trained in construction skills compared to the other Superadobe locations where only non-experienced builders were constructing the homes.

Image C shows that the island has outstanding, colorful, surreal landscapes. The community has strategically placed clusters, walkways, and other connective spaces for gathering, playing, and resting, creating a sense of community within these SuperAdobes. These colorful, permanent domes echo the terrain landscape compared to temporary ones that lack color and tactful placement. The interior details match the exterior and are bright and colorful. The interior’s construction

is suited to the climate as earth-based materials provide good thermal mass. The earthen walls<sup>28</sup> help absorb the sun’s heat. At night, when temperatures drop, the walls can radiate that stored heat, helping to regulate temperature fluctuations.<sup>29</sup>



Image C

## Conclusion

It’s important to note that there are multiple ways of using SuperAdobe. The first example is Superadobe technology used for quick temporary short-term solutions providing a breakdown of steps to create a Superadobe home. The second example of Superadobe technology uses a diplomatic analysis of the financial and physical cost requirements and the time frame of developing a SuperAdobe home. Finally, the third example of SuperAdobe technology uses a permanent solution for a long-term community space for a financially distressed community. Each example provides an interesting take on the SuperAdobe technology. In addition, it introduces a unique and functional take on this technology.

Among the many benefits of SuperAdobe technology is the history that pays tribute to Islamic Architecture that the paces are inspired by. Providing refugees an option to create a shelter by hand gives refugees a sense of hope and genuine comfort, knowing they will have protection as they continue their journey to become asylum seekers. Superadobe thrives in areas where the application is dry, and low-density rural areas are the best location in areas of warm terrain. However, one might question the use of these spaces long-term if they cannot stay appropriately headed during the cold months.

17. Kamal, Razia, and Md. Saifur Rahman. A Study on Feasibility of Superadobe Technology

18. the capacity of an insulating material to resist heat flow. The higher the R-value, the greater the insulating power.

19. a measure of the heat transmission through a building part (such as a wall or window) or a given thickness of a material (such as insulation) with lower numbers indicating better insulating properties

20. to emit (energy) in the form of radiation after absorbing incident radiation.

21. “Establishment of Low Cost Homes Using Super Adobe Technology”

22. v Establishment of Low Cost Homes Using Super Adobe Technology”

23. Kamal, Razia, and Md. Saifur Rahman. “A Study on Feasibility of Superadobe Technology

24. Kamal, Razia, and Md. Saifur Rahman. “A Study on Feasibility of Superadobe Technology

25. Body’s temperature with respect to time as a result of its thermal mass

26. Kamal, Razia, and Md. Saifur Rahman. “A Study on Feasibility of Superadobe Technology

27. <https://www.treehugger.com/superadobe-presence-domes-by-zav-architects-5091869>

28. constructed by ramming a mixture of selected aggregates, including gravel, sand, silt, and a small amount of clay, into place between flat panels called formwork.

29. Mok, Kimberley. “A Community of Superadobe Earthbag Domes Empowers Its

# Part 1

Afghanistan Refugee Experience  
Design Probe  
Cultural Identity

# What is a Refugee?

Refugees are people who have fled war, violence, conflict, or persecution and have crossed an international border to find safety in another country.

They often have had to flee with little more than the clothes on their back, leaving behind homes, possessions, jobs, and loved ones. Refugees are defined and protected in international law.

The 1951 Refugee Convention is a critical legal document and defines a refugee as:

“Someone unable or unwilling to return to their country of origin due to a well-founded fear of being persecuted for race, religion, nationality, membership of a particular social group, or political opinion.”



**1%**  
of the world's  
population is  
displaced



**80%**  
of the world's  
displaced  
people are

in countries or territories affected by  
acute food insecurity and malnutrition

**26M** *Refugees*

**45.7M** *Internally Displaced People*

**4.2M** *Asylum Seekers*

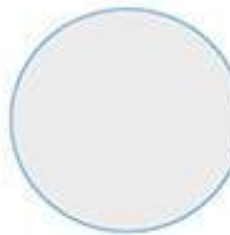
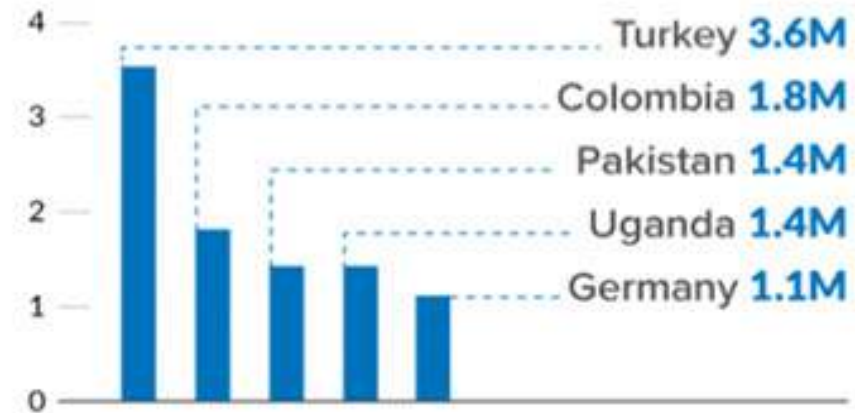


**73%**  
Hosted in  
neighbouring  
countries \*



**68%**  
Came from just  
5 countries \*

### TOP HOSTING COUNTRIES

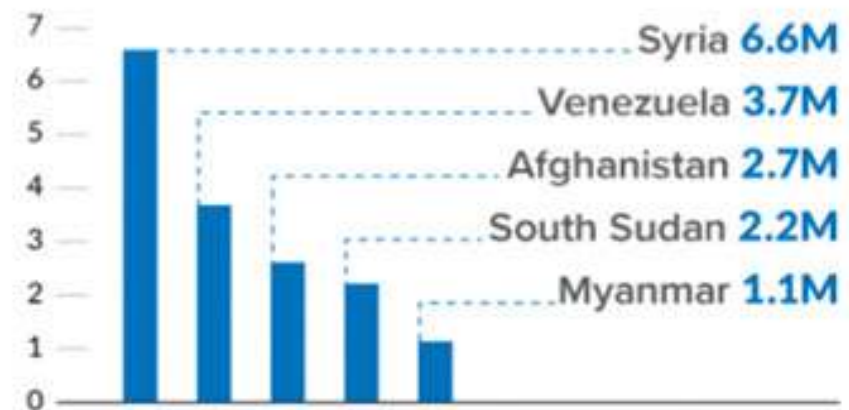


**5.6M**  
Returnees  
(in 2019)



**85%**  
Hosted in  
developing  
countries \*

### TOP SOURCE COUNTRIES



**40%**  
of the world's  
displaced people  
are children

**107,800**  
Resettled to 26 countries  
(in 2019)



**4.2M**  
Stateless people

**2M**  
Asylum applications  
(in 2019)

# Design Probe Refugee Experience

The experience of the Chung Family of 12 traveling from South Vietnam to Singapore to Arkansas, US.

Q: Why did the Chung Family become Refugees?

A: South Vietnam's fall to the communist in April 1975

Q: How many of the family members fled South Vietnam?

A: 12 Family members + 192 others from the community

Q: What method of transportation did they use?

A: Fishing Boat

Q: What personal items did they bring?

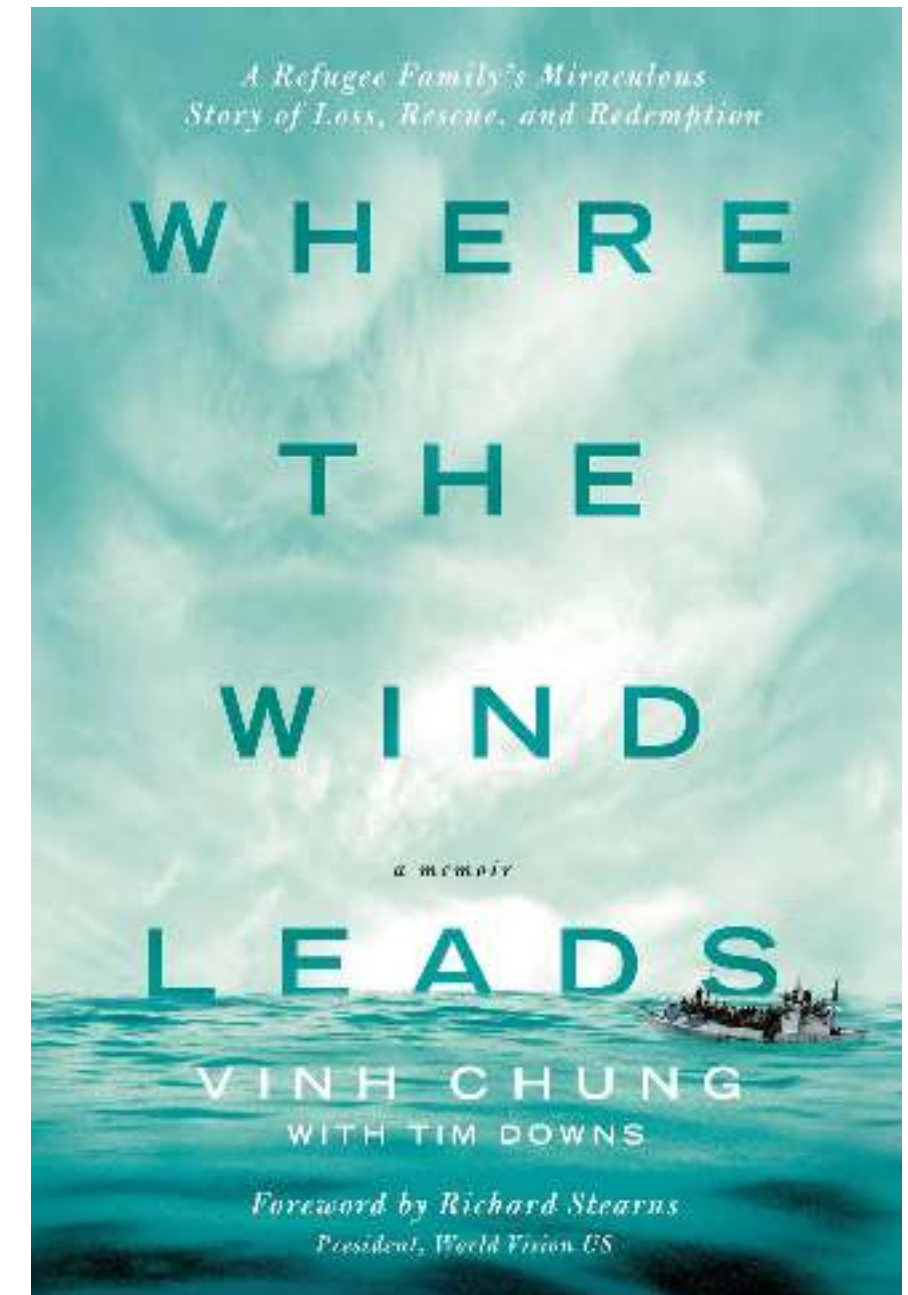
A: Furniture, gold, cash, jewelry pots, clothes.

Q: What sea did they travel by?

A: South China Sea

Q: What difficulties did the Refugees en route?

A: Seasickness, sea pirates, engine failure, lack of food and water, weather, violence.



# Design Probe Refugee Experience

After a treacherous journey from South Vietnam to the Malaysia coast, conditions began to worsen for the Chung Family. Unfortunately, the make-shift beach tents of sticks and twigs couldn't protect the refugees from the harsh summer sun and brutal sandy conditions.

The Malaysian officials were not pleased to have 192 refugees appear in their country and forced the family to leave the island. The group of 192 traveling was put into three fisherman boats with minimal fuel, food, and water and forced to leave the coast of Malaysia as they were not welcome.

Image A paints a picture of the Chung family unknowingly drifting out to the South Vietnam sea with little supply and minimal direction of travel. Finally, after seven days without food and water, a large ship passed the packed Chung family boat and took the family onto the ship, and gave them shelter, food, and safety.

This dangerous journey left many of the 192 passengers ill, malnourished, and lost hope. Finally, a miracle occurred when a large ship took each passenger onto the ship.

It is unknown where the other fisherman boats are or if they were ever rescued.



# Difficulties Within Refugee System

## *Pre-Migration*

Lack of livelihoods and opportunities for education and development, exposure to armed conflict, violence, poverty and persecution.



## *Migration Travel*

Exposure to challenging and life-threatening conditions including violence and detention and lack of access to services to cover their basic needs.



## *Post-Migration*

Accessing health care and other services to meet their basic needs. Poor living conditions, separation from family members and support networks, possible uncertainty regarding work permits and legal status asylum application.



## *Integration*

Poor living and working conditions, unemployment, assimilation difficulties, challenges to cultural, religious, and gender identities, challenges with obtaining entitlements, racism.





# Elements of Afghanistan Humanitarian Crisis

## 1 | Environmental

Afghanistan refugees are often fleeing by foot to reach a safer area. Many refugees travel by bus, train, boat or plane. There are a variety of possible routes to take by foot which can be strenuous on the body and mind with lack of proper equipment. Weather plays a different part of the environmental impact.

## 2 | Cultural Identity

Moving to an unfamiliar environment, often of a completely different culture, significantly predicted depression in refugee populations, more so than exposure to war in their countries of origin did. Other barriers to joining new communities, or acculturation, include not being able to speak the local language, struggling to find employment, and systematic discrimination

## 3 | Relocation

Lack of safety plays an integral role in how refugees experience relocation, as well as their subsequent mental health. Exposure to violence and unsafe environments occurs throughout the relocation process, beyond their countries of origin.

## 4 | Physiological

Due to the likelihood of exposure to multiple violent events, refugees are particularly vulnerable to the psychological aftereffects of experiencing violence, which include the development of PTSD, anxiety, psychosis, and schizophrenia. About one out of three asylum seekers and refugees experience high rates of depression, anxiety, and post-traumatic stress disorders

## 5 | Estrangement

Often, refugees are unable to bring their whole family with them. Leaving family members behind and advancing through the stages of relocation alone leads to intense anxiety for the safety of those left behind

## 6 | Navigation

Afghanistan refugees are often fleeing by foot to reach a safer area. Many refugees travel by bus, train, boat or plane. There are a variety of possible routes to take by foot. The red arrow indicates the path refugees take from Afghanistan through Iran; passing through the Van Providence border of Turkey and eventually to Europe.

## 7 | Education

In refugee camps, children face obstacles related to their education, as well. Children's education is therefore often disrupted, especially in contexts of heavy military activity

## 8 | Individual

Refugees often travel in large groups, but that doesn't necessarily mean that personal privacy shouldn't be considered in the refugee community. Providing homes specifically for women and children helps reduce gender based violence and aggression towards women as they travel toward a safer route. Having a specific area for women and children helps create a sense of safety and privacy.

## 9 | Families

Refugees often travel in large groups. These groups of people are made up of prominent family members and extended families. This is a cultural aspect as well as a safety aspect. A recent article shared a quote, "There is safety in numbers. As a group of 300 refugees began a long journey of traveling."

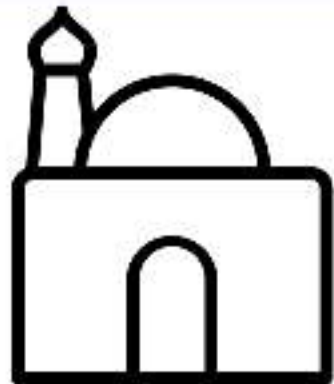
# Afghanistan Cultural Design Identity

## Community

Aspects of Middle Eastern cultures are fundamental to the everyday lives of individuals. In traditional Arab societies, the family unit is an extended family; cousins, grandparents, second cousins, in-laws, nieces, nephews, and more.

Migration to the cities has broken up some of these extended families, and the number of people living only with their immediate family in urban areas is increasing.

Families are considered to be at the heart of every Muslim community.



## Culture

The middle eastern families tend to be hierarchical. Unfortunately, this vertical style can lead to miscommunication between parents and children.

“Arab culture, the dominant culture of the central Middle East and the founding culture of Islam, is both a brilliant construction of human creativity and a practical response to many human problems.”

The family unit should encourage the individual to see themselves as part of a wider community and discourage anti-social behavior.

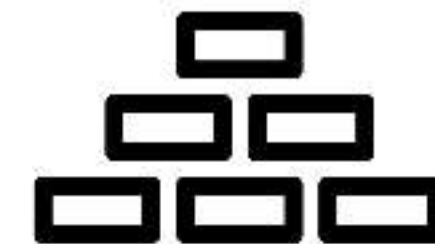


## Material

The most common Middle Eastern architectural building materials are bricks, chalk, tiles, stone, wood, and glass.

Initially, raw adobe was used as the primary material, then replaced by bricks, and the most used in mosques. These materials are found in older architecture and current architecture.

“Most mosques also feature one or more domes which are symbolic representations of the vault of heaven.”



# Afghanistan Cultural Identity

Afghanistan is multicultural and multi-ethnic, it's is a land-locked Asian country of 251,825 square miles bordered by Pakistan, Iran, Turkmenistan, Uzbekistan, Tajikistan, and China. The great majority of people are rural (80 %).

The population of Kabul peaked at more than one million in the 1980s but dropped after the fall of the Communist regime in 1992. Many inhabitants are bilingual or trilingual, and all the major languages are spoken in the neighboring countries.

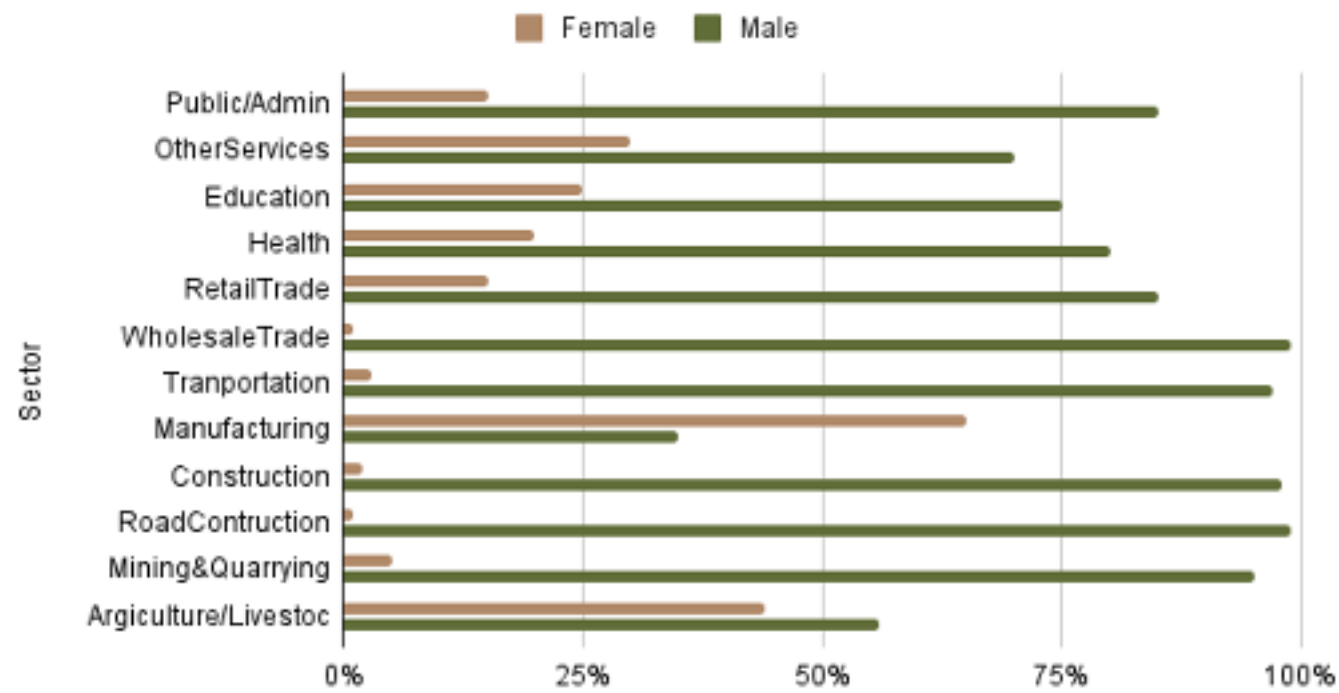


Blue Mosque  
Mazari Sharif  
Afghanistan

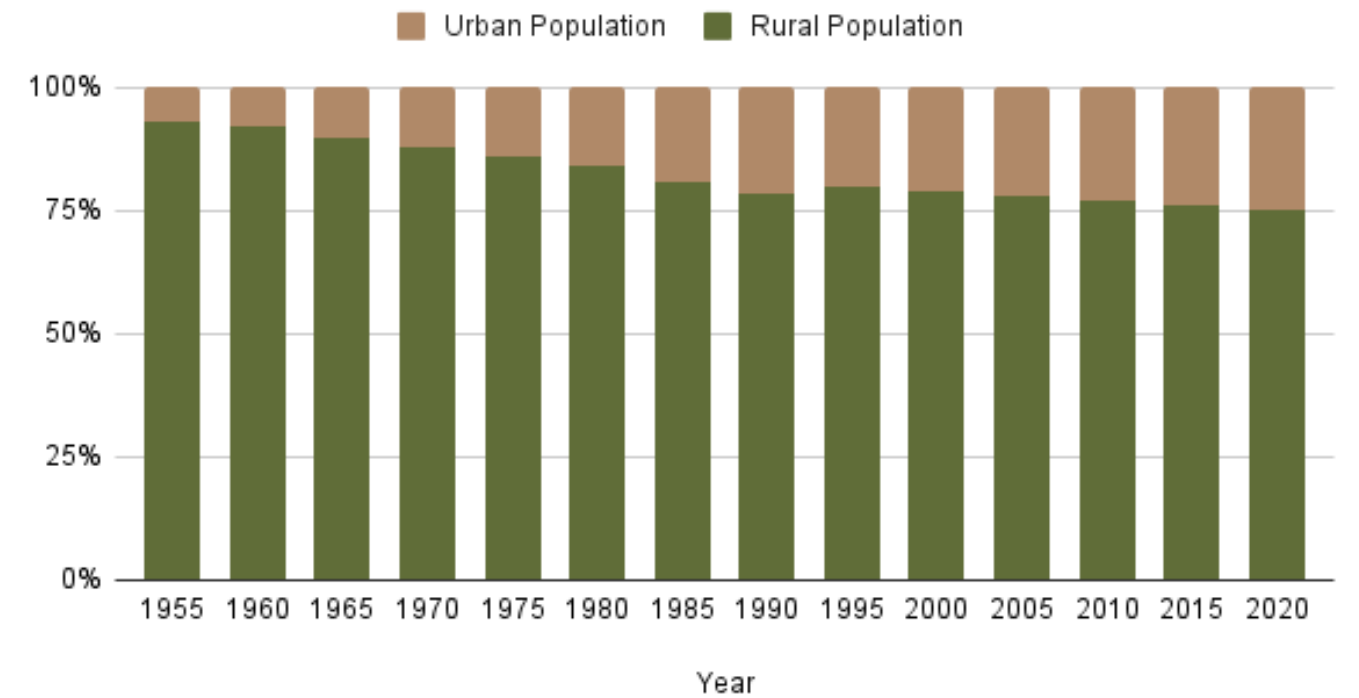


# Afghanistan Organizational Structure

*Gender Distribution of Workers*

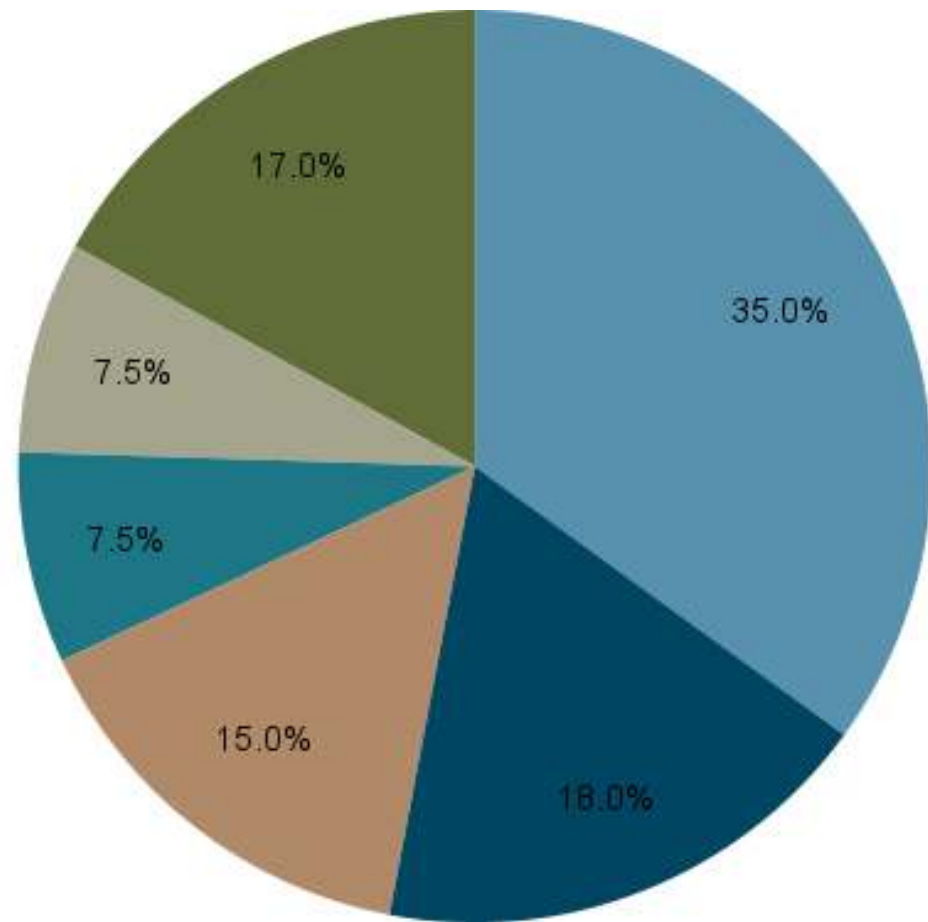


*Rural Population VS Urban Population from 1955-2020*



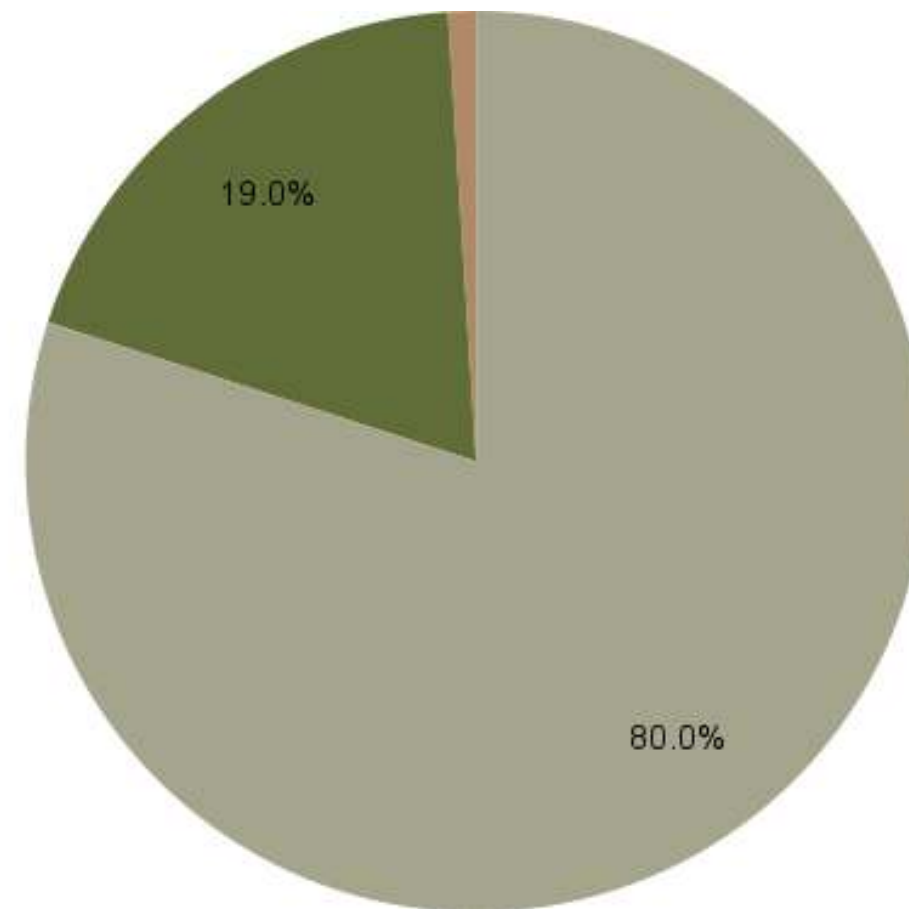
# Cultural Identity

*Religious Affiliations*



- Other
- Iran
- Pakistan
- Kazakhstan
- Uzbekistan
- China

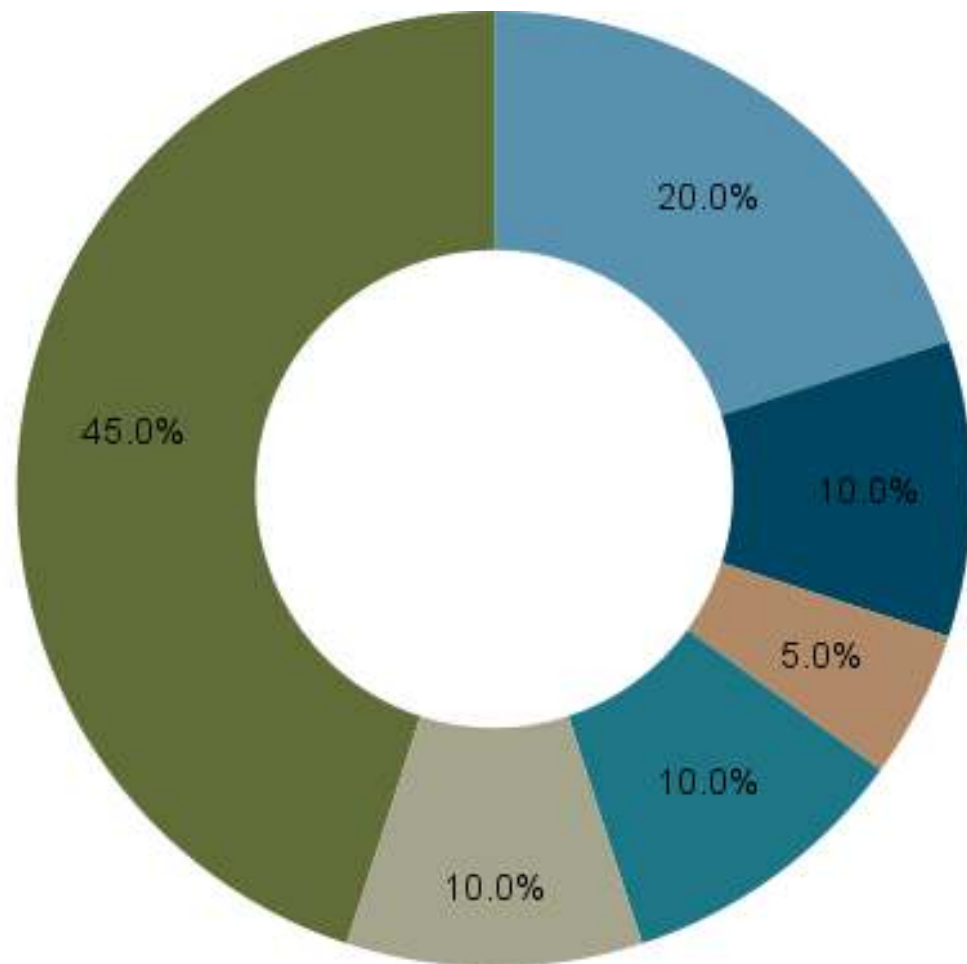
*Various Ethnicity*



- Sunni Muslim
- Shii Muslim
- Other

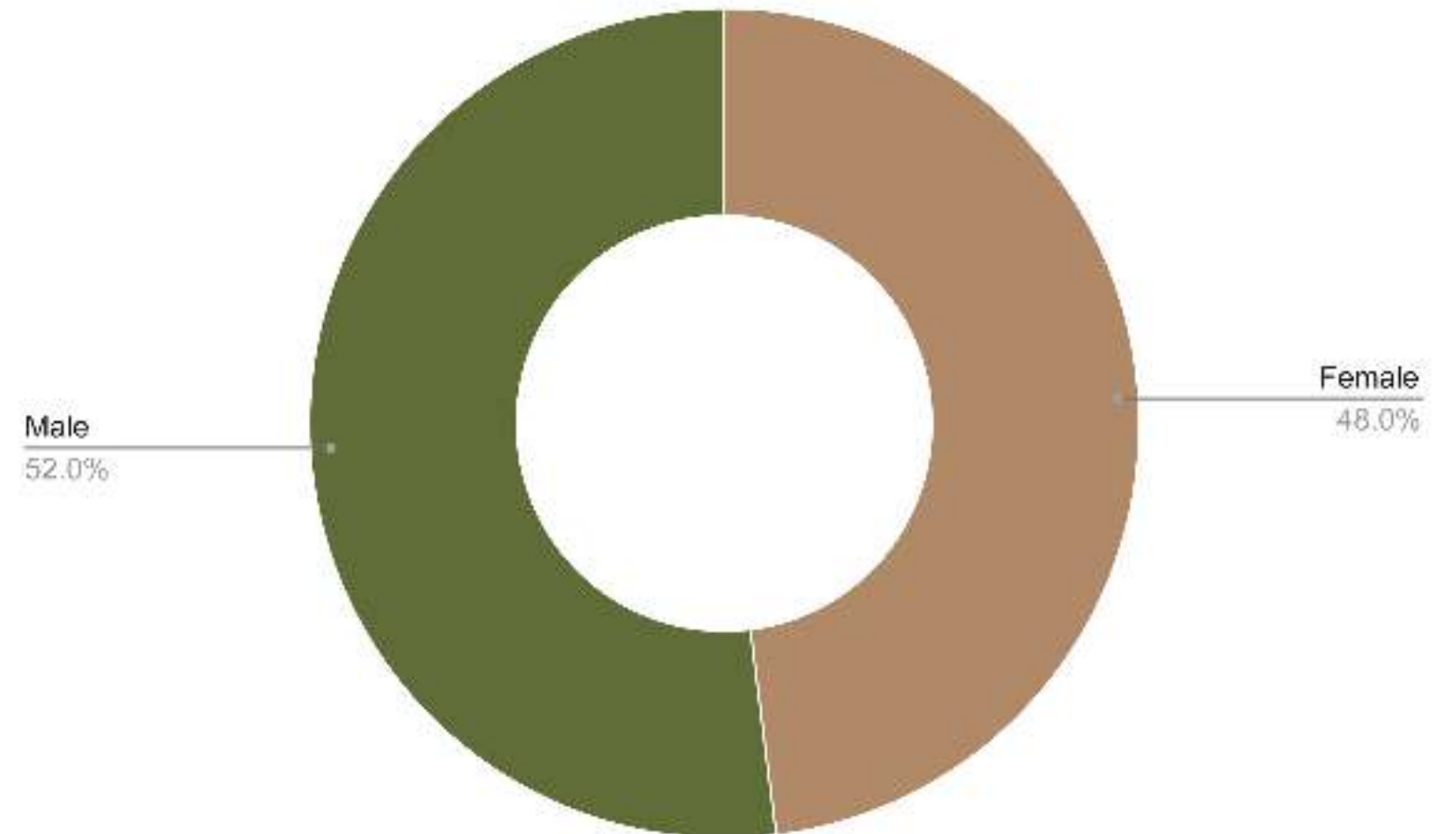
# Cultural Statistics

*Major Import Sources*



- Sugar & Fat
- Produce
- Other
- Meat
- Dairy & Eggs
- Grain

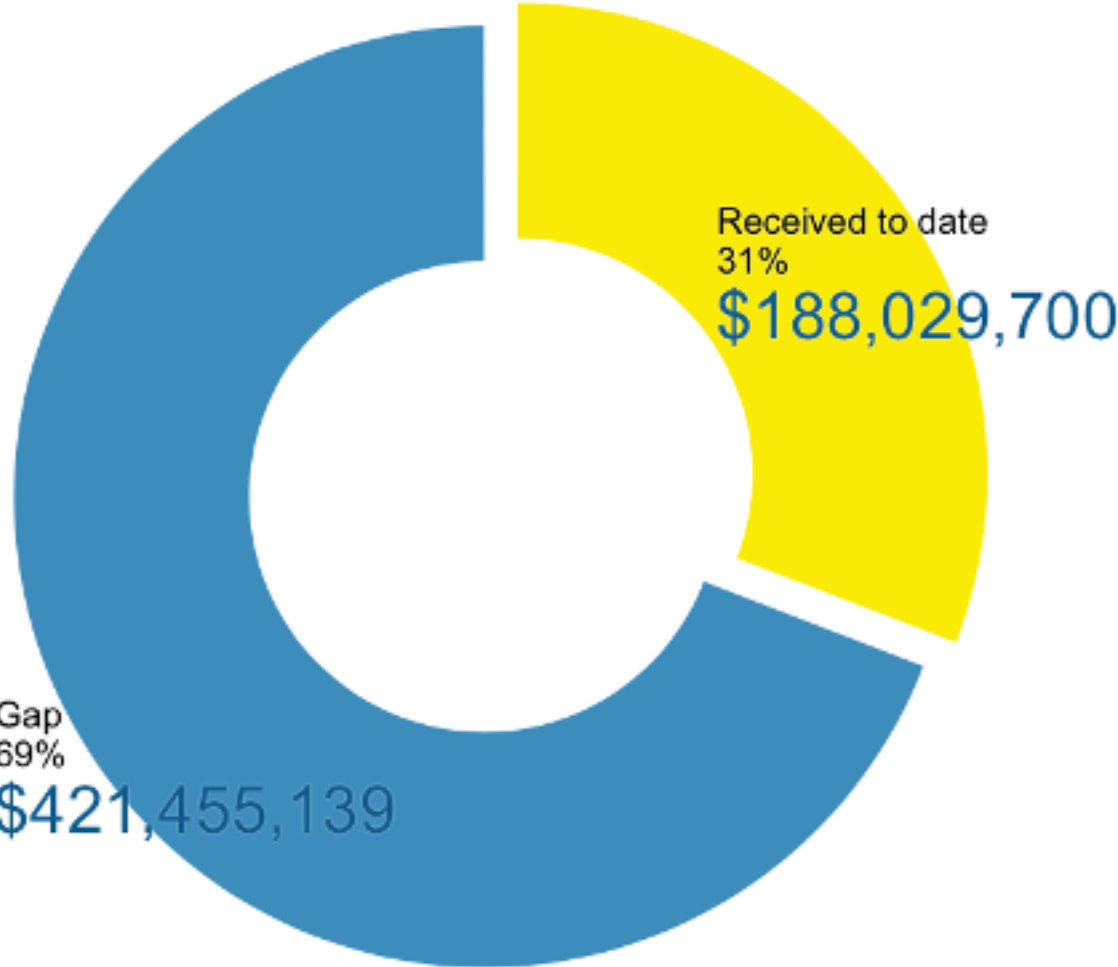
*Male VS Female Ratio*



# Situation Funding 2020

**\$609,484,839**

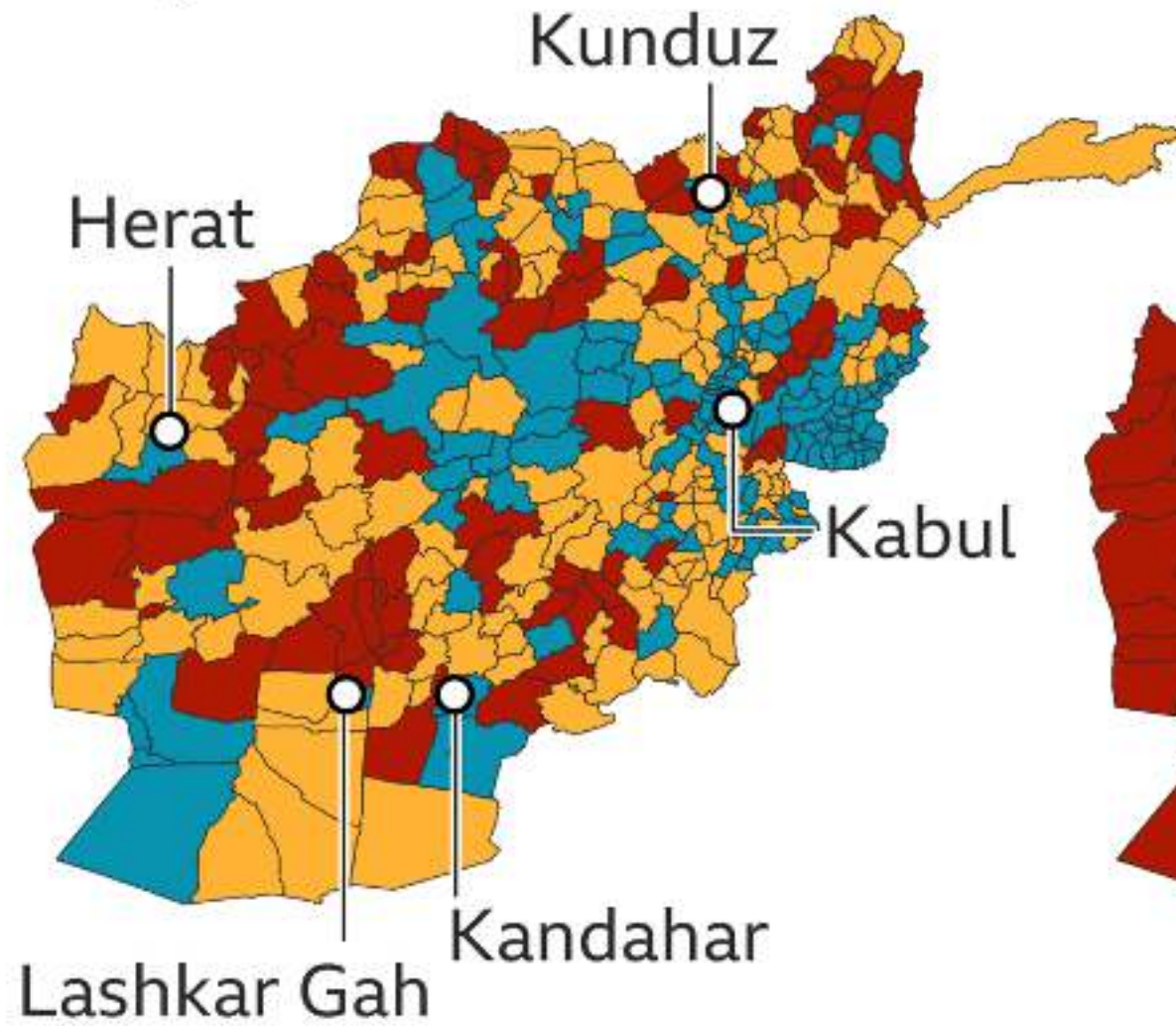
Total appeal



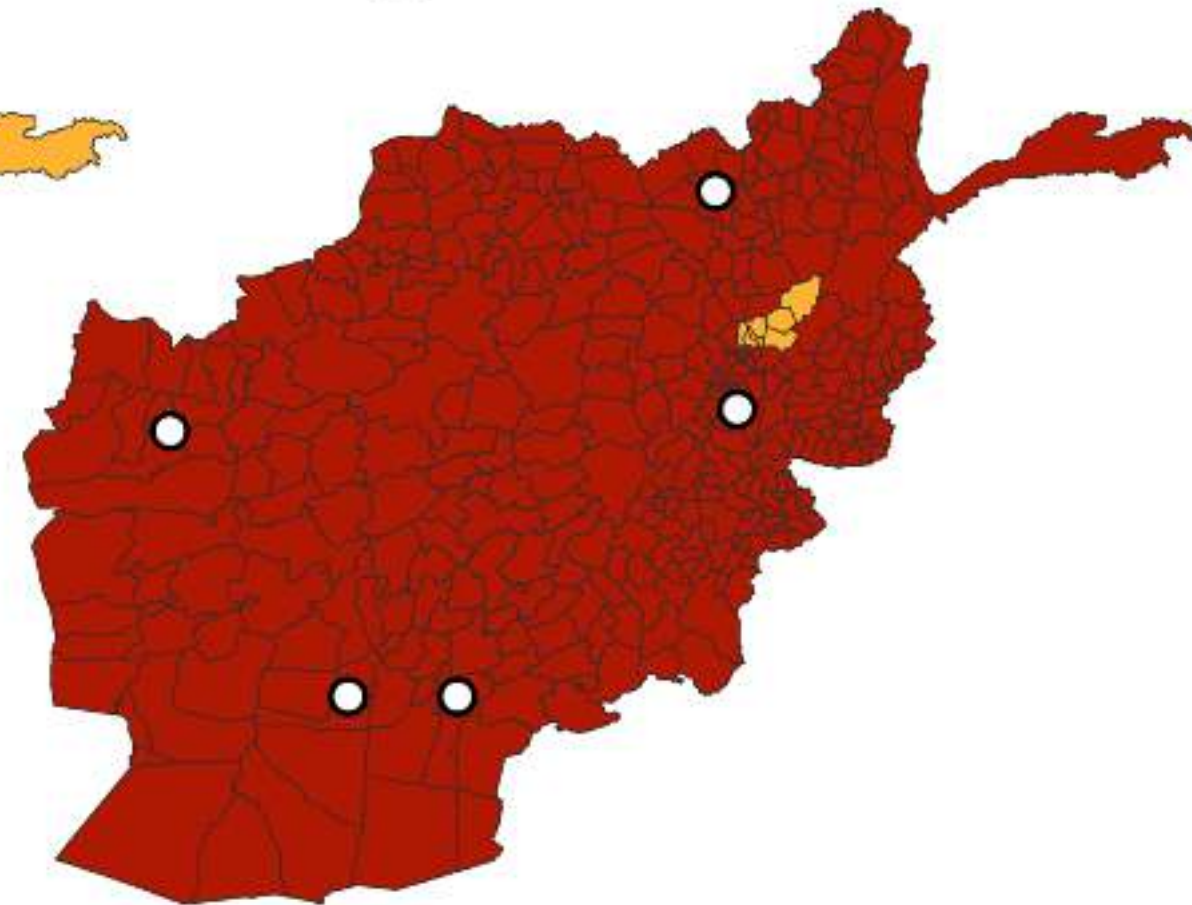


# Displacement Reasons

9 July



16 August



Contested



Government



Taliban control



0





# Criteria for A Safe Humanitarian Space

## Security

A safe distance from the border, not more than a day's walk. Average living space per person 484 Sq ft.

## Geography

Safe geographical features. Easy access to water supplies and waste management.

## Accessibility

Adequate and reliable access to roads to ensure logistics and supplies.

## Services



Housing



Registration



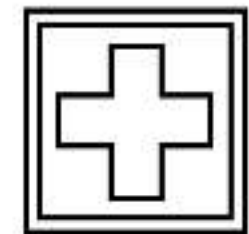
Water



Sanitation



Healthcare



Emergency

# Part 2

## United Nations High Commissioner for Refugees Supplies and Sponsorship

# What is UNHCR?

The United Nations High Commissioner for Refugees is a UN agency mandated to aid and protect refugees, forcibly displaced communities, and stateless people and assist in their voluntary repatriation, local integration, or resettlement to a third country.



Our primary purpose at UNHCR is to safeguard the rights and well-being of people forced to flee. Together with partners and communities, we work to ensure that everybody has the right to seek asylum and find safe refuge in another country. We also strive to secure lasting solutions. UNHCR relies almost entirely on voluntary contributions

## Who it helps?



**Asylum Seekers:** An individual who is seeking international protection.



**Returnees:** People who have finally returned home.



**Refugees:** People fleeing conflict or persecution.



**Stateless People:** People who do not have a nationality and can struggle to realize their human rights.



**Internally Displaced People:** People who seek safety in other parts of their country.

## Essential Items Provided by UNHCR



*Life Jackets, Medicine, Bandages, Syringes, Sunscreen, Slings, Crutches, Bug Spray.*



*Water, Baby Formula, Snacks, Dried Foods, Dried Fruits, Coffee, Tea, Sugar.*



*Adapters, Chargers, Phones, Headphones.*



*Hijab, Turban, Scarfs, Childs Apparel, Winter Apparel, Jackets, Shoes, Backpacks, Purses, Wallets.*



*Nation ID, Passport, Social ID, Bus/Plane Tickets, Vaccinations.*



*Pillows, Shampoo, Conditioner, Deodorant, Toothbrush, Toothpaste, Toilet Paper, Pads, Tampons.*

# Elements of UNHCR Sponsored Refugee Community

## Element 1

*Community Center: UNHCR Sponsored Prefabricated Community Centers used for UNHCR Volunteers to assist refugees in the administrative resettlement process.*

## Element 2

*Housing Opportunity: UNHCR Sponsored Built on site 3D Printed Dome Housing. Individual Units to tailor refugees traveling alone and family units for larger family members.*

## Element 3

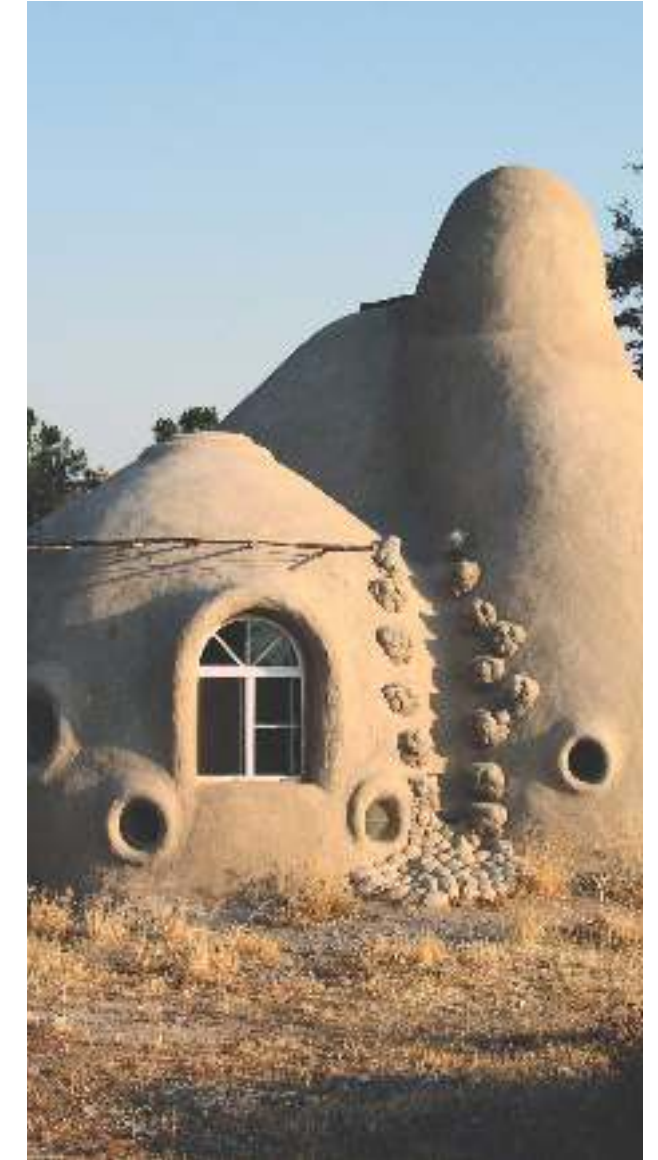
*Hybrid: Unique hybrid of the permanent prefabricated Community Center to aid in the resettlement process and support refugee efforts. Built on-site 3D refugee housing for temporary lodging for families and individuals will circulate the community center to create a sense of harmony of both facilities.*

# Part 3

Super Adobe Technology  
Design Probe



# SuperAdobe Technology Exterior



# SuperAdobe Technology Interior



# Design Probe Material Analysis



+



+



+



+



**5**

=



Materials required to build a Superadobe Home:  
1. Sand 2. Soil & Water 3. Degradable Sand Bags 4. Barbed Wire 5. Shovels + Tampers

# Design Probe Refugee Crisis



Refugees often flee with just the clothes off their backs.

When thinking about the essential items for Refugees, the following comes to mind: shelter, clothes, blankets, water, food, chairs, sleeping bags.

During a Refugee's travel route, the item they carry must be essential to the path taken.

# Part 4

Design Solution Elements  
Technology  
Materiality

## Solution Element 1 - UNHCR Sponsored Prefabricated Modular Community Centers



## Solution Element 2- UNHCR Sponsored 3D Printed Housing



## Solution Element 3

UNHCR Sponsored On Site Modular Refugee Housing + Prefabricated Modular Community Center





# Modular Shipping Container Technology



These buildings are formed using recycled containers of 12 meters long; all transformation is done by hand with careful consideration to preserve its raw, industrial form. Applying these shipping containers allows for rapid construction and dismantling that opens up possibilities for re-fabricating the architecture if deemed necessary. Six different stacking designs were carried out, compounded to respond directly to the program.

# Modular Shipping Container Interiors



## Materiality



Steel Beam



Glazing



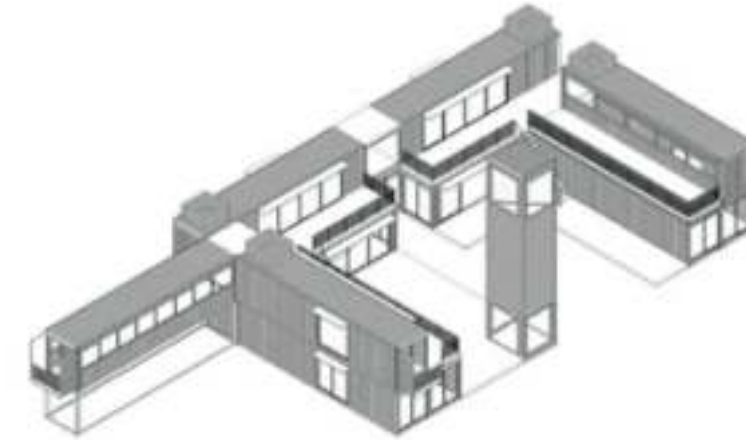
Polished Concrete

# Modular Shipping Container Configuration

Functional Layout 1/6



Functional Layout 4/6



Functional Layout 2/6



Functional Layout 5/6



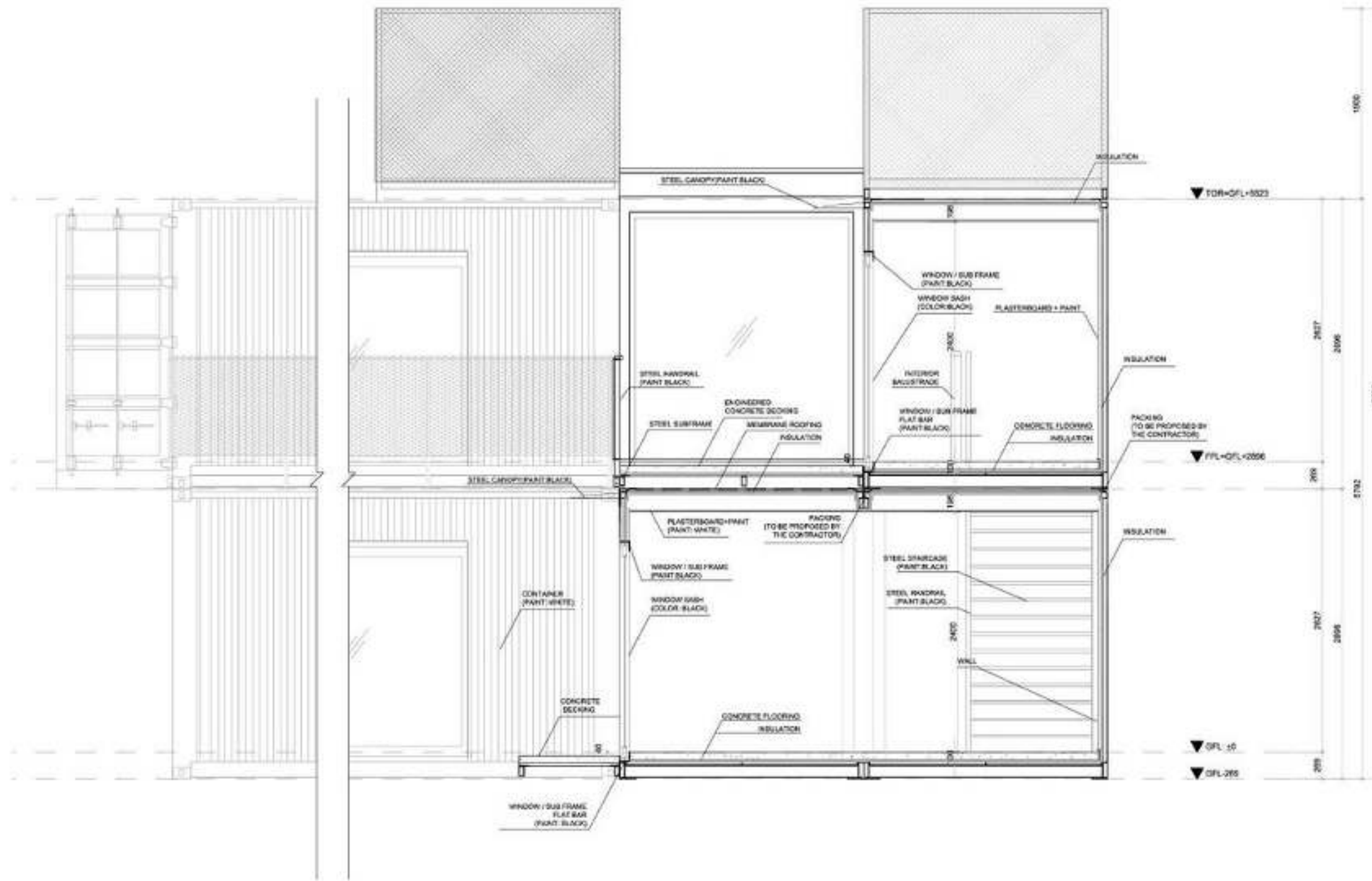
Functional Layout 3/6



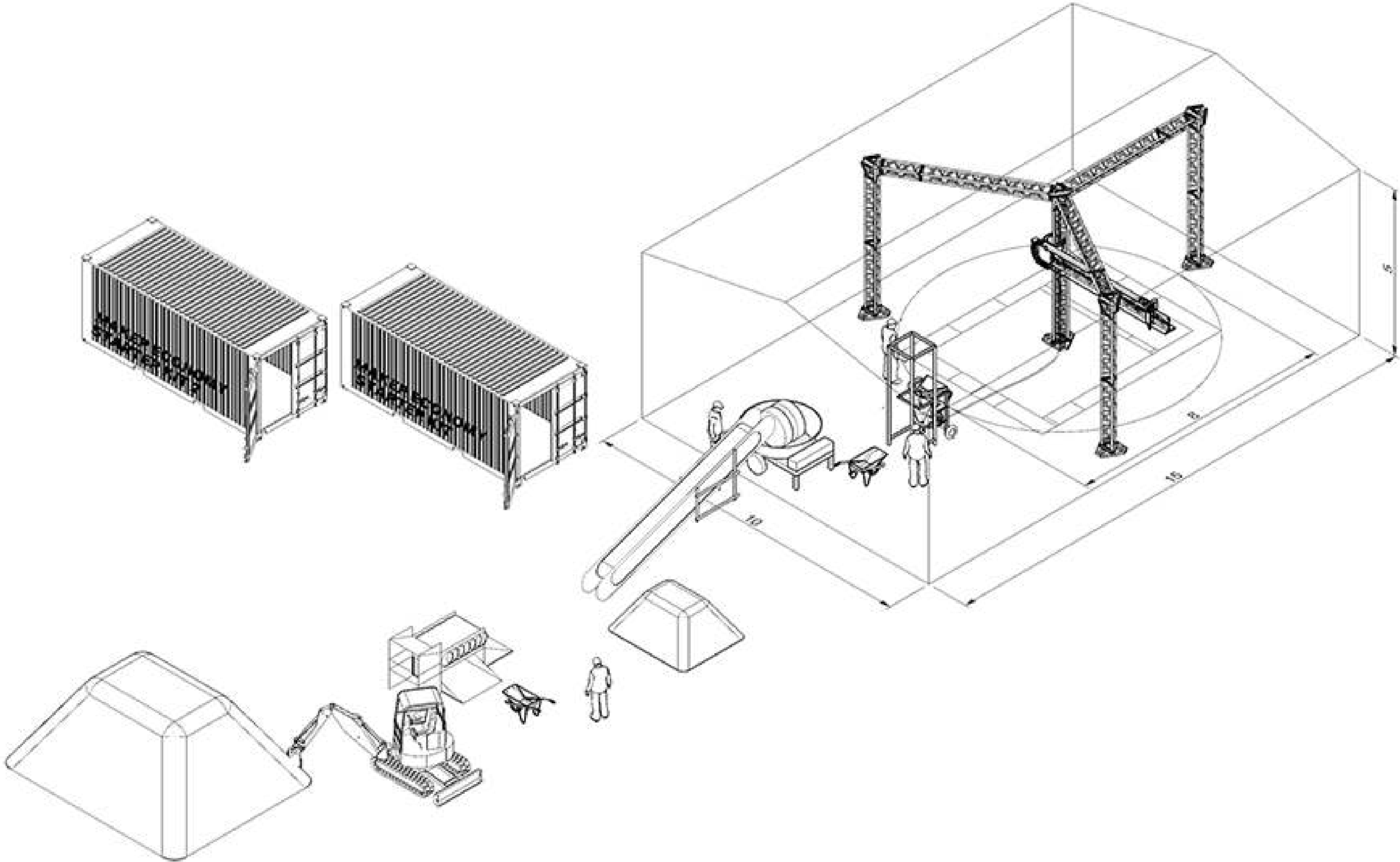
Functional Layout 6/6



# Modular Shipping Container Technology



# 3D Printing Technology | Crane WASP



# Crane Wasp Configuration

1 Crane Wasp Unit:

- 1 Truss Column Height = 4000mm
- 1 Printer Arm Length = 4200mm
- 1 column basement
- 1 movement core
- 1 LDM WASP Extruder XXL

Control System

- Truss Aluminum Pieces ( 3 way set up )
- Installation + Training + Remote
- Earth Screening
- Earth Mixture
- Earth Moving
- 2 Containers

Interface: WiFi Remote Control

Physical Dimensions:

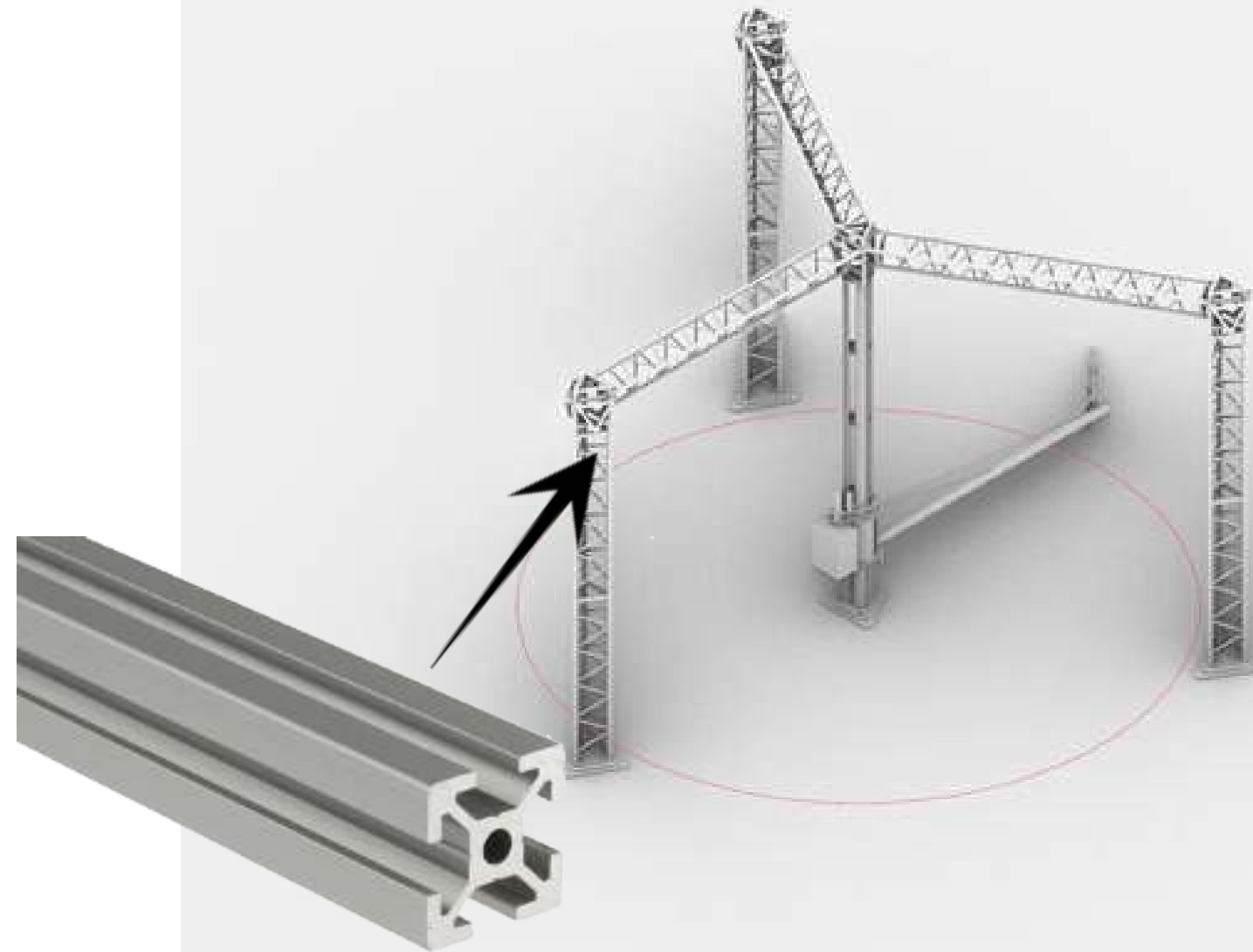
Column Height 4050cm arm length 3300 cm

Machine weight: 150 kg

Temperature:

Use: 10-40 C

Warehouse: 0-30 C



Aluminum Steel Frame

## 3D Printing Technology | Manufacture

The single module can work self-sufficiently by printing fluids of different kinds: cement, bio cement, raw dough. Moreover, once you have a single module, you can expand it by adding traverses and printer arms, thus generating an infinite digital manufacturing system.

It is not necessary to “cover” the entire area involved in the construction with the printing area of the WASP Cranes because they can be reconfigured and can advance with a generative attitude depending on the growth and shape of the building. More WASP Cranes, when working together, have a potentially infinite printing area and can be set by the on-site operators following the evolution of the architectural project. On-Site 3D printing technology can build homes with a maximum speed of 300 mm/s and an entire printing area of 50 sqm per unit.



## 3D Printing Technology | Method

The method of 3D printing employed yields a layered texture that demonstrates its production method.

About 200 printing hours are required to build each unit, consisting of 350 clay layers, each 12 mm thick.

Several homes can be printed simultaneously using multiple Crane WASP 3D printers.





## 3D Printing Technology | Method

Crane WASP, The Infinity 3d printer, is a modular collaborative 3D printing system. It reinterprets the classic building cranes from a digital manufacturing point of view.

It is composed of the leading printer unit that can be in different configurations. The print area of the single module is 6.60 meters in diameter for a height of 3 meters.



## 3D Printing Technology | Method

A WASP employee stands near the siding for scale. The company's printer can create buildings up to 21 feet in diameter and 10 feet in height.

The siding of the dome shows multiple layers of clay stacked one on top of the other. The slow, systematic process guarantees resiliency in various climates and varying weather conditions.

The method of 3D printing employed yields a layered texture that demonstrates its production method.

Two hundred printing hours are required to build each unit, consisting of 350 clay layers, each 12 mm thick.



## 3D Printing Package

1. Crane Wasp
2. Deltawasp 3MT
3. Deltawasp 40 70
4. Deltawasp 20 40
5. Clay Kit
7. Tools and Raw Material Kit
8. SD Card

The Starter Kit is born to build residences using local, natural recycled, or standard building materials. Thanks to this technology, all gathered Knowledge can be reproduced several times and spread everywhere through the web. The necessary Knowledge to set up the Starter Kit is supplied online, using some tutorials that drive the users to realize their ideas. Together with its contents, the house project is open source and allows project managers, designers, engineers, architects to enter the website and take or exchange contents.



# Earth Based Materiality



Clay



Concrete Mortar



Geo Polymers



Aluminum Steel Frame

## Earth Based Materiality | Clay

Clay is a soft, loose, earthy material containing particles with a grain size of fewer than four micrometers.

It forms due to the weathering and erosion of rocks containing the mineral group feldspar over vast periods.

A mineral is a naturally occurring crystalline material with a specific or limited range of chemical compositions. There are two clay types primary and secondary clay.



## Earth Based Materiality | Concrete Mortar

Mortar is composed of cement, fine sands, and lime; it is used as a binding material when building with brick, block, and stone.

Mortar is yet another building material composed of cement mixed with fine sands and water, with lime added to improve the product's durability. Adding water to this mix activates the cement so that it hardens or cures, just as with concrete. However, mortar is not as strong as concrete and typically,

It is not used as a sole building material. Instead, the "glue" holds together bricks, concrete blocks, stone, and other masonry materials.



## Earth Based Materiality | Geopolymer

Geopolymers are a new technology that provides an alternative to Portland cement used in concrete and masonry. Geopolymers have primarily relied on fly ash, a byproduct of burning coal, or blast furnace slag, a byproduct of iron and steel production.

These industrial waste products are available only adjacent to coal-fired power plants and steel production facilities. The world does not produce enough to meet the demand for concrete products. In place of these materials, Watershed Materials' technology activates globally abundant natural clay-based minerals to form strong geopolymer reactions.

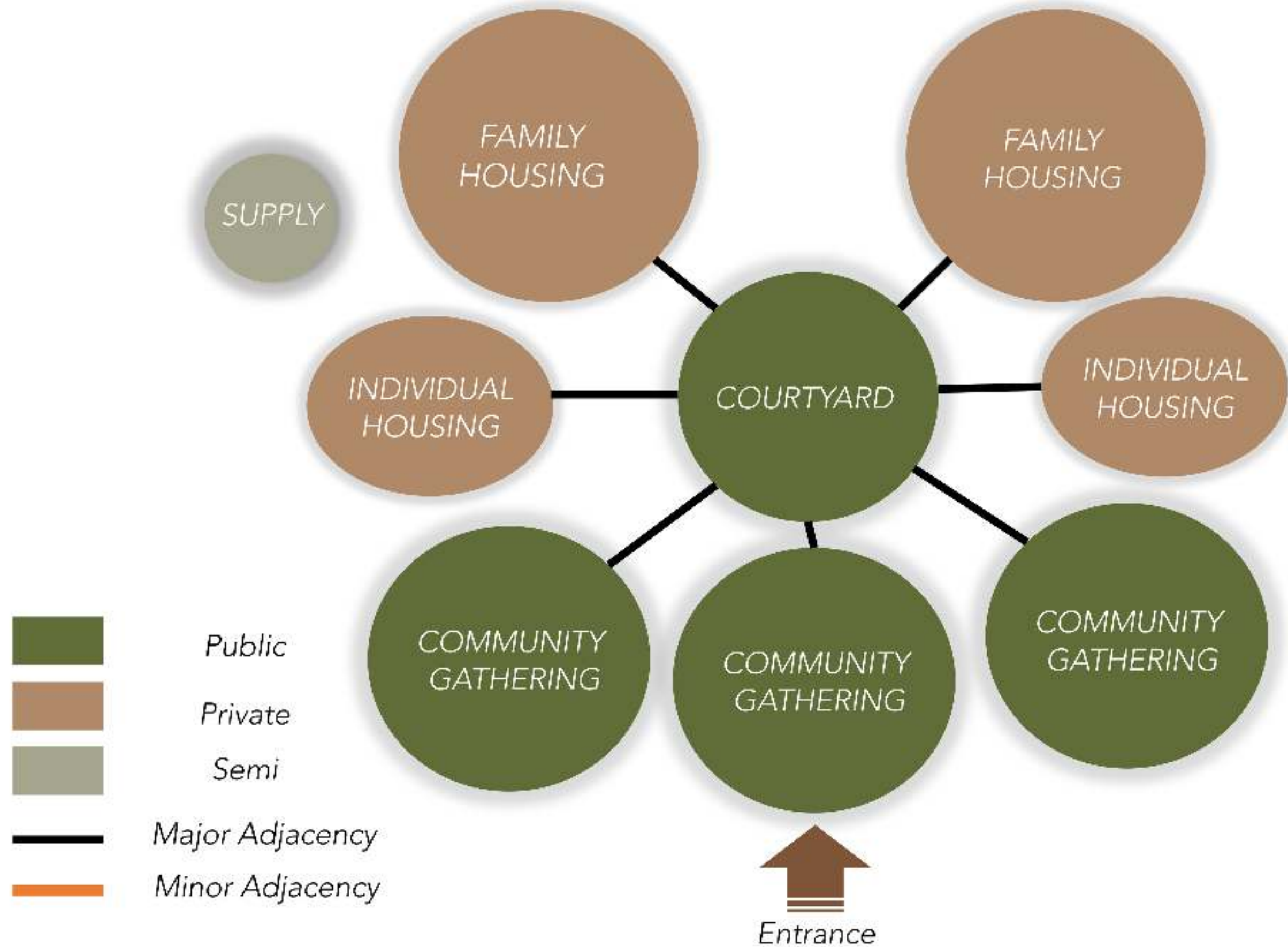


# Part 5

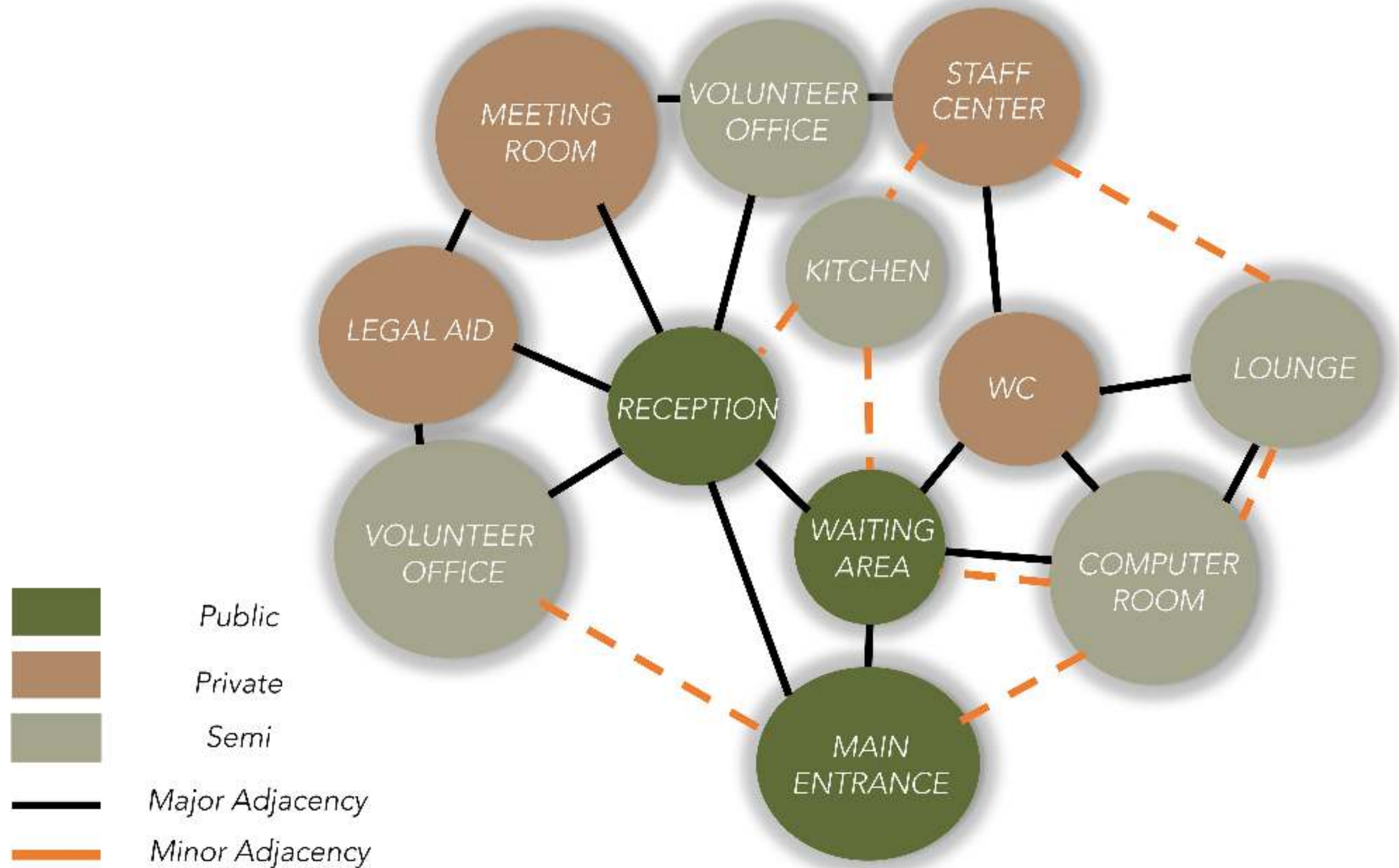
Bubble Diagram  
Process Sketches



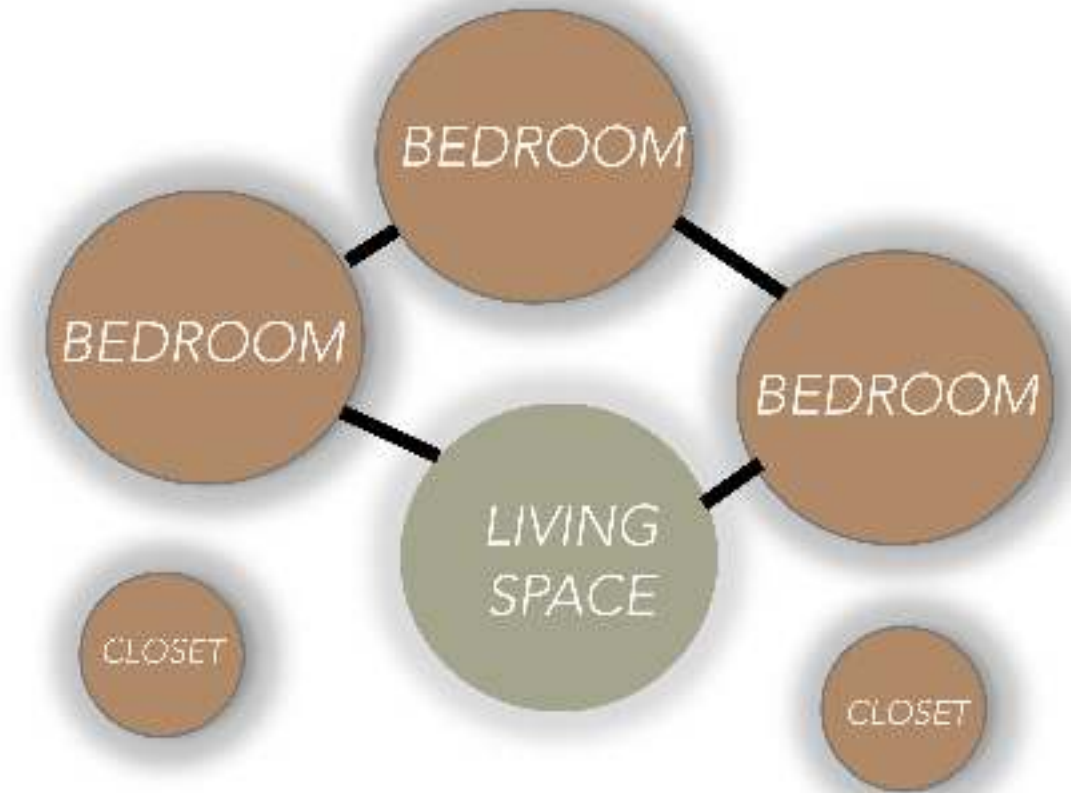
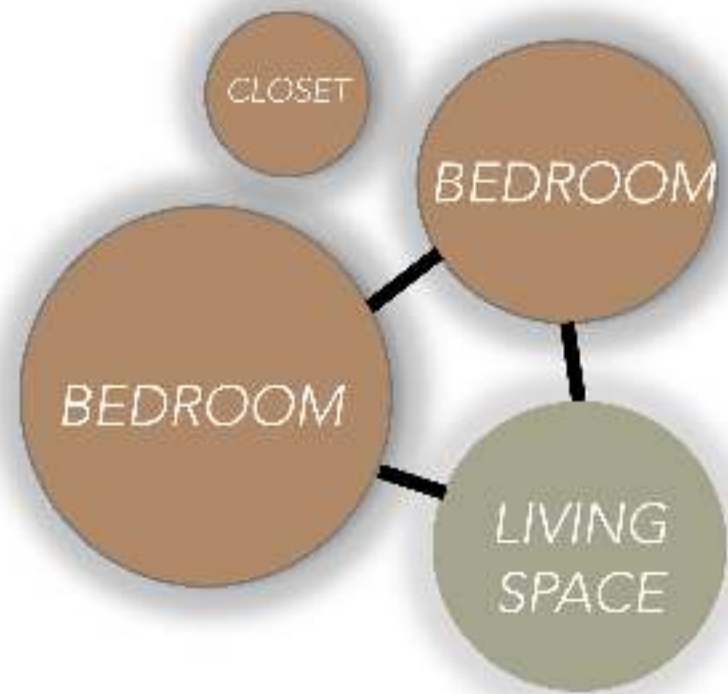
# Refugee Camp Bubble Diagram



# Community Gathering Bubble Diagram



# Individual & Family Housing Bubble Diagram



*Public*

*Private*

*Semi*



*Major Adjacency*

*Minor Adjacency*

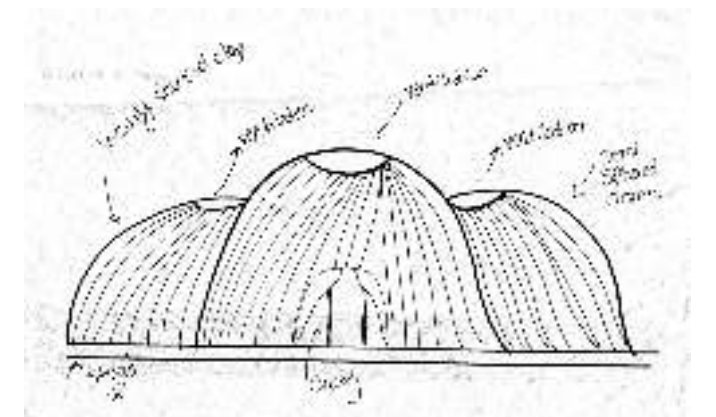
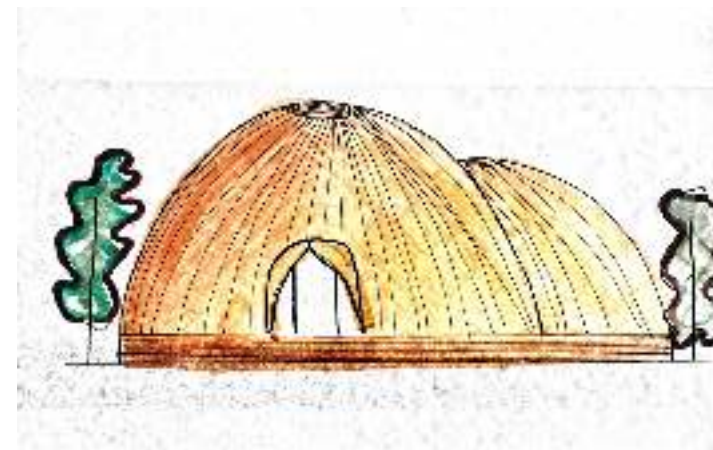
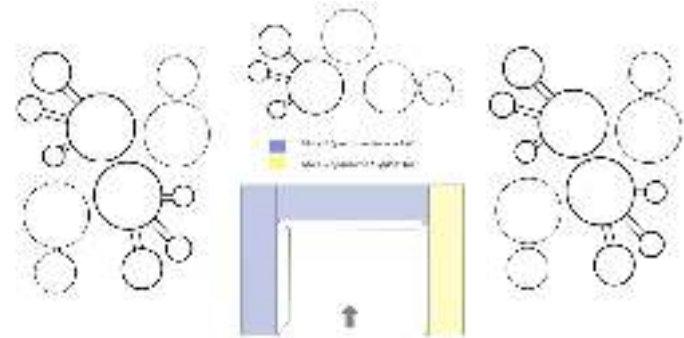
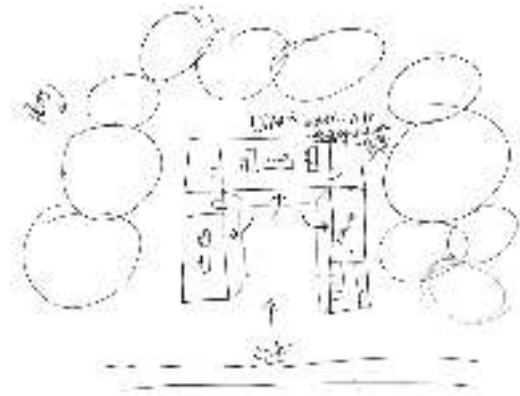
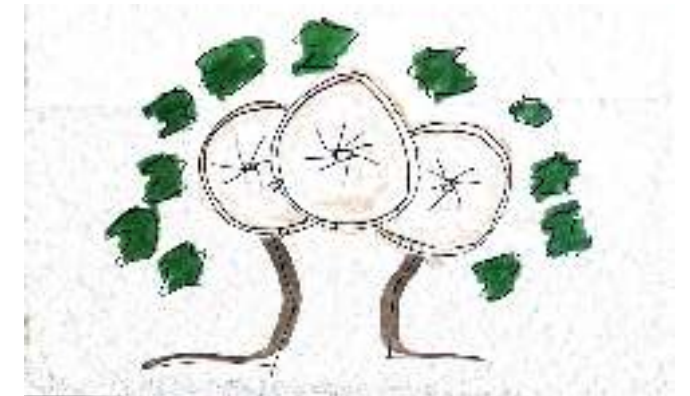
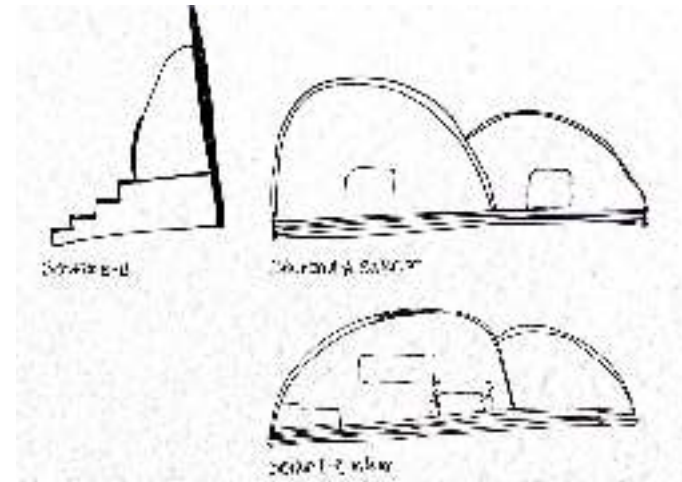
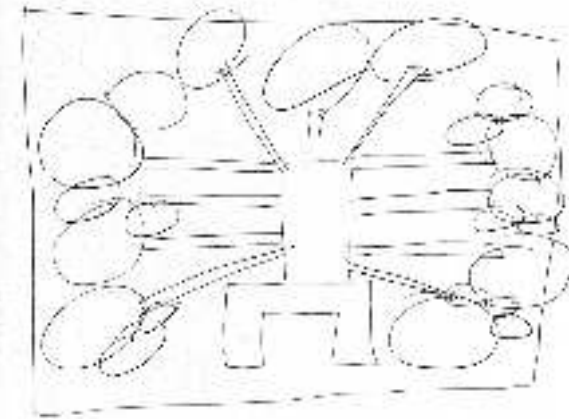
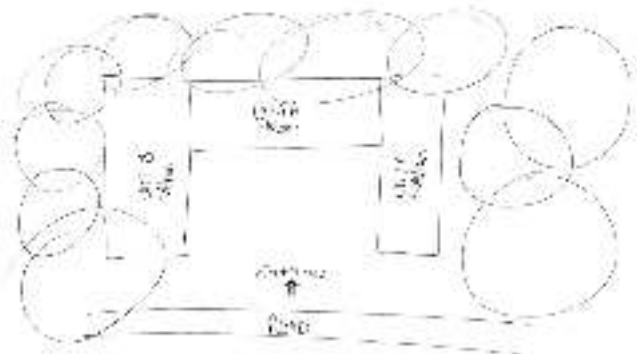
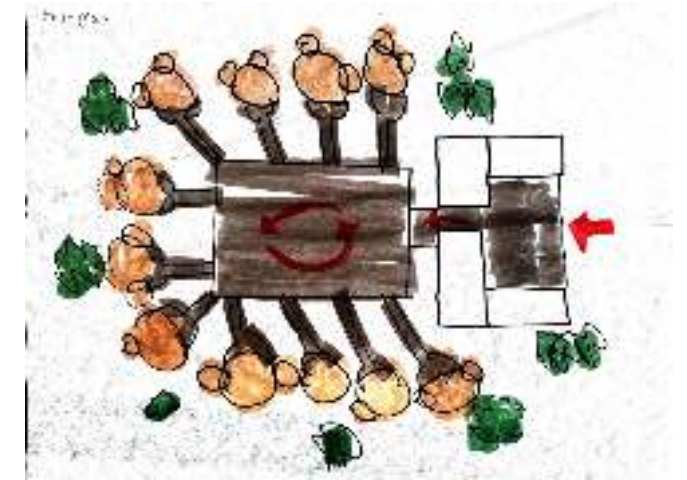
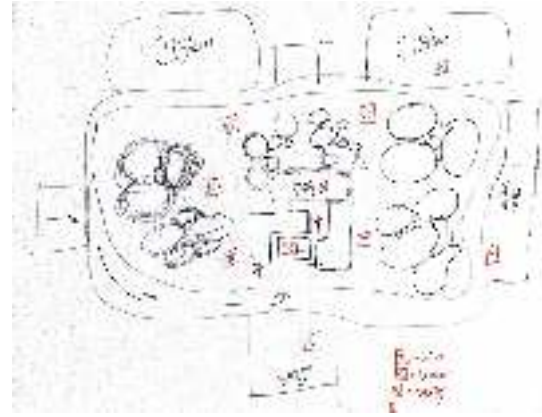
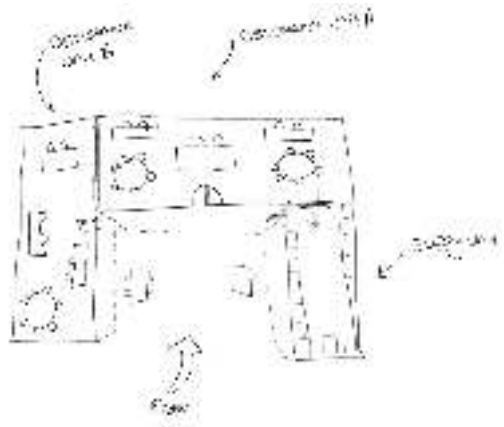


*Entrance*



*Entrance*

# Process Sketches



# Part 6

Site Conditions  
Architectural Characteristics

# Site Conditions Urban Demographics

Van is a city in Eastern Turkey's Van Province. Is a mostly Kurdish populated and historically Armenian-populated city in eastern Turkey's Van Province. The city lies on the eastern shore of Lake Van. 1.46% were Kurds, 32.70% were Armenians and 5.53% were Turks.

The Van Central district stretches over 2,289 square kilometers. The demographics of Ottoman Van are a debated and contentious point as they relate directly to claims of ownership by either side before the outbreak of World War I. V

an is the economic center of the province was the city of Van. It was also a major wine producer. Both wine and brandy were made in small amounts. Van also produced flax and hemp. Van also had a major sheep herding industry. "In 2010 the official population figure for Van was 367,419."



# Site Conditions Rural Geography

Van is located in Turkey in Eastern Anatolia Region and the Van Province. It is part of Asia and the northern hemisphere. The southern part of the province features the Zakros mountain range, covered by fruit trees and wild trees, while the northern and the eastern parts, besides having grazing hills, also feature vast and fertile flat lands.

Various kinds of roots and fruits grow in the eastern provinces. The southern provinces are thick with forest oak, Norway maple, hornbeam, and rose hip bushes. The city lies at an elevation of about 5,750 feet.



# Site Conditions Climate

July, August, and September are very dry, while July has an average maximum temperature of 80 degrees. In contrast, the coldest months are January. There is more rainfall in the winter than in the summer, with an average of 17" per year. " The average temperature for the year in Van is 48.0°F (8.9°C)"

Throughout history, the city of Van has seen various earthquakes. In 2011 the country faced a 7.1 magnitude earthquake. The earthquake affected much of eastern Turkey, demolishing hundreds of buildings and burying numerous victims under the rubble. For example, at least 100 people were confirmed dead in Van city center, and 970 buildings collapsed in and around the city.



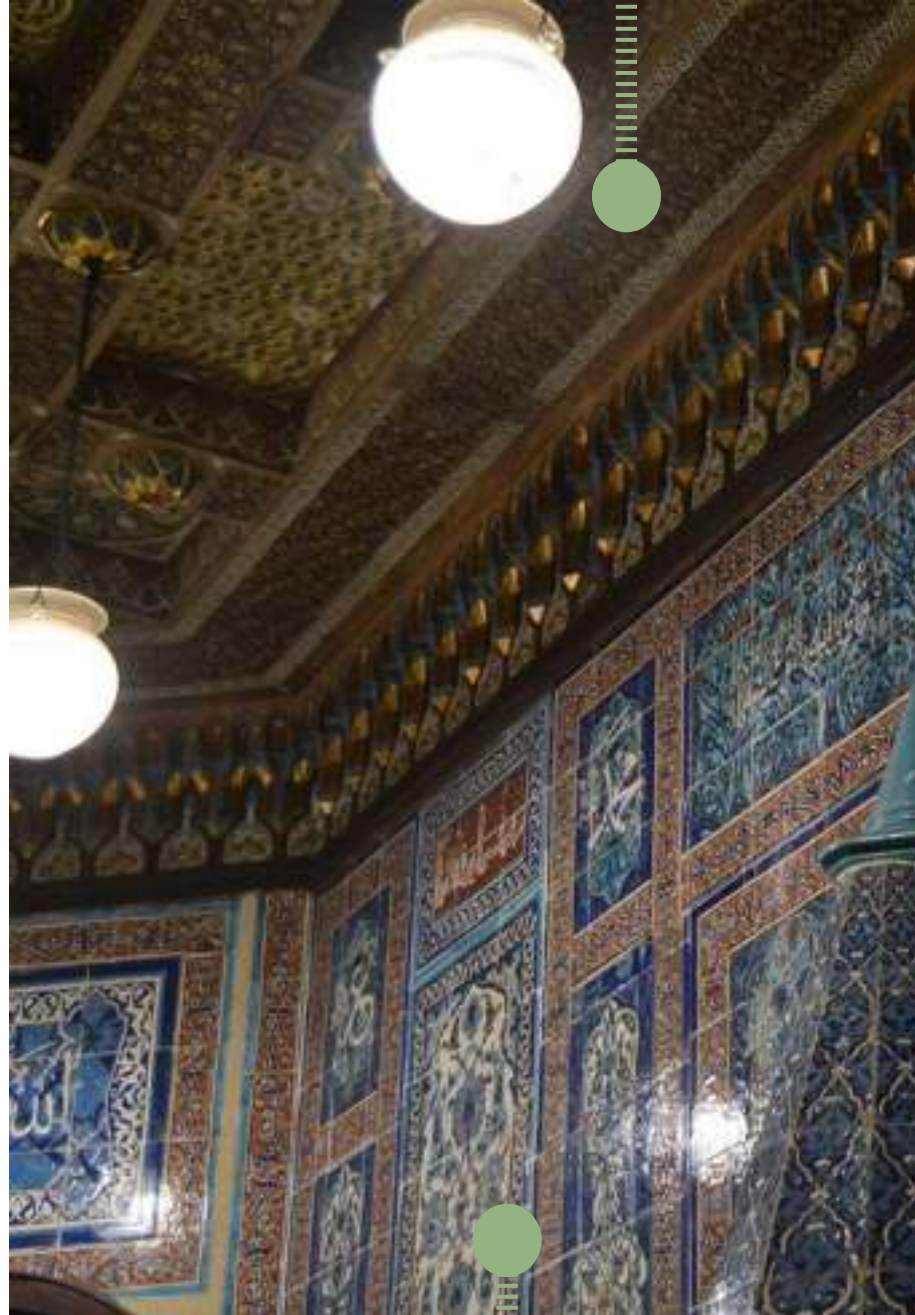


# Van, Turkey Residential Architecture Characteristics

Arches



Ornamentation



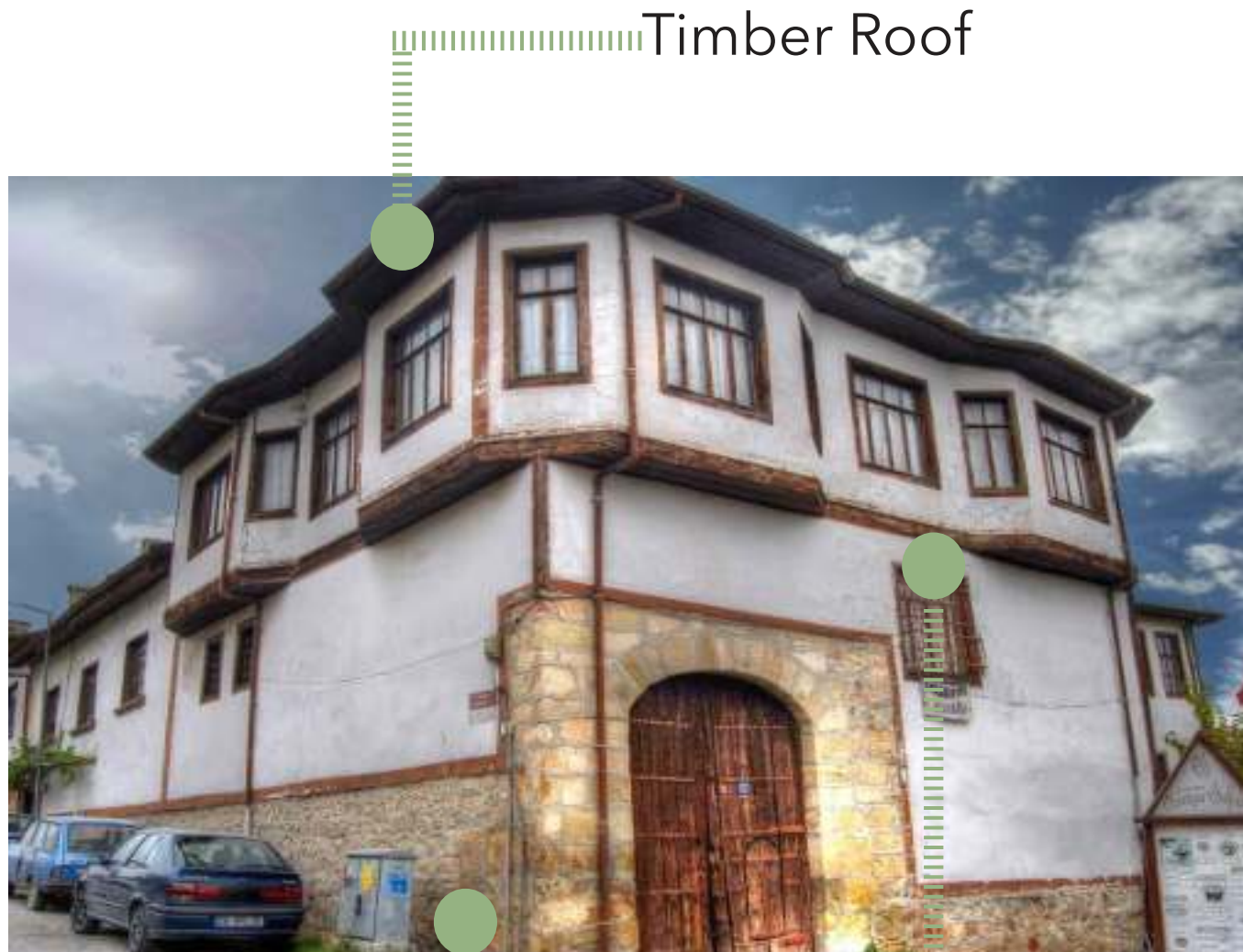
Islamic Art



Ornamentation

Islamic Script

# Van, Turkey Commercial Architecture Characteristics



Timber Roof

Masonry Ground Floor

Timber Frame Flooring



Minaret

Pitched Roof

Symmetrical Shutters

# Turkish Architecture Materiality

## Wood / timber frame

Allow more windows +  
building protections + wider  
eaves

Enables building to breath in  
humid climates

Provides climate conditions

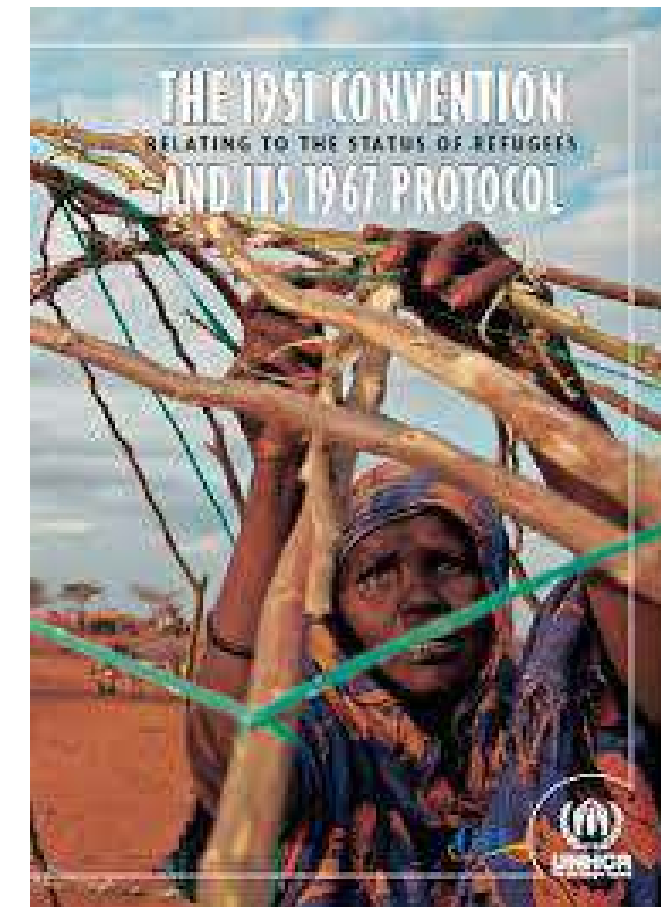
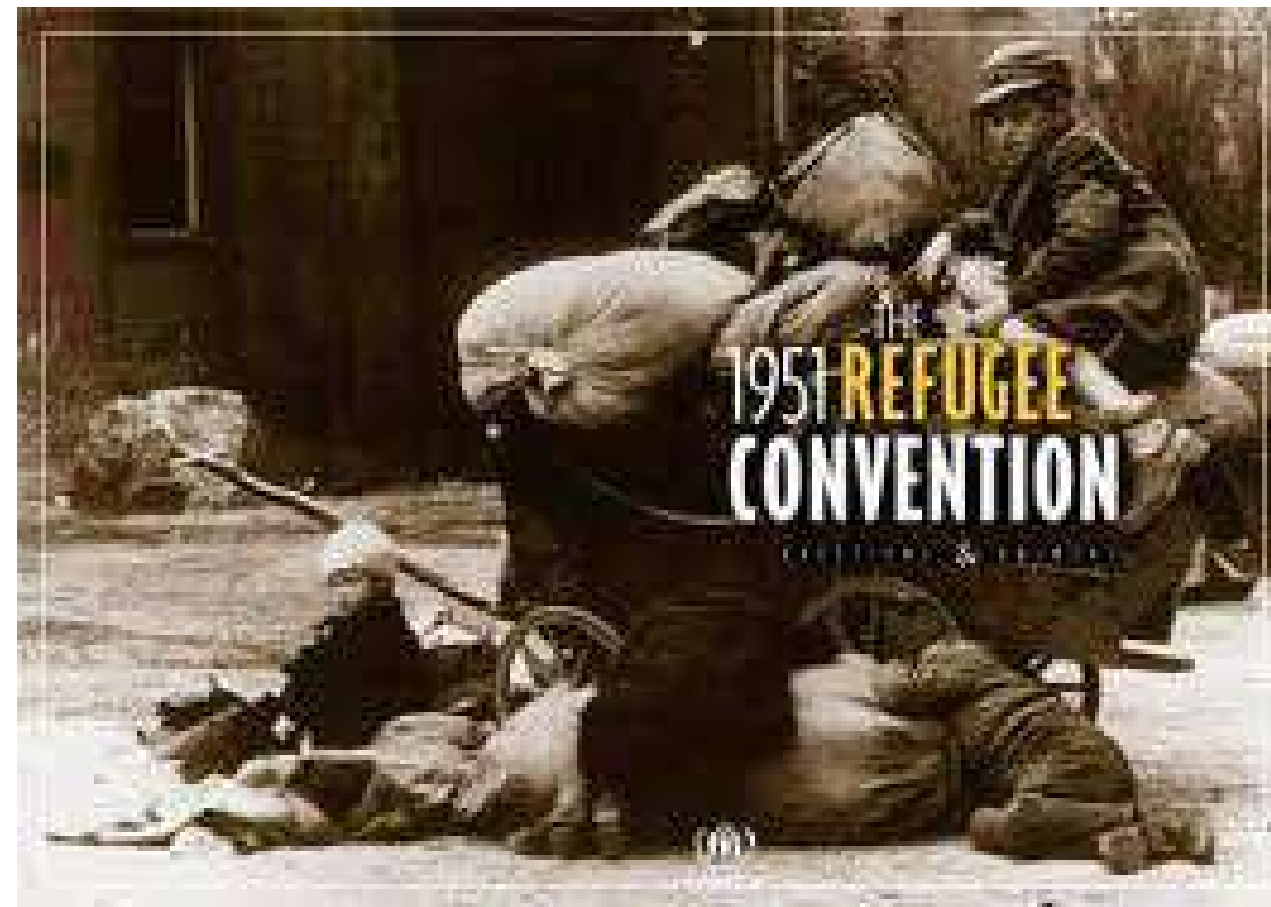
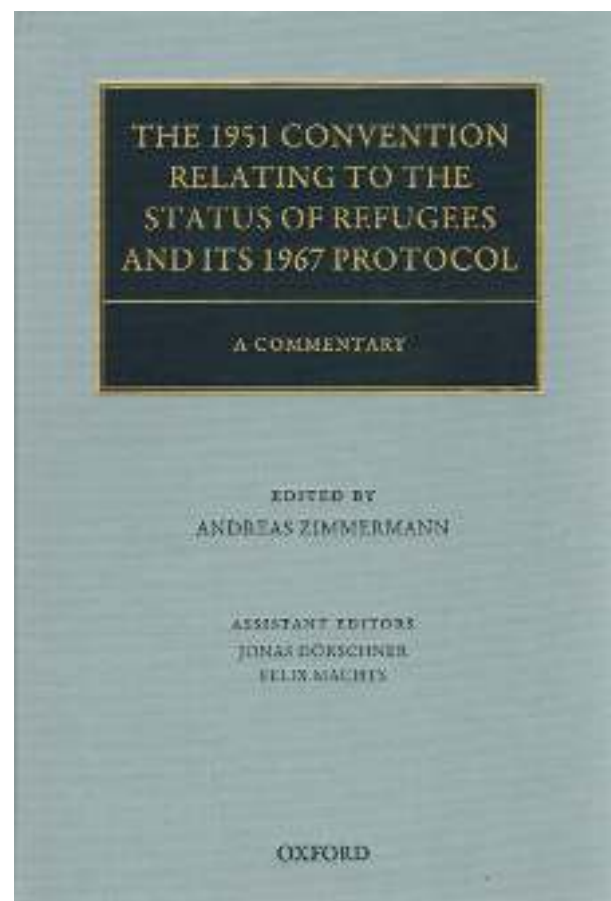


# Part 7

The Republic of Turkey  
Social Sustainability

# Why Turkey?

The Republic of Turkey is a party to the 1951 Refugee Convention and 1967 Protocol, maintaining the geographical limitation of the 1951 Convention, thus retaining resettlement to a third country as the most preferred durable solution for refugees who arrived due to the events that occurred outside of Europe. Turkey has been undertaking legislative and institutional reforms to build an effective national asylum system complying with international standards. In April 2013, Turkey's first-ever asylum law, the Law on Foreigners and International Protection, was endorsed by the Parliament and entered into force on 11 April 2014. The Law set out the main pillars of Turkey's national asylum system. It established the Directorate General of Migration Management (DGMM) as the primary entity in charge of policy-making and proceedings for all foreigners in Turkey. Turkey also adopted the Temporary Protection Regulation on 22 October 2014, which sets out the rights and obligations, and procedures for those granted temporary protection in Turkey.



# Why Turkey?

## *Refugee Population*

Turkey is home to the world's largest refugee population, 4 million refugees and asylum-seekers. 3.6 million of whom are Syrian under temporary protection and close to 370,000 are refugees and asylum seekers of other nationalities.

## *Key Locations*

Over 98% of refugees in Turkey live among the host community, and less than 2% in Temporary Accommodation Centers.

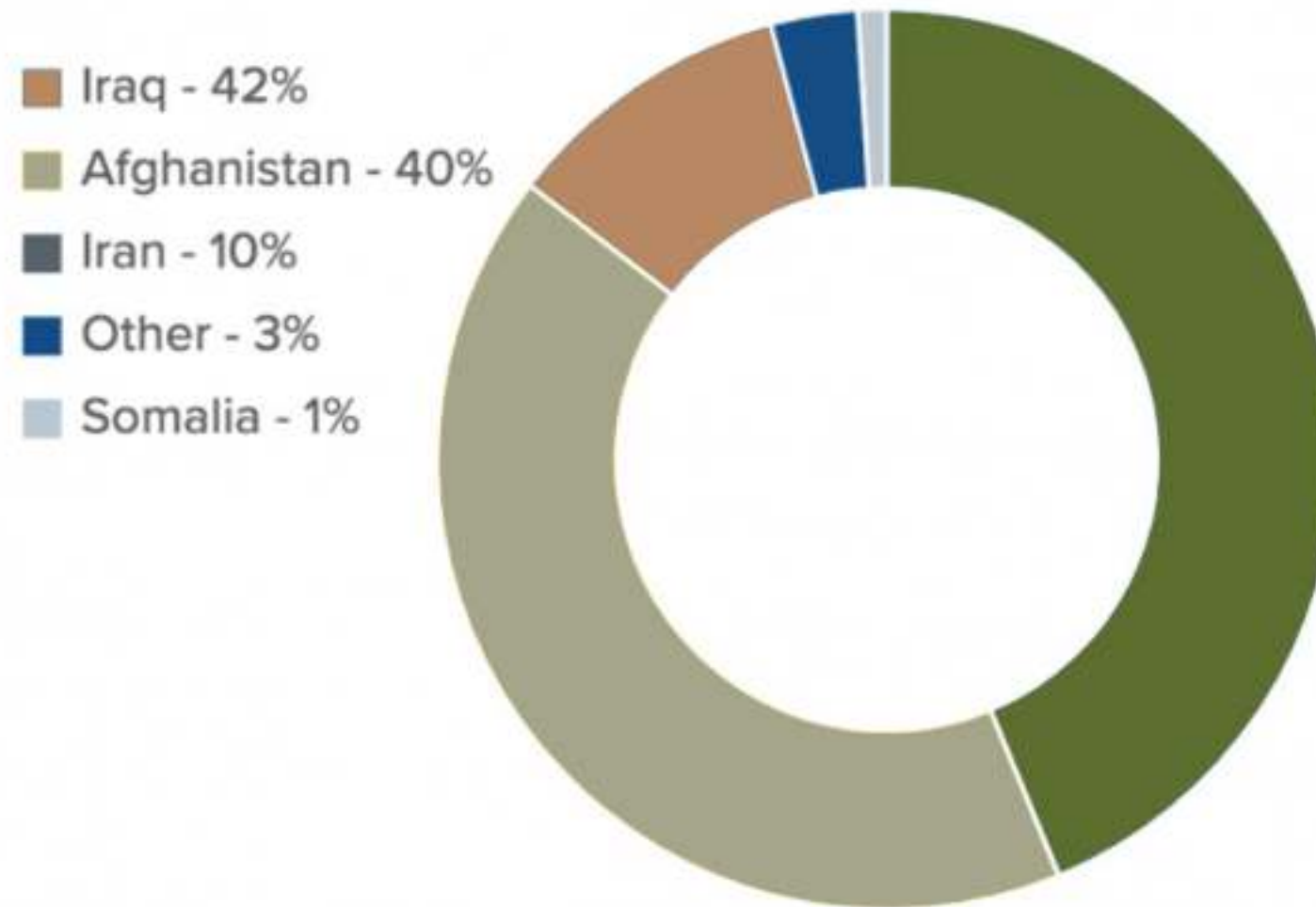
## *Legal Framework*

Turkey's refugee response is based on comprehensive legal framework, in particular the Law on Foreigners and International Protection (2013) and the Temporary Protection Regulation (2014)

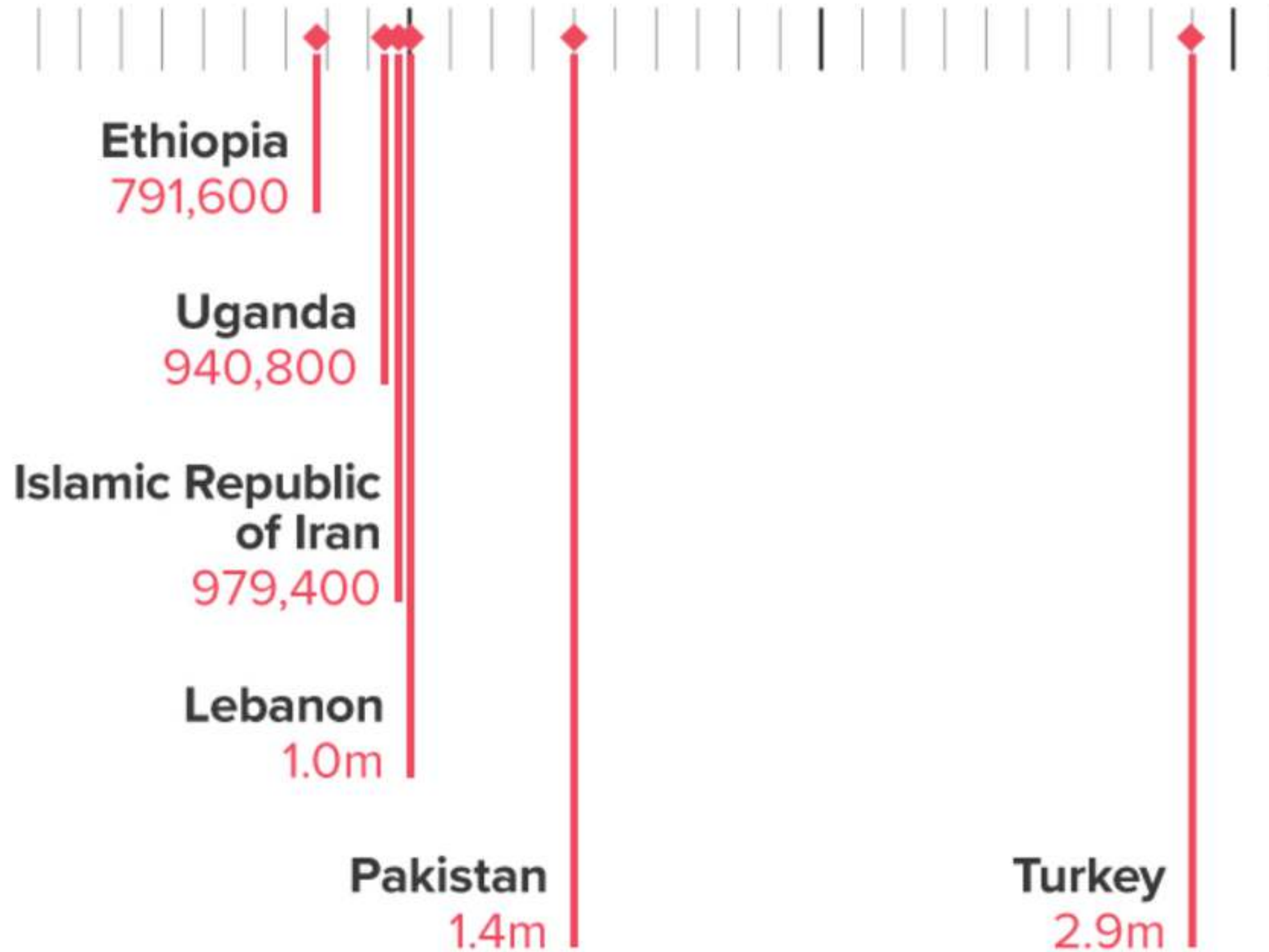


Turkey is bounded on the north by the Black Sea, on the northeast by Georgia and Armenia, on the east by Azerbaijan and Iran, on the southeast by Iraq and Syria, on the southwest and west by the Mediterranean Sea and the Aegean Sea, and the northwest by Greece and Bulgaria.

## Non- Syrian Population Of Protection Seekers In Turkey

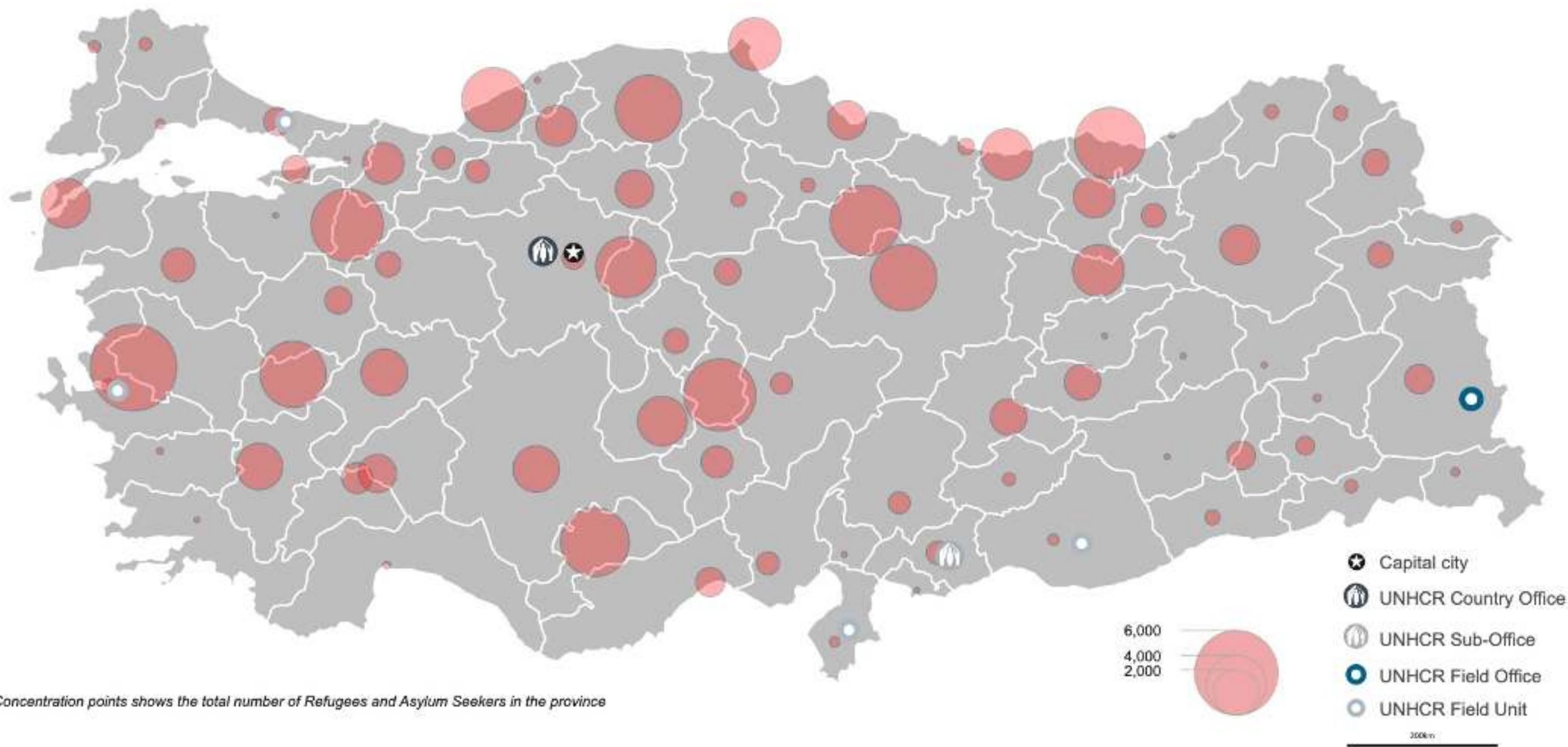


# Top Hosting Countries





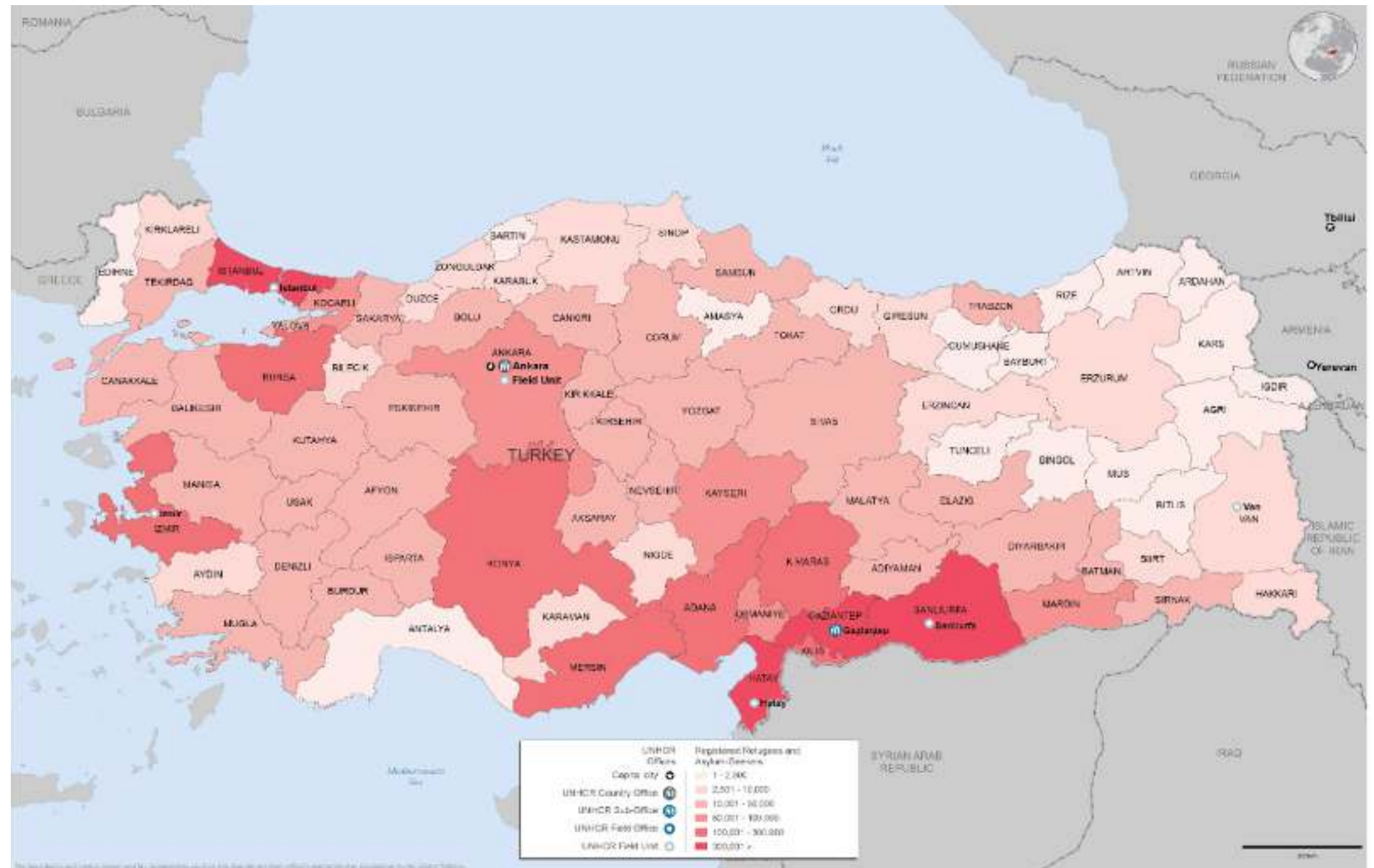
# Density of Afghan Refugees and Asylum Seeker by Province



Concentration points shows the total number of Refugees and Asylum Seekers in the province

# UNHCR Presence in Turkey

UNHCR Turkey has a country office in Ankara, presence in Istanbul, Izmir, Gaziantep, Hatay, Sanliurfa, and Van.



Refugees and Asylum- Seekers population breakdwon in Turkey per Provence ( January 30th 2020 )

# Key Figures

**116,422**

Total Number of  
Persons of Concern

**3,278**

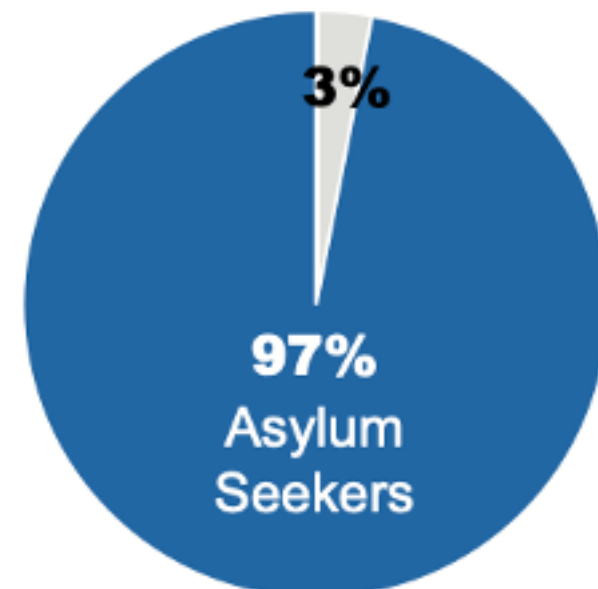
Total Number of Afghan  
Refugees

**113,144**

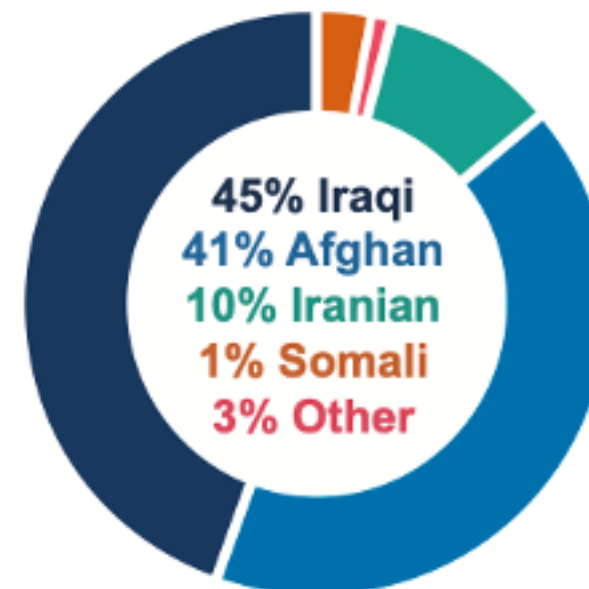
Total Number of Afghan  
Asylum Seekers

**2,844**

Afghans  
Registered in  
September



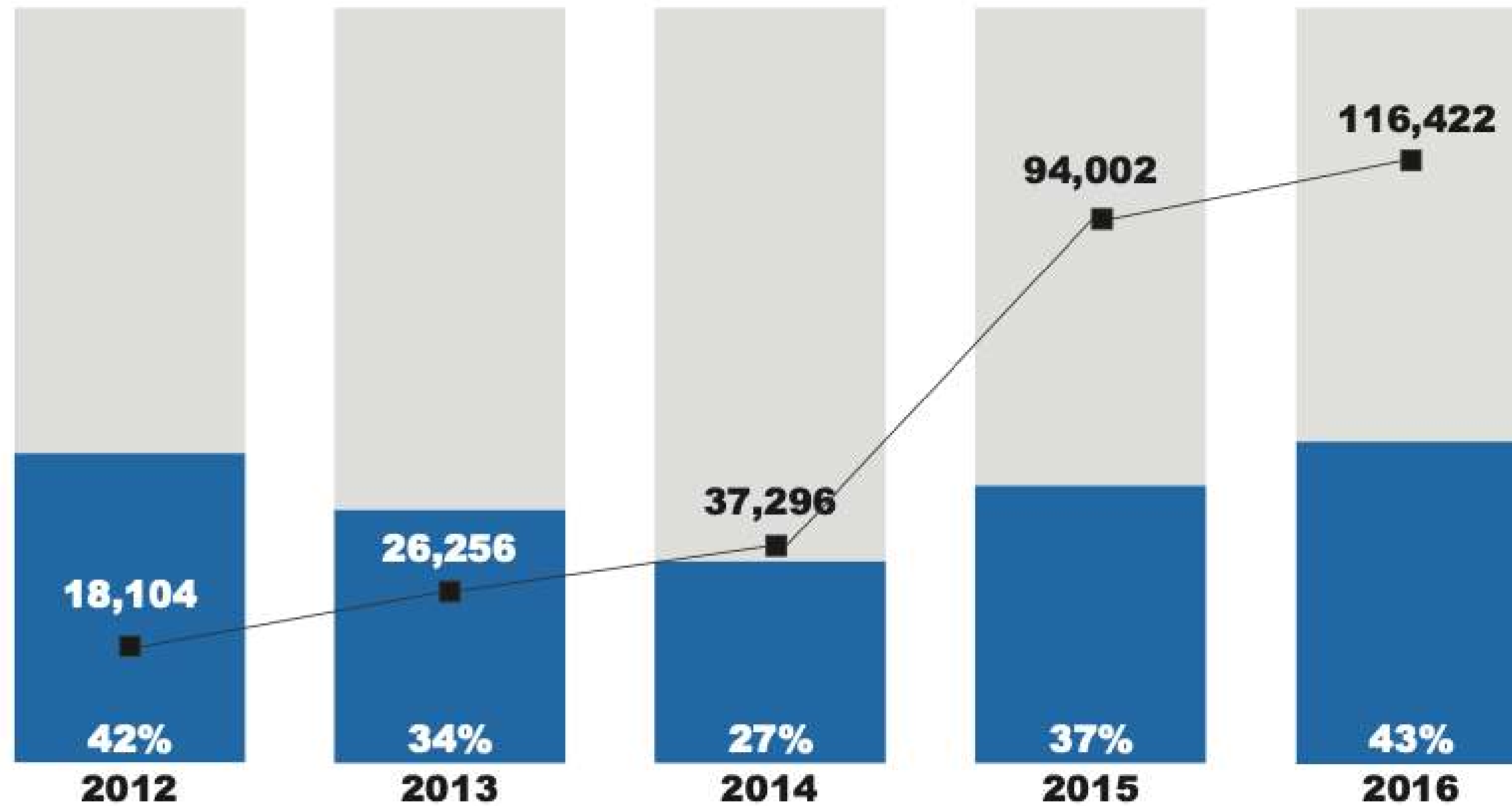
**Refugees vs  
Asylum Seekers**



**Registration  
Proportions**

# Proportion of Afghan Refugees & Asylum Seekers by Year

- All Refugees and Asylum Seekers
- Afghan Refugees and Asylum Seekers
- Total numumber of Afghan Refugees and Asylum Seekers







**Turkey**

Ukraine

Romania

Georgia

Italy

Bulgaria

Greece

Azerbaijan

Syria

Iraq

Iran

Afghanistan

Pakistan

India

Libya

Egypt

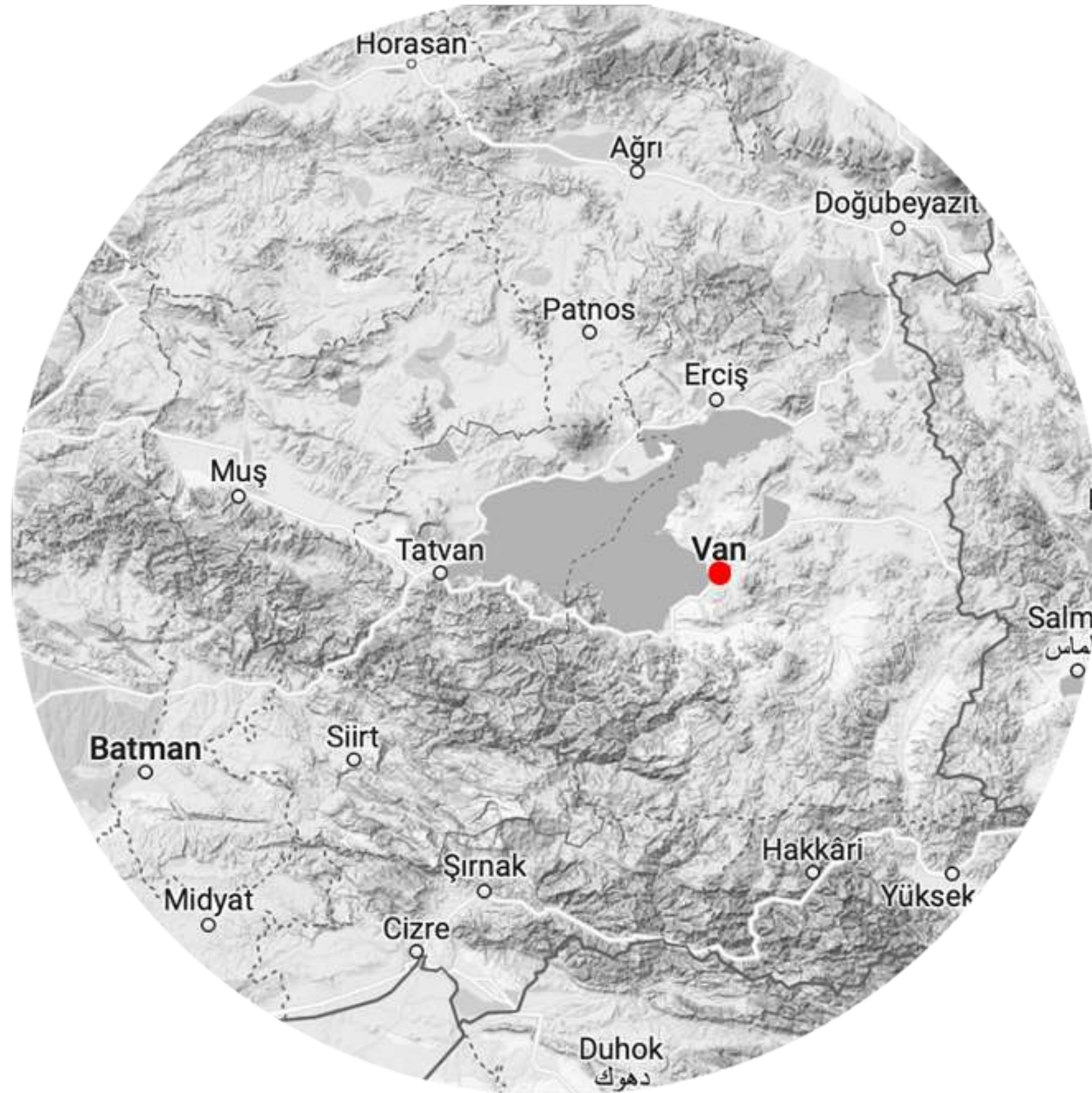
Saudi  
Arabia

Oman

Sudan

Yemen



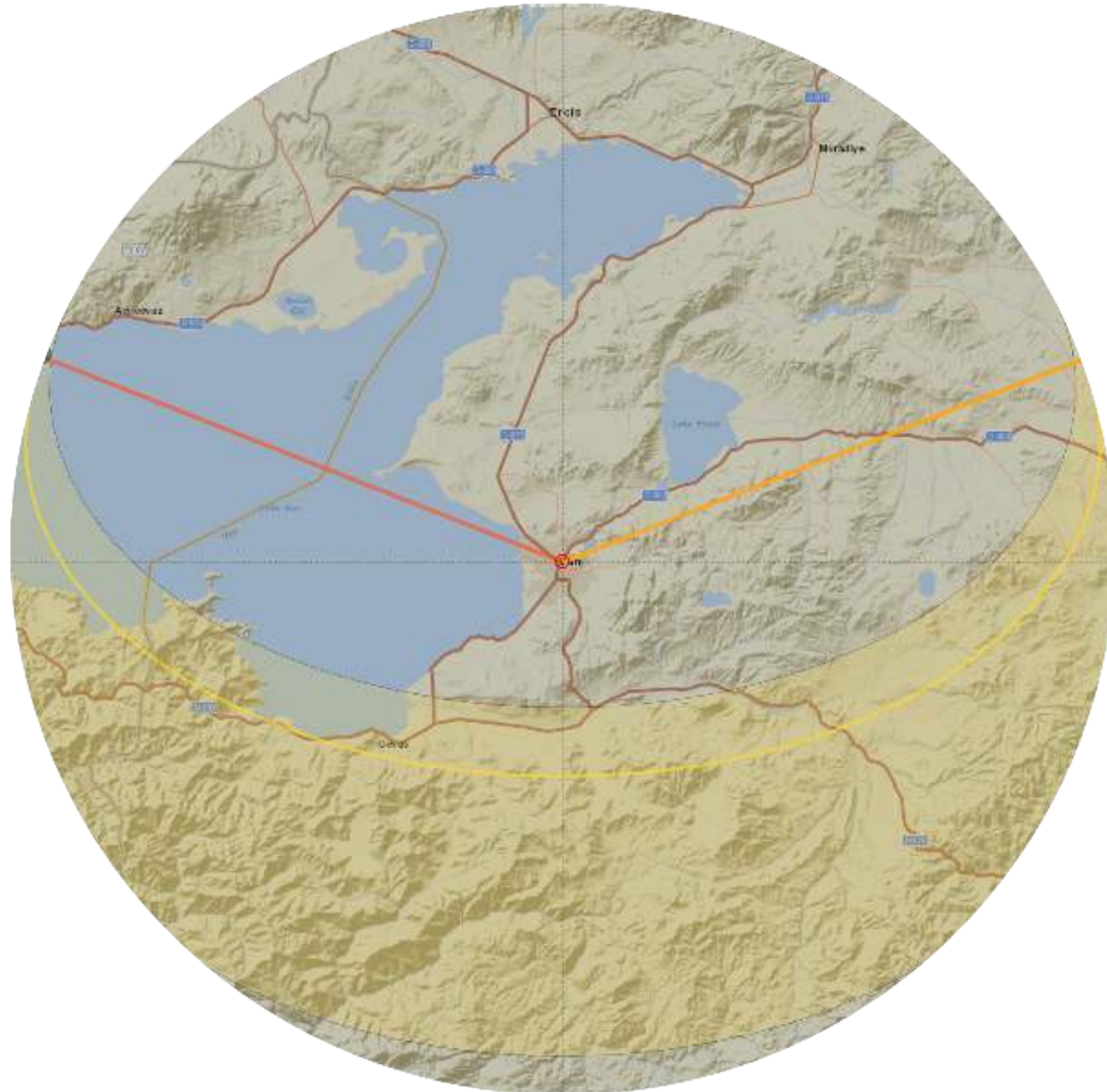






# Sun Study

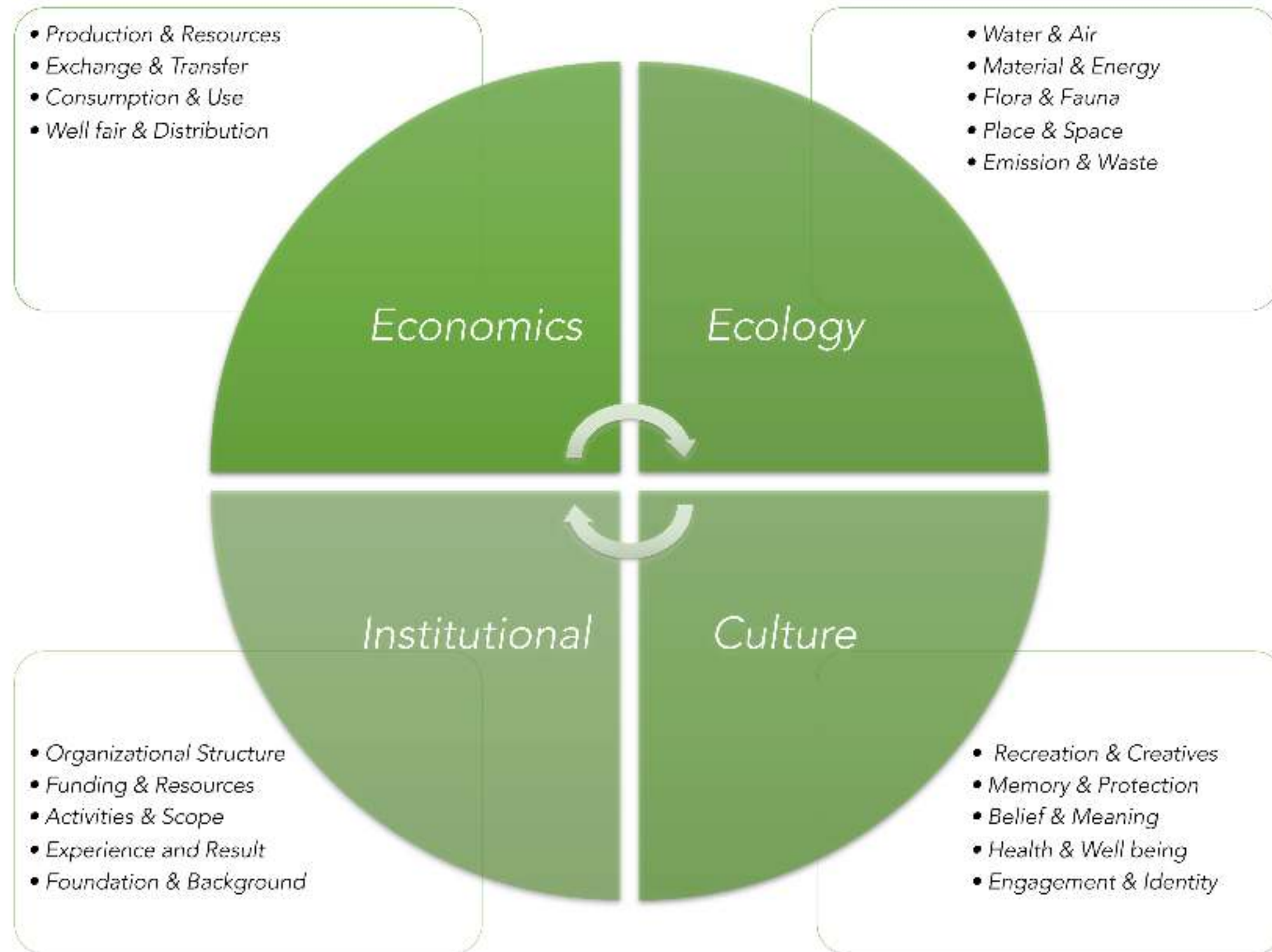
Dawn: 06:20:20  
Sunrise: 06:46:58  
Culmination: 12:19:47  
Sunset: 17:53:10  
Dusk: 18:19:41  
Daylight  
Duration: 11h6m12s  
Altitude: -4.21v  
Height: 1709M  
Lat: N 38 31' 31.78"  
Lng: E 43 23' 14.97"

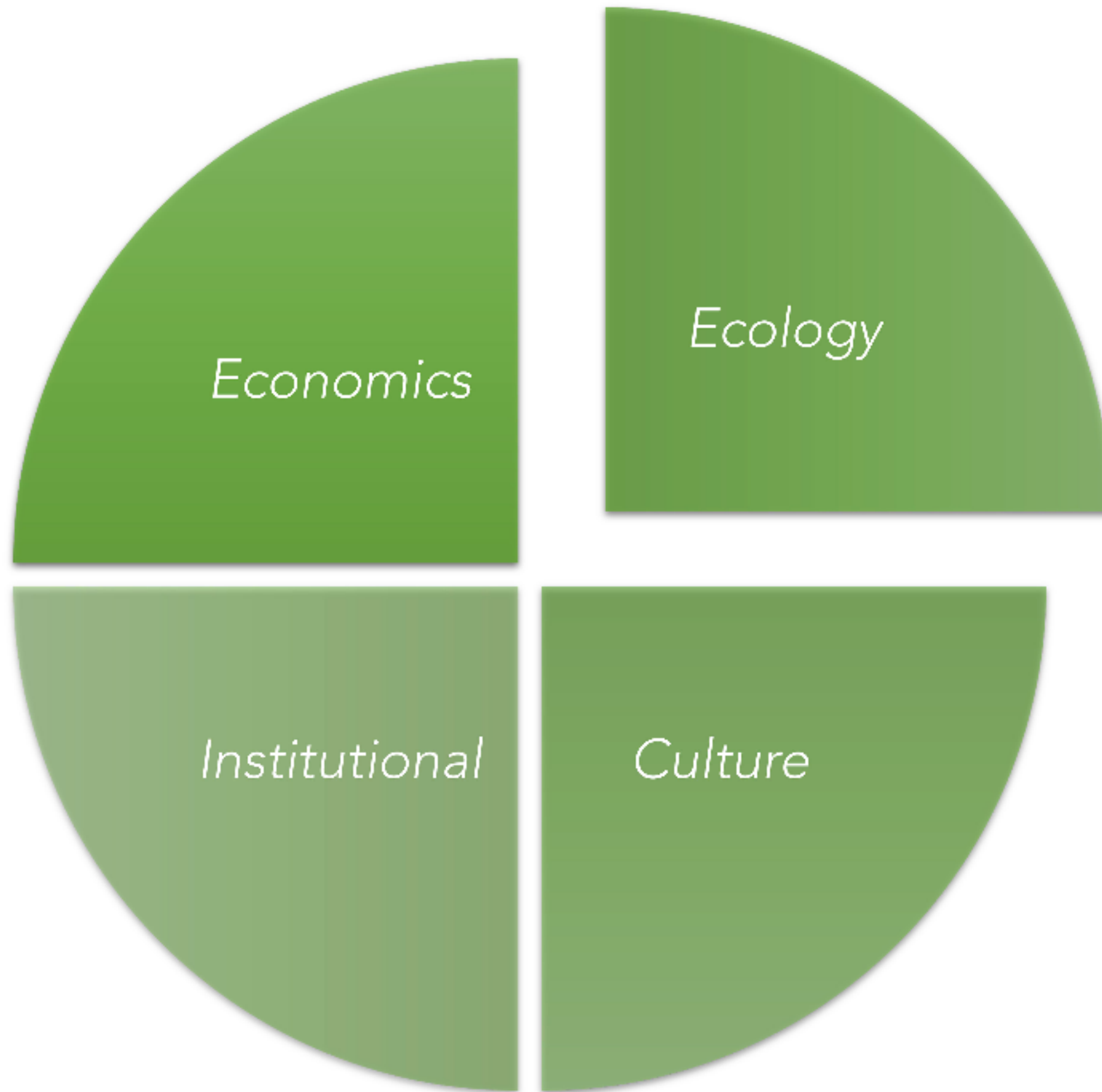


# Part 8

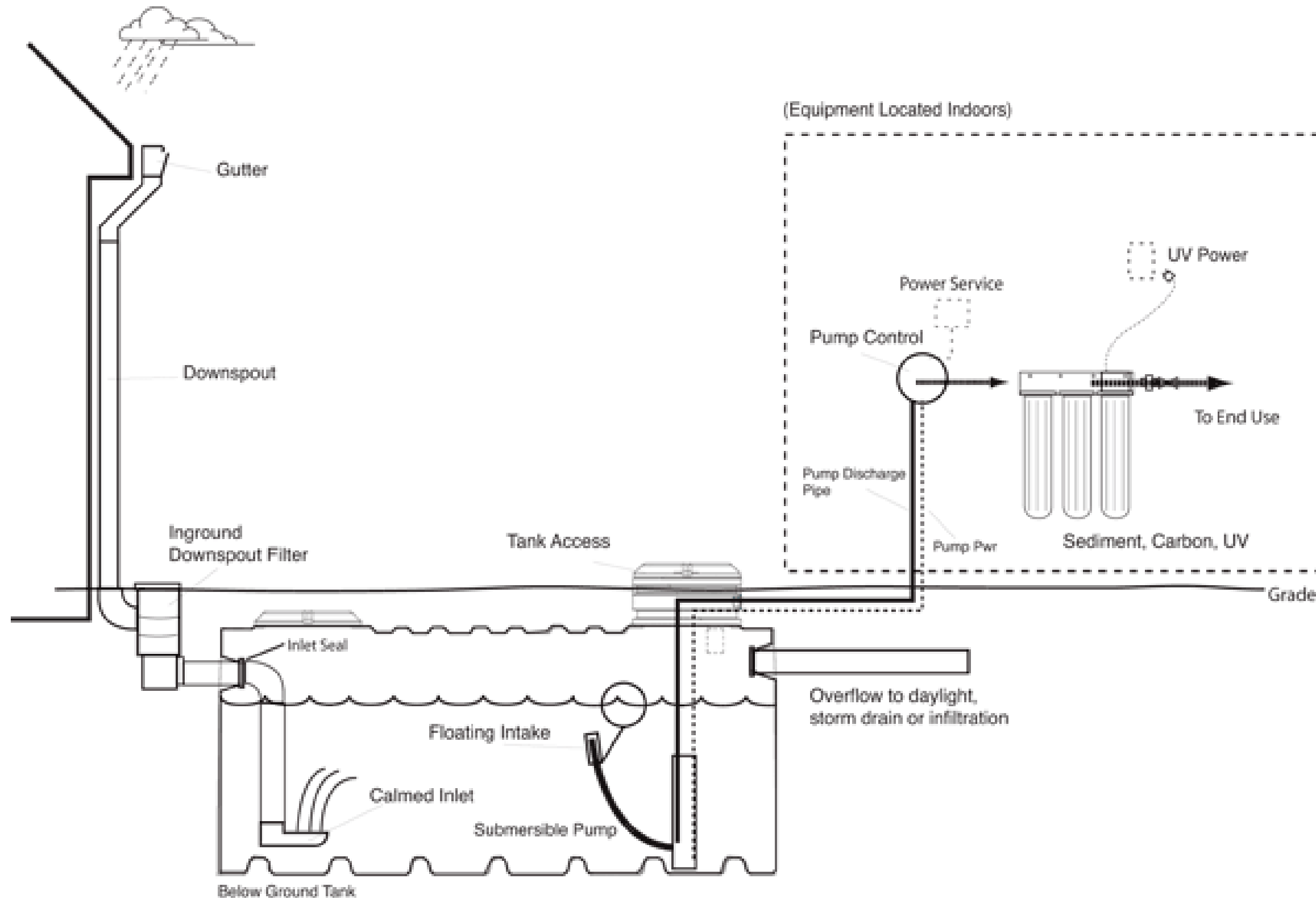
## Social Sustainability

# Social Sustainability





# Water | Above Ground Cistern System



# Water | Above Ground Cistern System

## Benefits of An Above Ground Cistern Systems:

Less labor to place above ground / Ease of Installation / Experience Level

Plan to water your roof reliant landscape using gravity

Aboveground can provide wind protection, shade, and inspirational conversation piece

Can be painted for aesthetically needs

Easier to maintain then underground

Leaks are easily spotted above ground

## Materiality:

High end Materials: High density Polyethylene / Epoxy Coated Steel / Fiberglass

Low End Materials: Wood, Rock, and Concrete

Above ground material- concrete - plastic liners ( prevents leaking )

Can be made out of any shape

Minimum storage capacity is 5000 gallons or 3" of rain to fill cistern completely



# Wind | Wind Towers

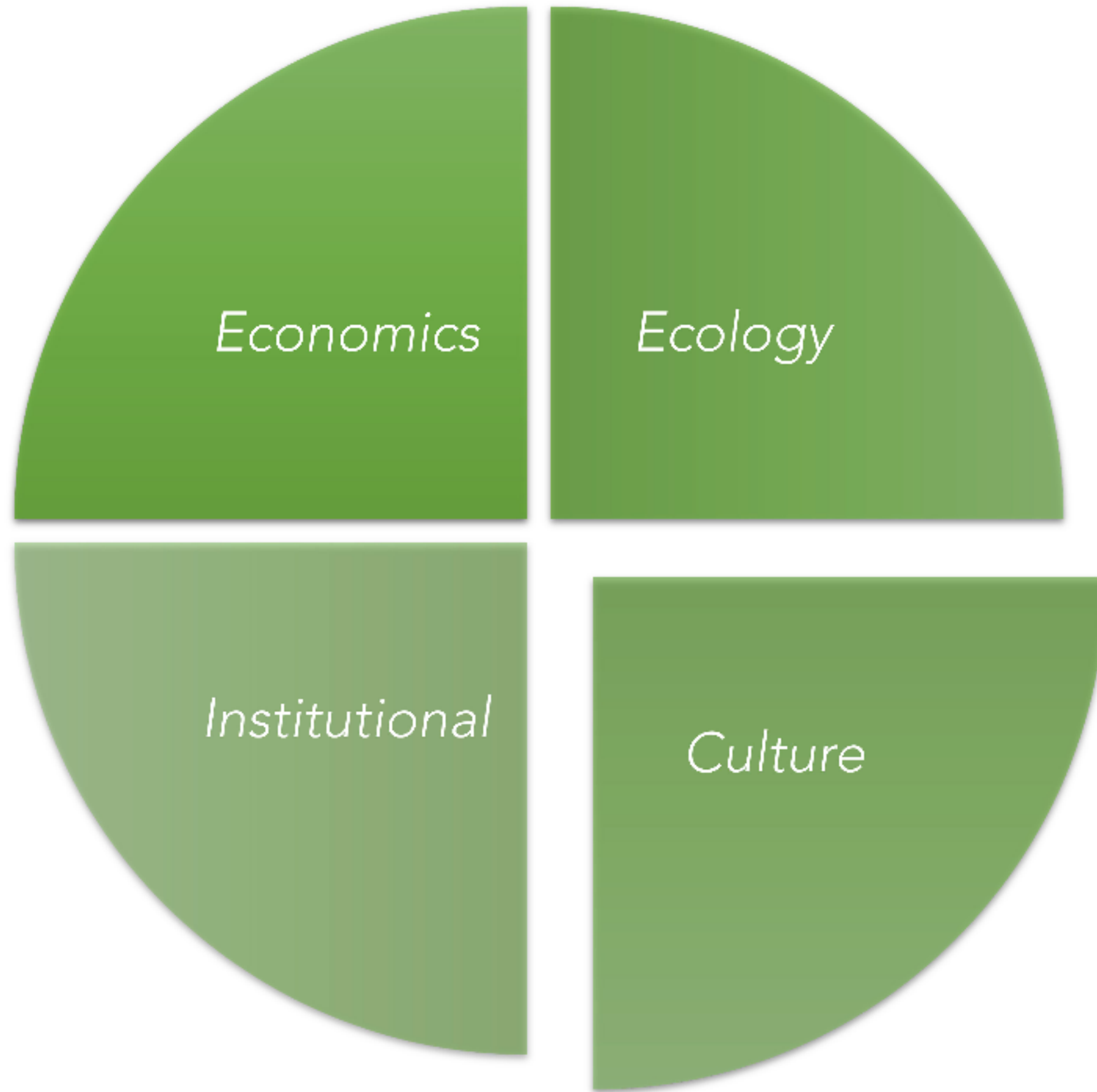
Passive cooling through shipping containers implemented as “wind towers” are distributed throughout the site. These wind towers promote natural ventilation by capturing strong currents of winds that channel into the patios.

A wind tower is a critical element of the traditional architecture of Iran. It is seen in settlements in hot, hot-dry, and hot-humid climates. They look like big chimneys in the skyline of ancient cities of Iran. They are vertical shafts with vents on top to lead desired wind to the interior spaces and provide thermal comfort. This architectural element shows the compatibility of architectural design with the natural environment. It conserves energy and functions based on sustainability principles. A wind tower is an architectural device used for many centuries to create natural ventilation in buildings.

One of the shafts operates all the time to receive the breeze, and the other three shafts work as outlet air passages. They convey the stuffiness out of the living space through the “flue” (chimney) effect. The chimney effect is based on the principle that the air density increases with increasing temperature.





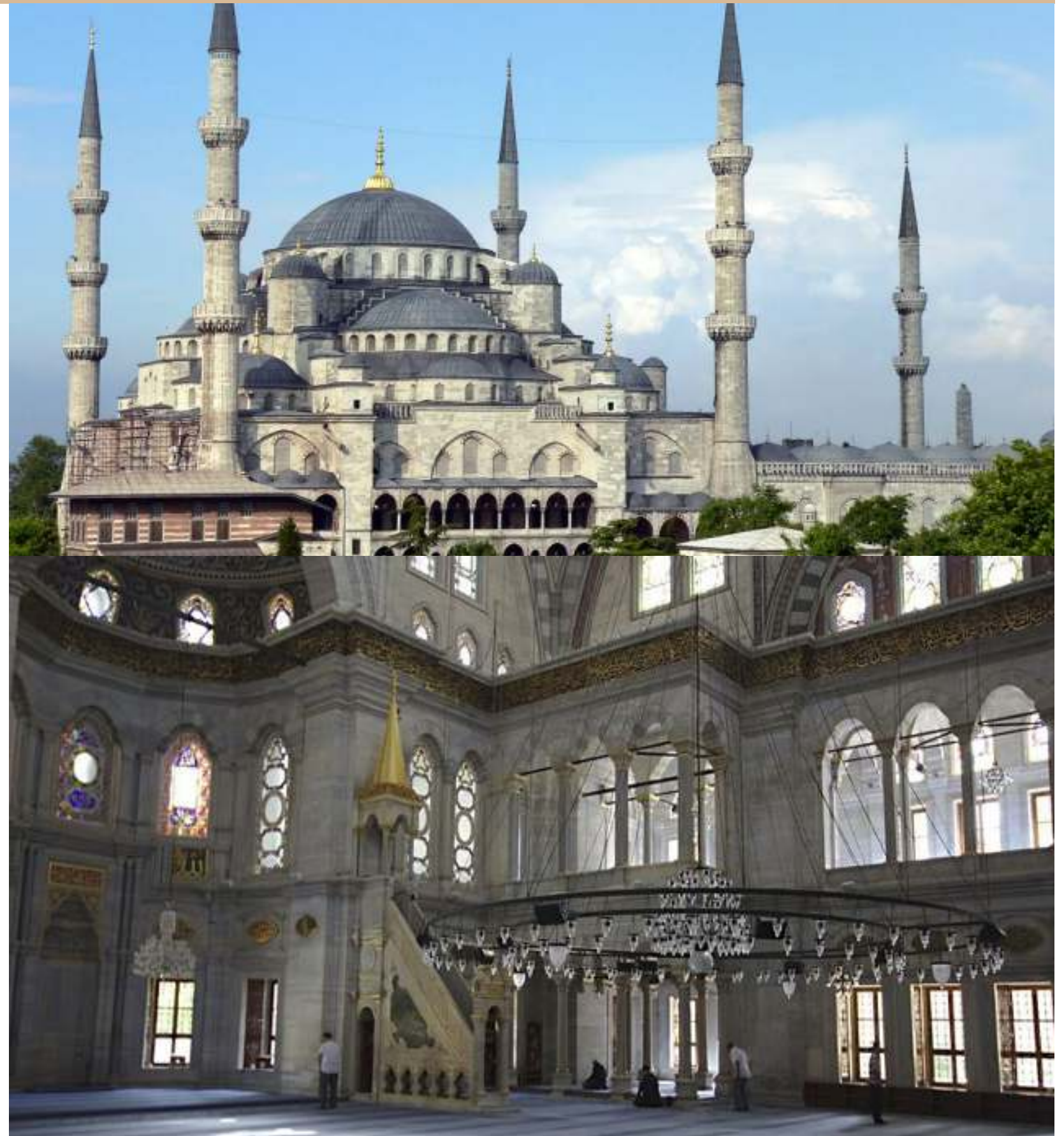


## Culture | Engagement & Identity

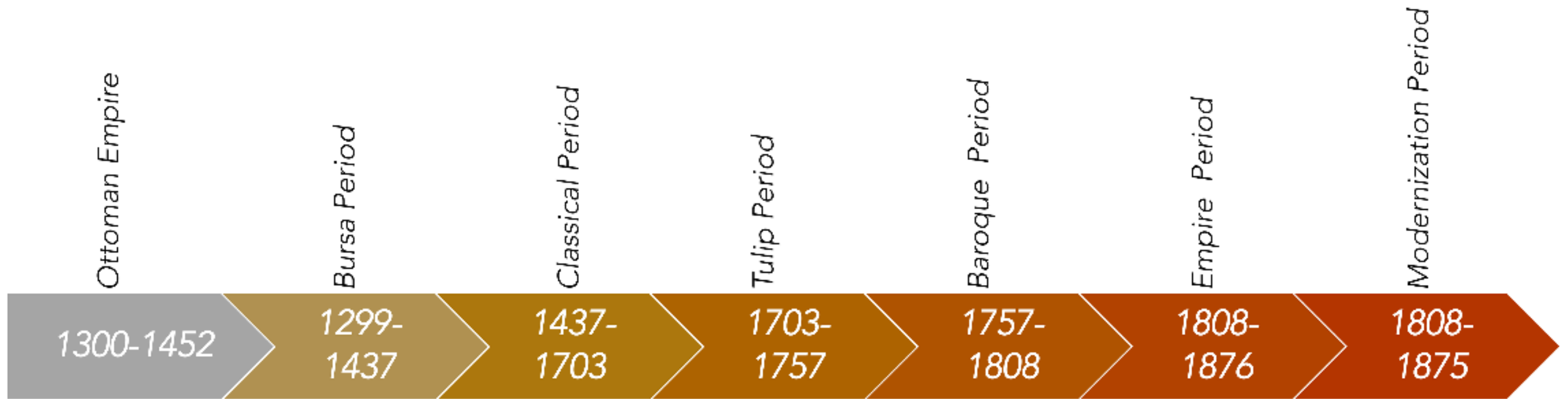
The arrival of the Seljuk empire in Turkey sparked the beginning of a distinctive architectural movement in the country. Even though the empire consisted of cultural diversity, it excellently adapted the architectural features to the Turkish region.

The defining features of these structures included elegant, bare form work of simple design and harmonious proportions. These structures were more or less plain but used the concept of a 'Monumental Portal', a doorway decorated with colorful intricate embellishments and designs.

Buildings usually incorporated eyvans, a three-sided walled room, with the fourth side open to a large, internal courtyard, muqarnas, minarets, domes, and "Turkish triangles", triangular preventives that support the dome.



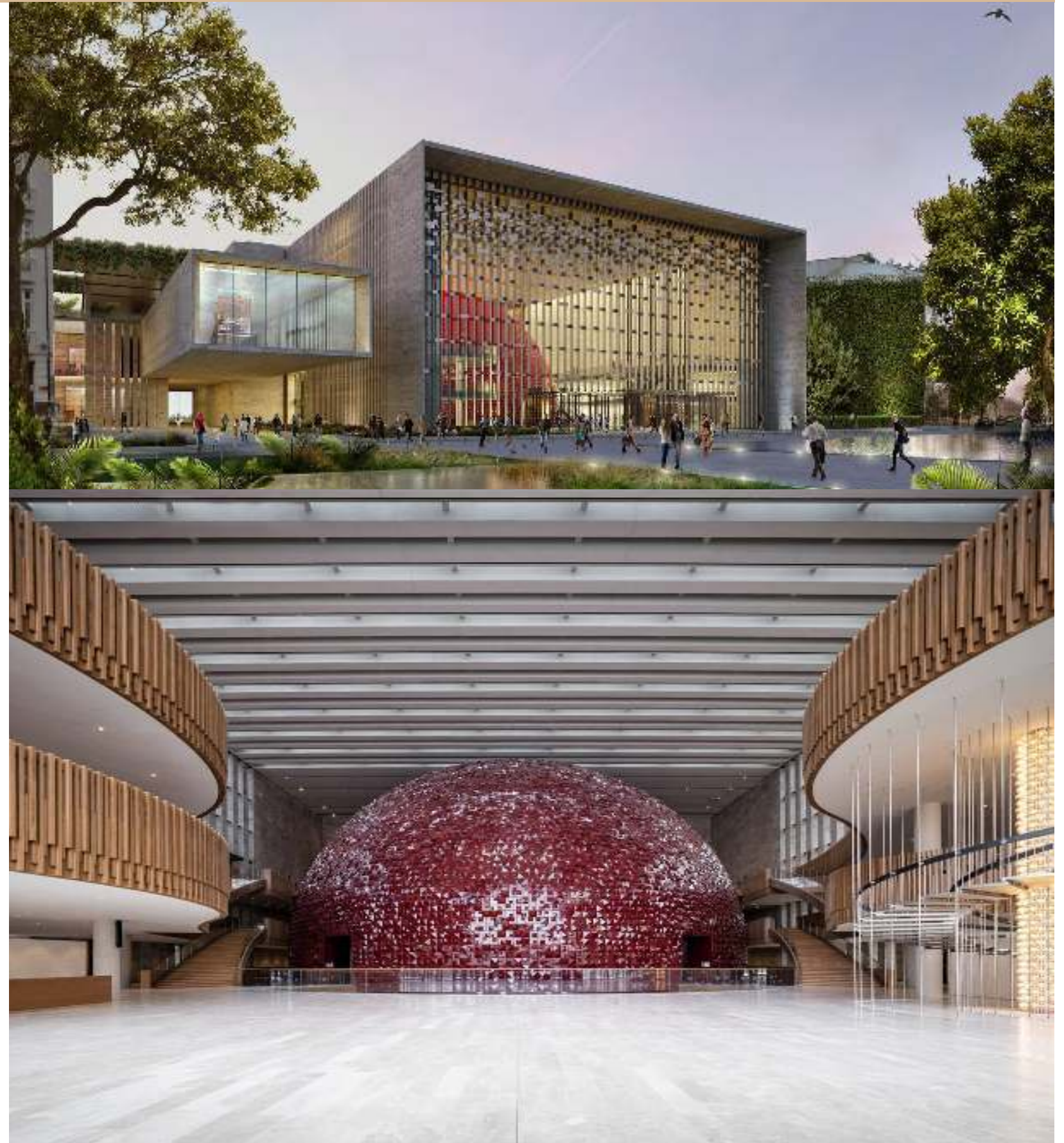
# Culture | Memory and Protection

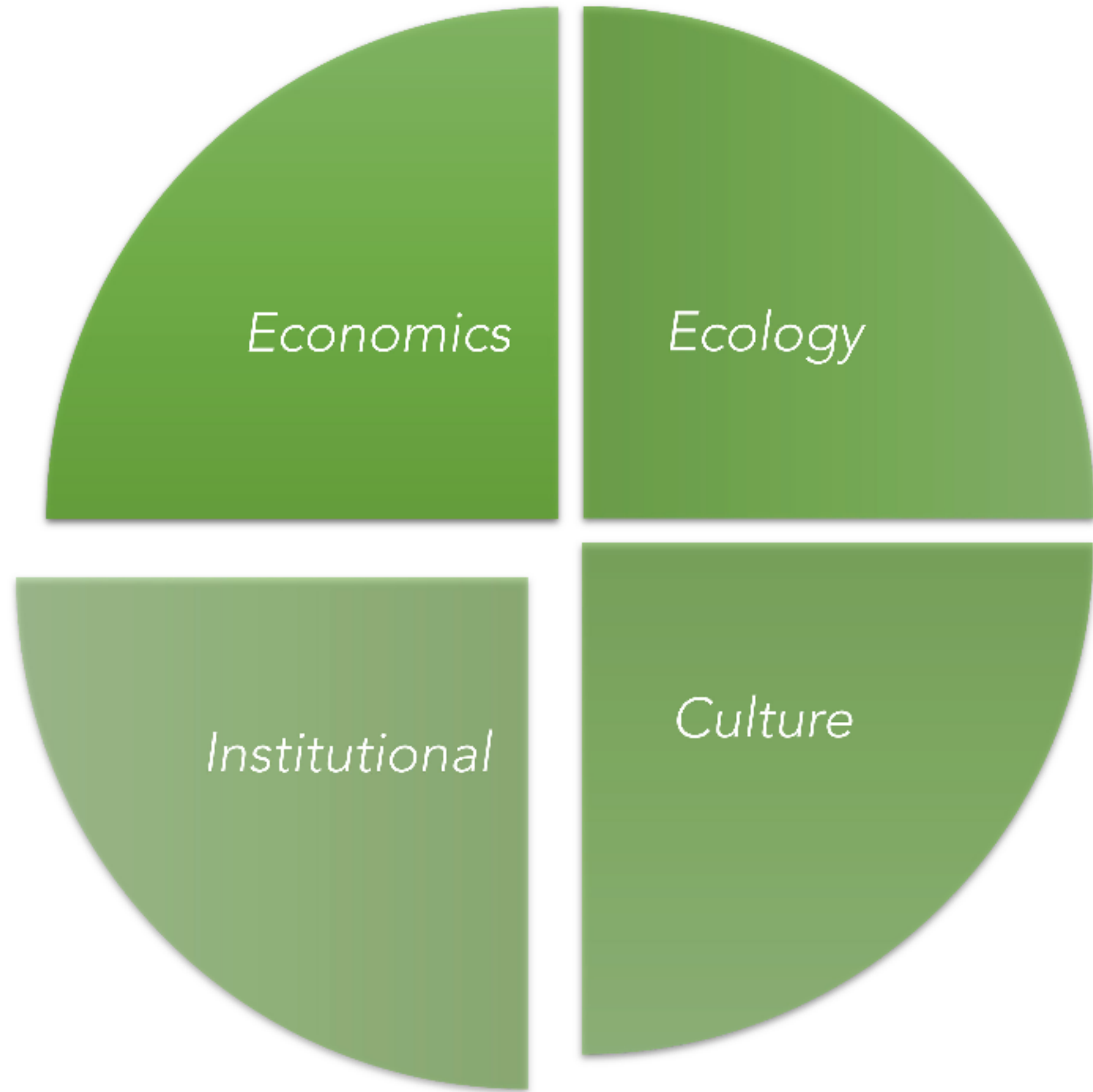


## Culture | Memory & Protection

After a period of great shifts in Turkish society, in response to various political movements and economic crises, the architectural scene was forced to develop itself, to cope with these changes. The rationalistic style of design was abandoned and a more fragmented, flexible, and modern form work was adopted.

Architects could now use modern tools and technology to design the fast-growing Turkish society. The introduction of new materials such as steel, aluminum, plastic along with the new technological developments as such curtain wall systems and prefabrication technology led to a drastic shift in form work which greatly influenced the local architecture scene.





# Institutional | Organizational Structure

*Khasan,  
Iran*



# Institutional | Foundation & Background

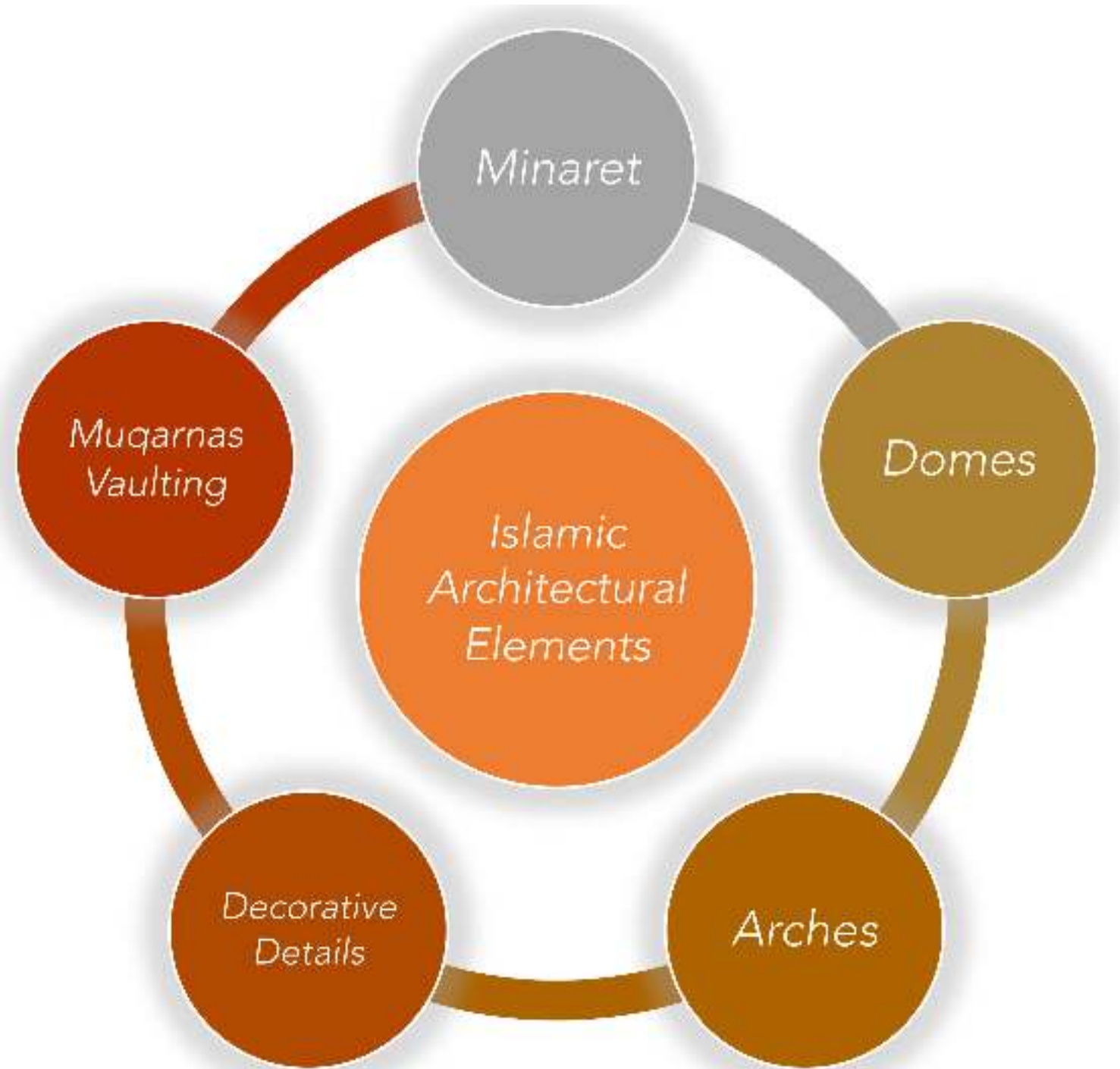
**Minaret:** Spire or tower-like structure featuring small windows and an enclosed staircase. It is one of the oldest elements of Islamic architecture and is found next to most mosques.

**Domes:** Like many pioneering architectural movements—including Byzantine and Italian Renaissance building traditions—Islamic architects also incorporate domes into their designs.

**Muqarnas Vaulting:** Due to their sculptural composition and patterned aesthetic, Muqarnas is often compared to stalactites or honeycomb. In addition to domes and pendentives, this unique ornamentation also adorns vaults, culminating in monochromatic, sculptural ceilings that contrast the surrounding tiles.

**Arches:** Another fixture of Islamic architecture is the arch. Evident in both entrances and interiors, Islamic arches are categorized into four main styles: pointed, ogee, horseshoe, and multifoil.

**Decorative Details:** A final element of Islamic architecture is attention to ornamental detail. Often reserved for interiors, this lavish approach to decoration includes jewel-like tiles arranged into geometric mosaics, patterned brickwork and kaleidoscopic stones, and exquisite calligraphic adornments.



Süleymaniye  
Mosque  
Istanbul, Turkey





# Institutional | Foundation & Background

**Minaret:** A minaret is a slim tower with balconies or open galleries from which a mosque's muezzin calls the faithful to prayer five times each day. Minarets are distinctive traditional features of many mosques, though they vary in height, style, and number.

**Dome:** The main dome of a mosque usually covers the main prayer hall of the structure. Some mosques may have secondary domes, as well.

**Prayer Hall:** It is deliberately left quite bare. As worshipers sit, kneel, and bow directly on the floor, no furniture is needed. There may be a few chairs or benches to assist elderly or disabled worshipers who have mobility difficulties.

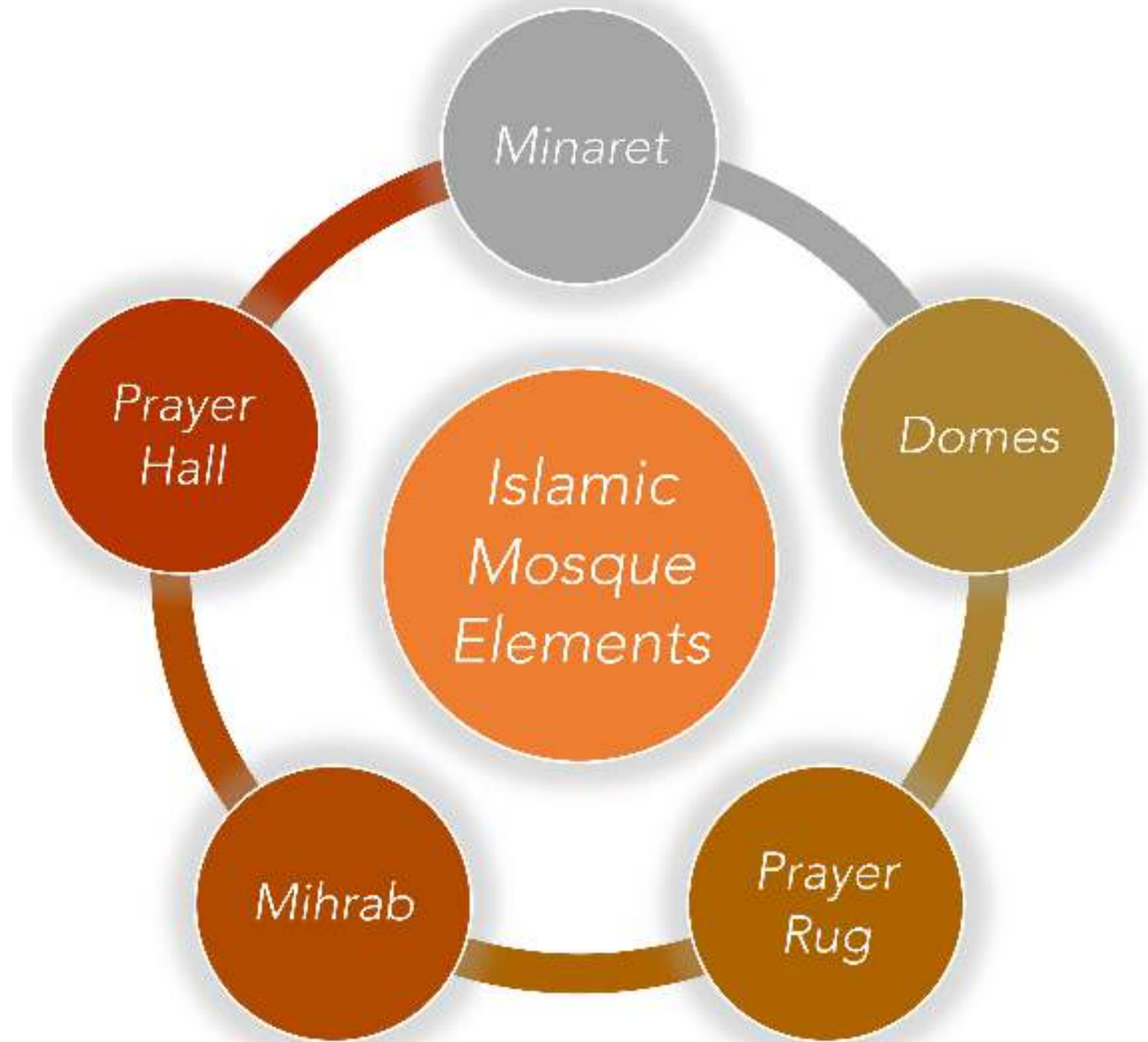
**Mihrab:** The mihrab is an ornamental, semi-circular indentation in the wall of the prayer room of a mosque that marks the direction of the qiblah—the direction facing Mecca which Muslims face during prayer.

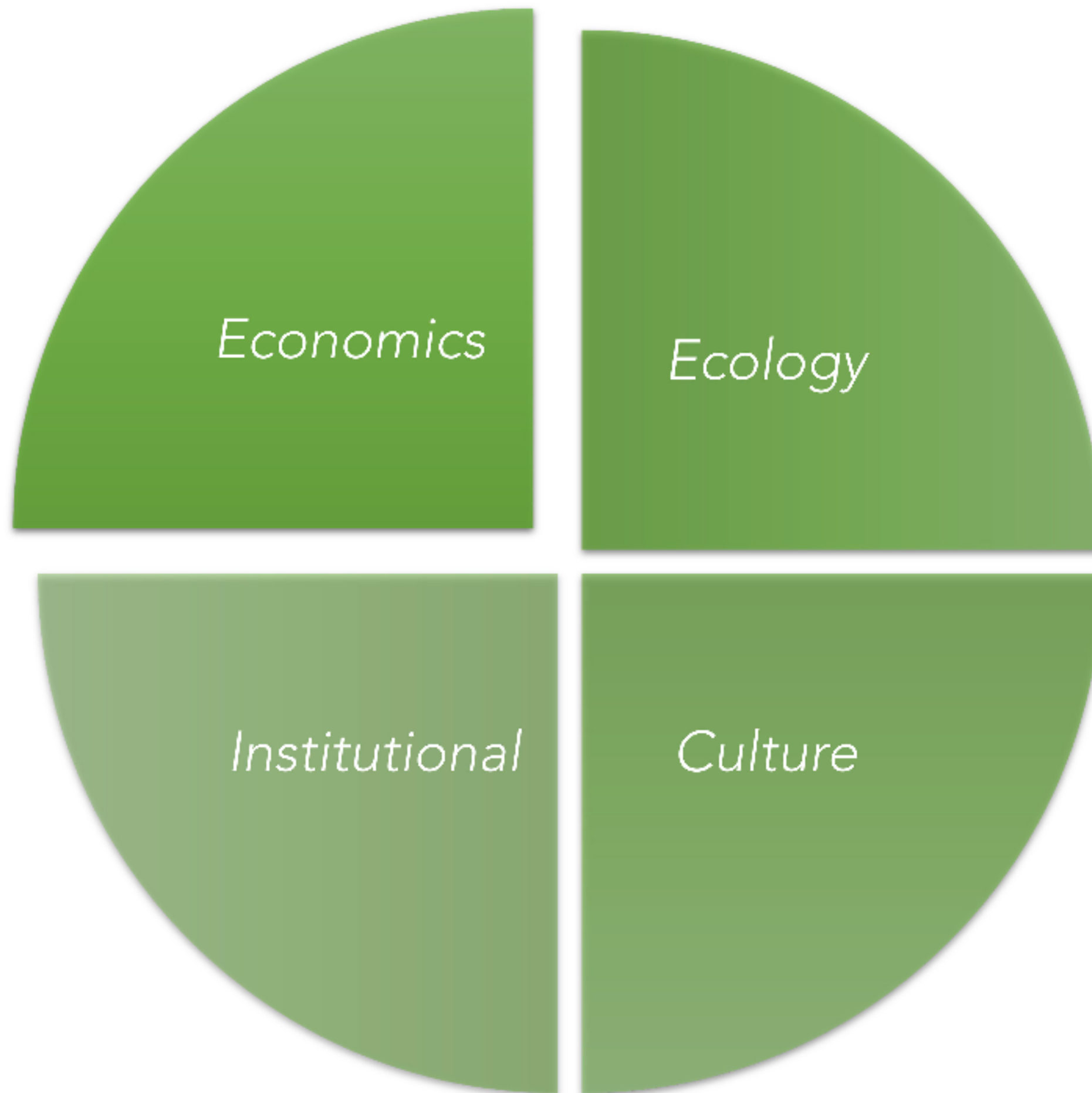
Mihrabs vary in size and color, but they are usually shaped like a doorway and decorated with mosaic tiles and calligraphy to make the space stand out.

**Minbar:** The minbar is a raised platform in the front area of a mosque prayer hall, from which sermons or speeches are given. The minbar is usually made of carved wood, stone, or brick.

**Ablution Area:** Ablutions are part of the preparation for Muslim prayer. Therefore, sometimes space for ablution is set aside in a restroom or washroom.

**Prayer Rug:** Rugs and carpets have become a traditional way to ensure the place of prayer's cleanliness and provide some cushioning on the floor. Traditional prayer rugs include an arch-shaped symbol at one end. This symbol represents the mihrab and must point toward Mecca during prayer.



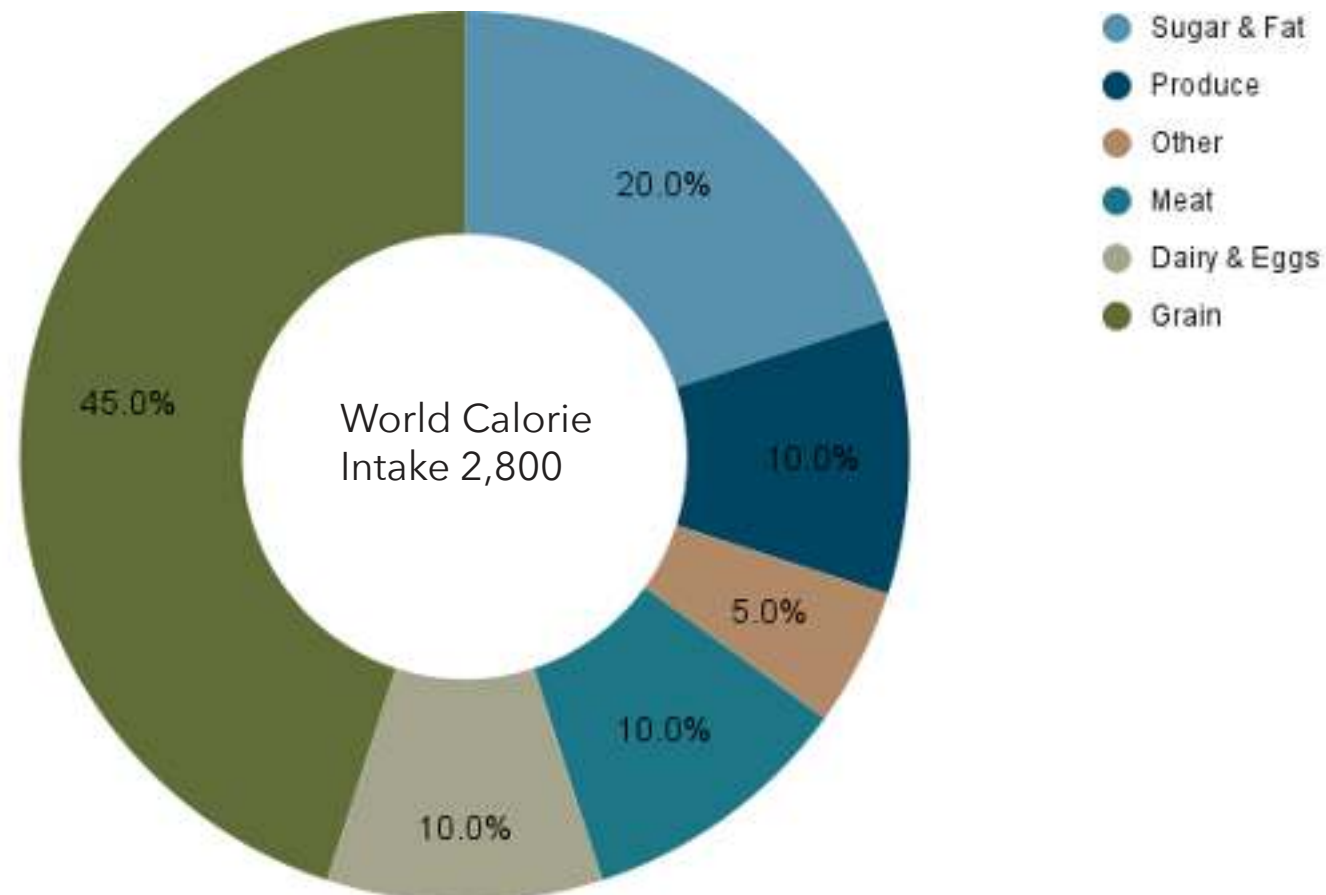


# Economics | Consumption and Use

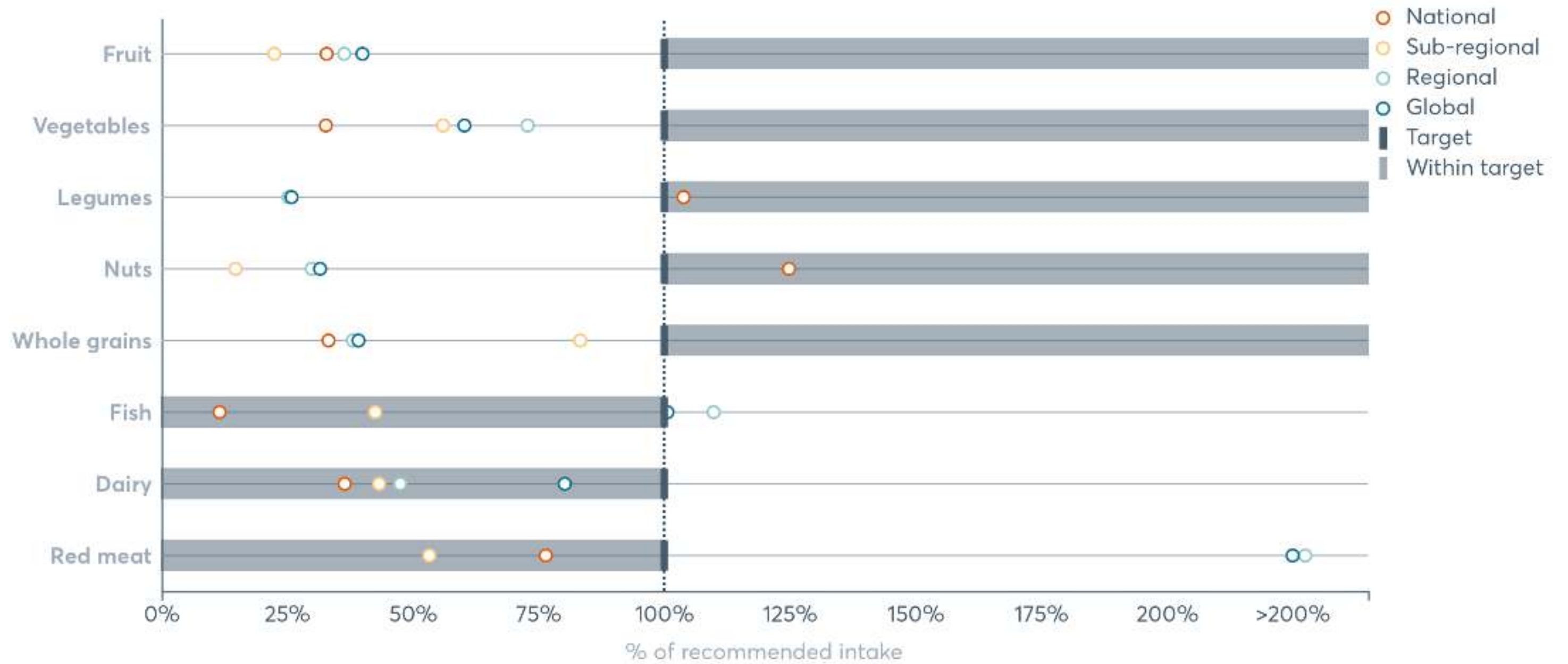
UNHCR's Standard consumption rationale allows each person to have one set of items.

- 140 Grams of Burglar Wheat
- 20 Grams of Beans or Peas
- 12 Grams of Oil
- 12 Grams of Corn Soya Blend
- 2 Grams of Salt

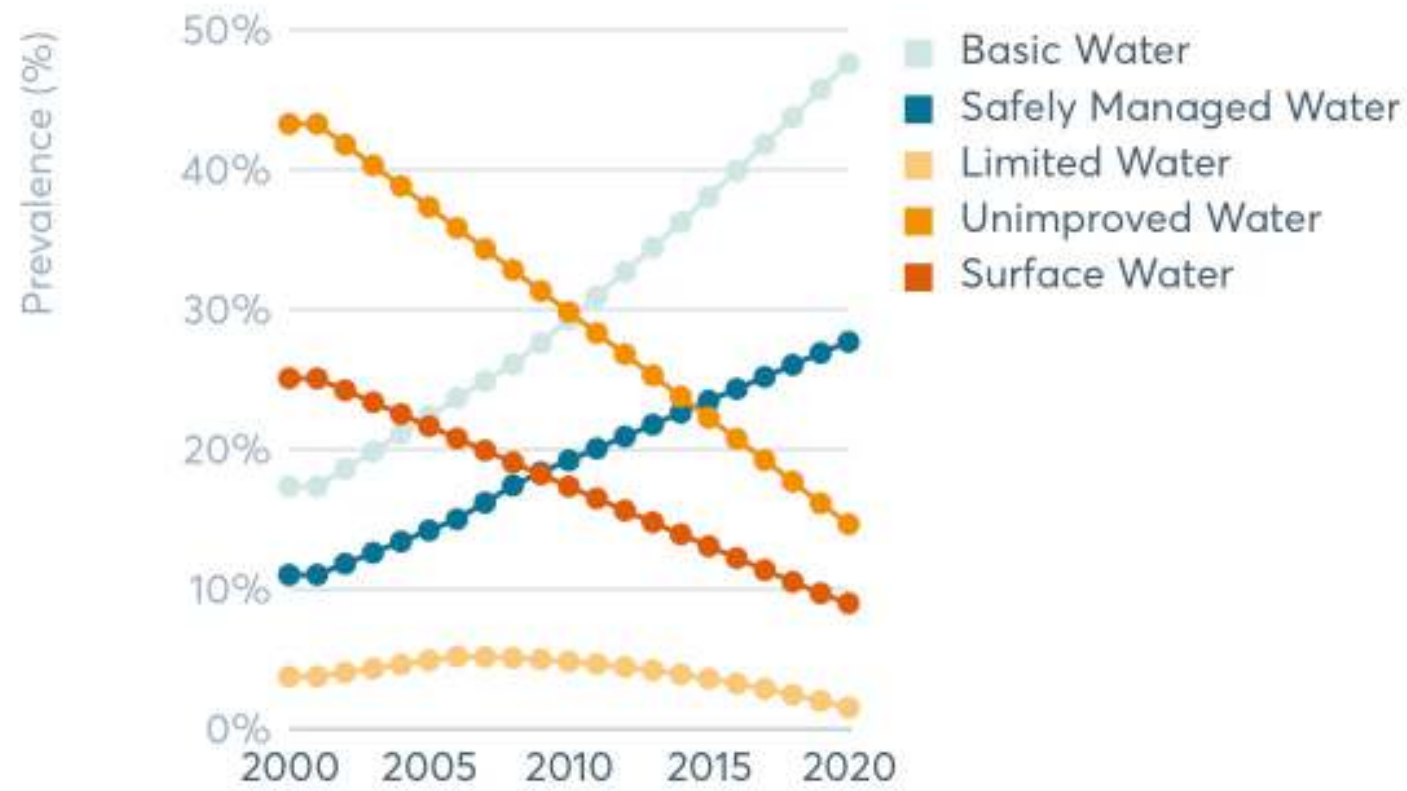
Nutritional Value of 900 Calories



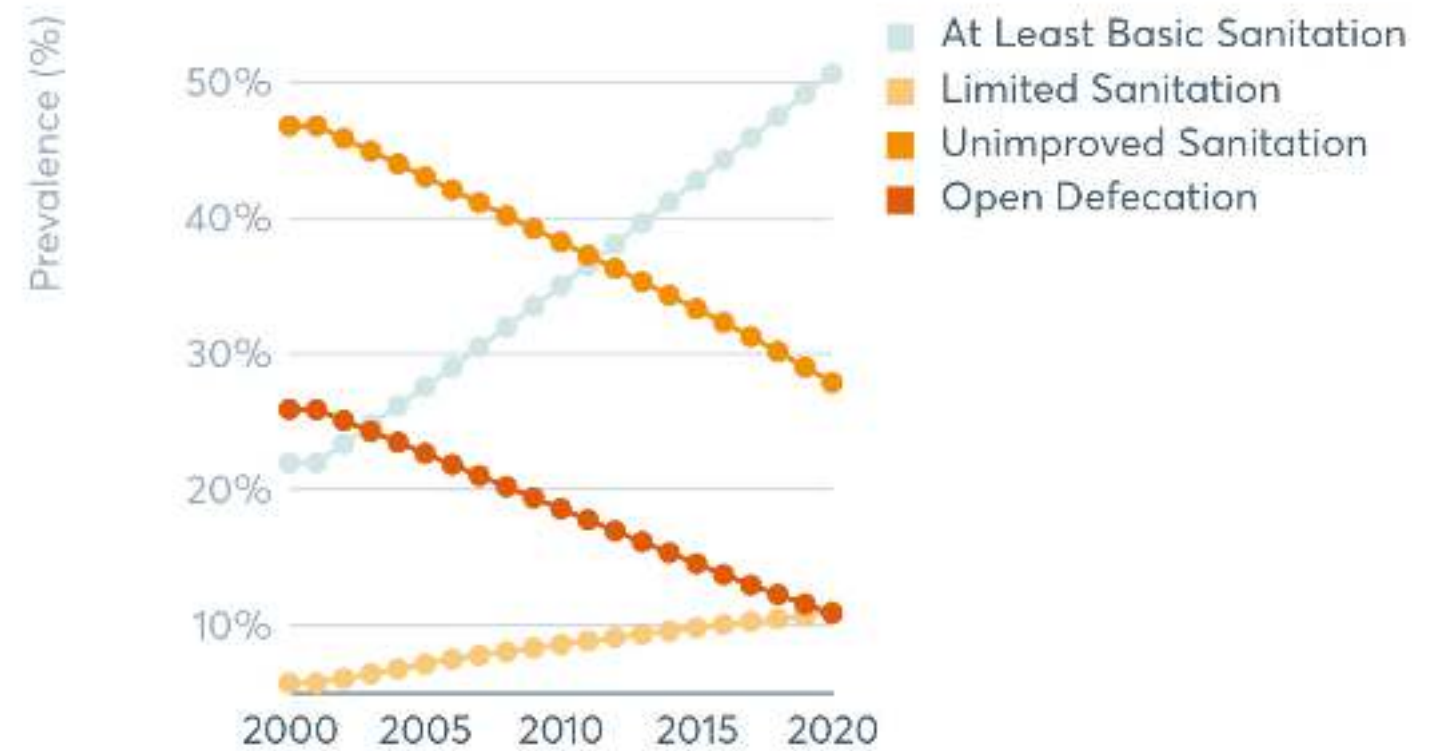
# Economics | Consumption and Use



## Source of drinking water



## Type of sanitation facility



## Economics | Wellfair and Distribution

UNHCR is expanding cash-based assistance so that the millions of people it serves can meet their needs in dignity, be protected, and become more resilient.

In the three years between 2016 and 2019, when it ramped up cash assistance, UNHCR - in partnership with governments, UN agencies, NGOs, and the private sector - has distributed roughly \$2.4 billion to 20 million vulnerable individuals in more than 100 countries.

“It benefits the refugees and the host economy simultaneously.” - UNHCR



# Part 9

## Furniture & Finishes Documentation

# Material Solutions



Key:

1. 3D Printing Clay
2. Steel Shipping Container
3. 3D Printed Paneling
4. Courtyard Flooring
5. Teak Dome Flooring
6. Polished Concrete Shipping Container Flooring



## Lighting Solution Exterior



Item: Lumo Led Street Light

Brand: Sokoyo

Use: Exterior Street Light

Location: Court Yard

Sustainability: Solar

Life Span: Anti Rust

LED Life Span: 50000H

Material: Aluminum + Cast Aluminum

Voltage: 12V

Power: 40-60W

Model Number: KY-D-XC-001

Efficiency: 130LM/W

Color Temperature: 3000k-6500k

# Furniture Solution | Domes



**A**



**B**



**C**



**D**

Item: UNO Conference  
Chair  
Brand: Steelcase  
Material:  
Finish:  
Color:  
Sustainability

Item: Turnstone Simple Seating  
Brand: Steelcase  
Material: Polypropylene & Steel  
Finish: Black (7207)  
Color:  
Sustainability:  
Dimensions: 19"D x 19" W x  
8/9" H

Item: Turnstone Simple Seating  
Brand: Steelcase  
Material: Polypropylene & Steel  
Finish: Black (7207)  
Color:  
Sustainability:  
Dimensions: 19"D x 19" W x  
8/9" H

Item: Sistema Lounge System  
Brand: Coalesse  
Material: Laminate & Paint &  
Fabric  
Finish:  
Color: Blue  
Sustainability:  
Dimensions: 36.25" D

# Furniture Solutions | Soft Surfaces



**A**



**B**



**C**



**D**

Item: UNO Conference Chair  
Brand: Steelcase  
Material:  
Finish:  
Color:  
Sustainability

Item: Turnstone Simple Seating  
Brand: Steelcase  
Material: Polypropylene & Steel  
Finish: Black (7207)  
Color:  
Sustainability:  
Dimensions: 19"D x 19" W x 8/9" H

Item: Sistema Lounge System  
Brand: Coalesse  
Material: Laminate & Paint & Fabric  
Finish:  
Color: Blue  
Sustainability:  
Dimensions: 36.25" D

Item: Bumper Ottoman  
Brand: Blu Dot  
Material: Fabric  
Finish:  
Color: Blue  
Sustainability:  
Dimensions: 15" H x 26" W x 26" D

# Furniture Solutions | Hard Surfaces



**A**

**B**

**C**

---

Item: Medium Coffee Table  
Brand: Steelcase Bolia  
Material: Wood  
Finish: Solid Marble  
Color:  
Sustainability:  
Dimensions 60×60

Item: Como Medium  
Coffee Table  
Brand: Steelcase Bolia  
Material:  
Finish:  
Color:  
Sustainability  
Dimensions: 60×120

Item: Book Case Green Point  
Storage  
Brand: West Elm  
Material: Wood Surfaces  
Finish: Veneers  
Color: Black  
Dimensions: Varies

# Furniture Solutions | Healthcare Clinic



**A**

Item: Mitra Recliner  
Brand: Steelcase Health  
Dimensions: 32" D x 31" W x 46" H  
Material: Wood & Plastisol  
Finish: Wood Legs  
Sustainability:



**B**

Item: Verge Save to project by  
Brand: Steel case Health  
Dimensions: 19"H  
Material: Paint & Plastic  
Sustainability:



**C**

Item: Mar Egeo Electric Treatment & Medical  
Examination Bed  
Brand: Steelcase Health  
Dimensions: 72" L x 28" W x 20" H  
Material: Metal Frame  
Finish: Memory Foam  
Color: Black



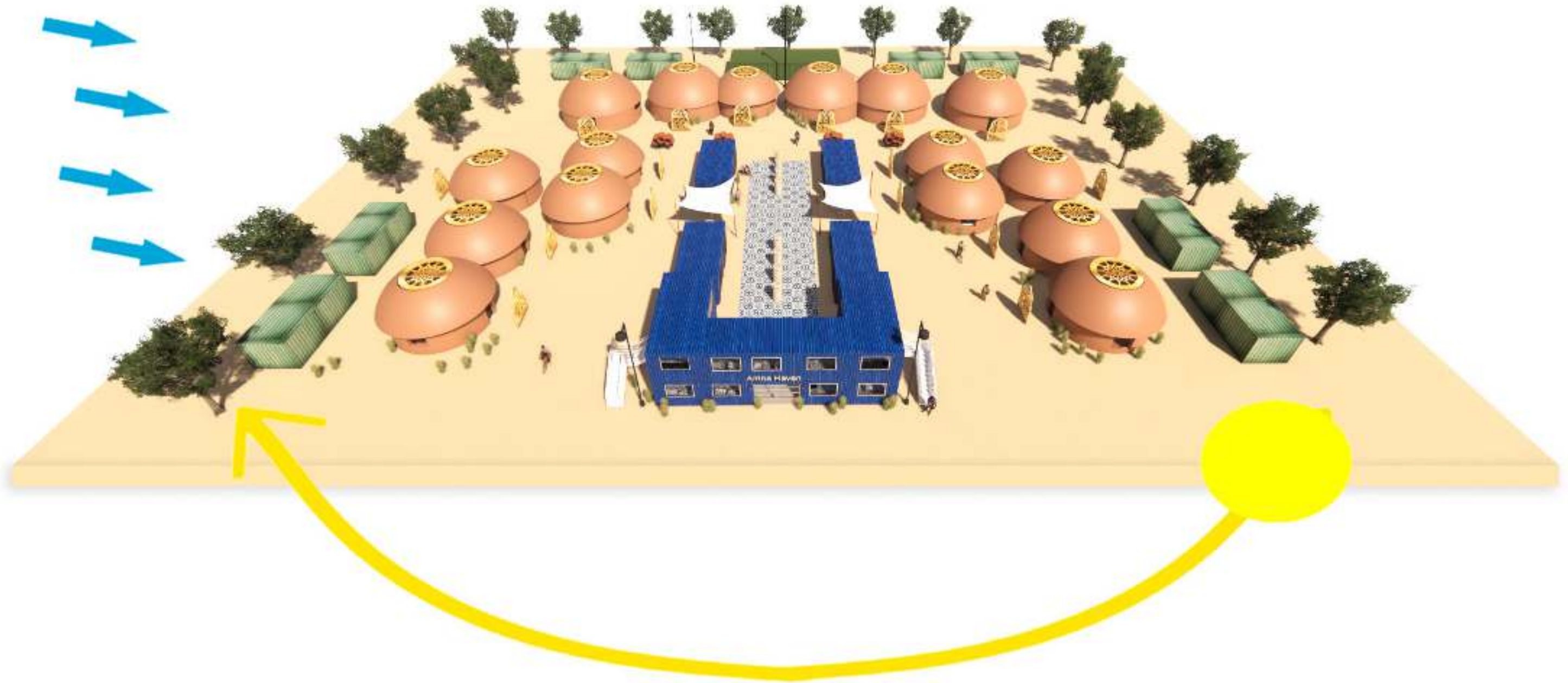
**D**

Item: Clinician Workstations Pocket  
Brand: Steelcase Health  
Dimensions: 18" W x 21 1/2" D x 38" H  
Material: Paint & Plastic  
Finish: Platinum  
Sustainability: Made with up to 35% recycled content

# Site Plan



# Wind and Sun Study



# Facade Render





# Exterior Dome Render



# Courtyard Render



# Interior Dome Render



# Interior Dome Render



# Reception Desk Render



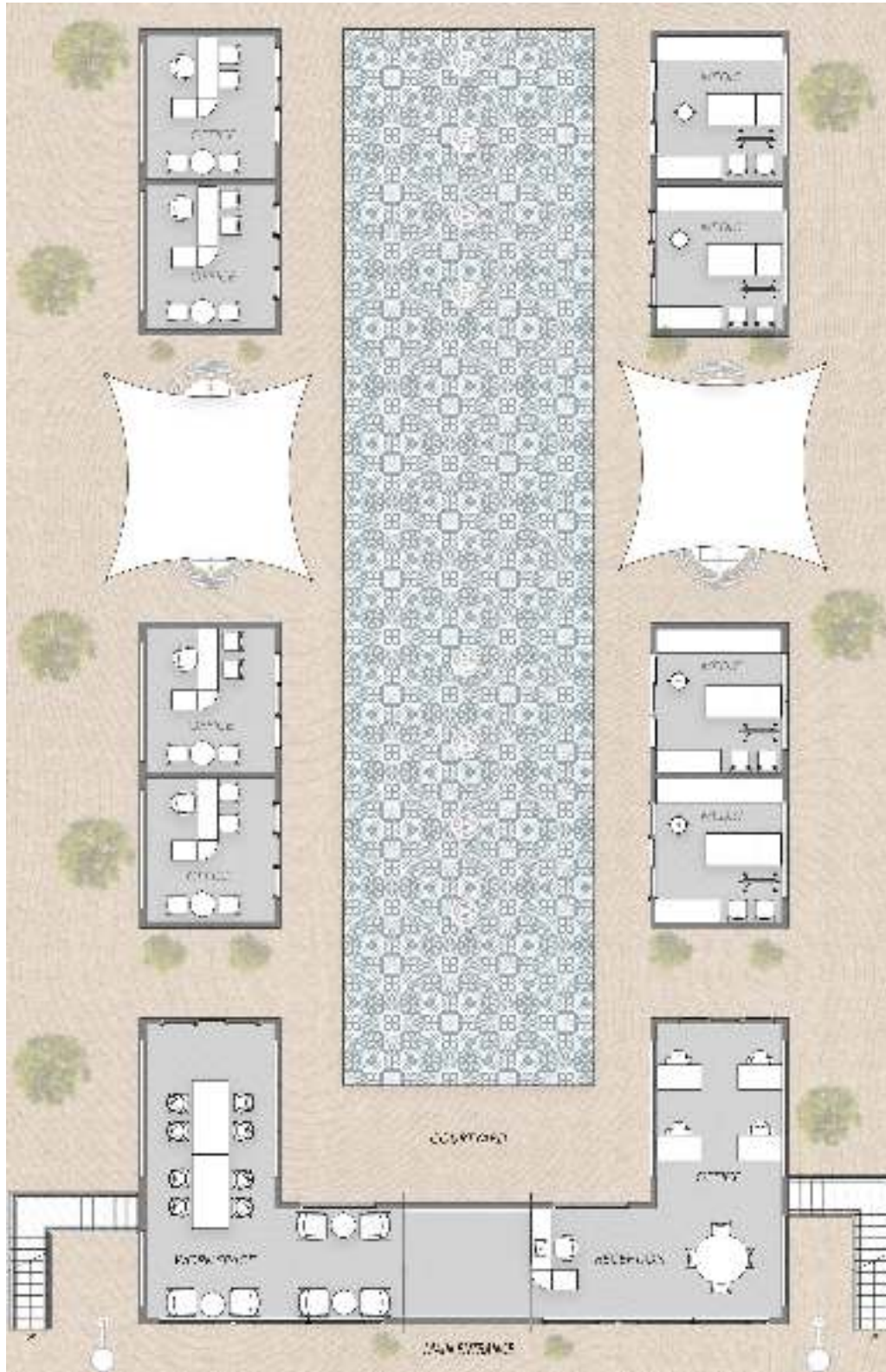
# Work Space Render



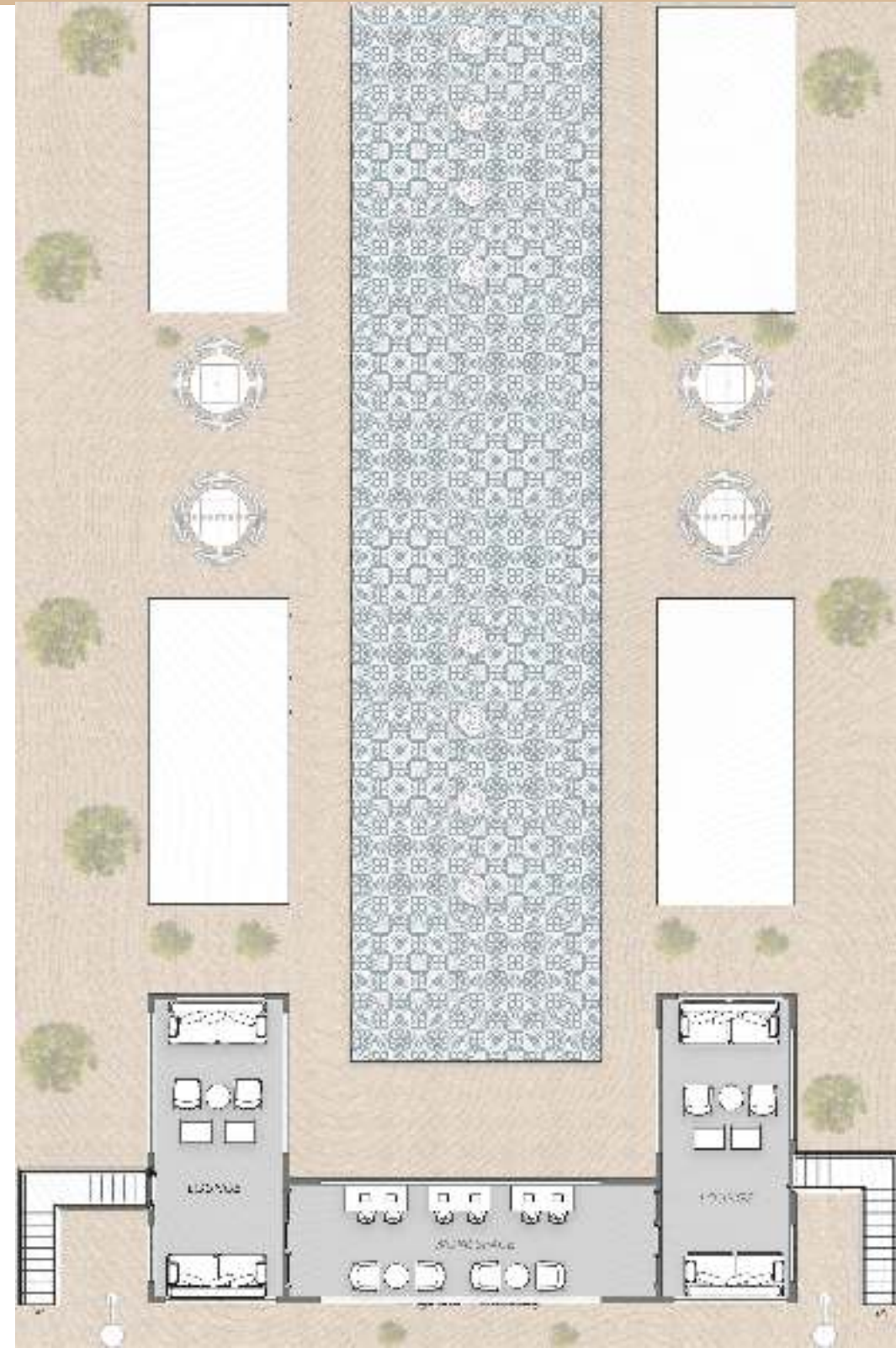
# Public + Private Spaces



# Floor Plans



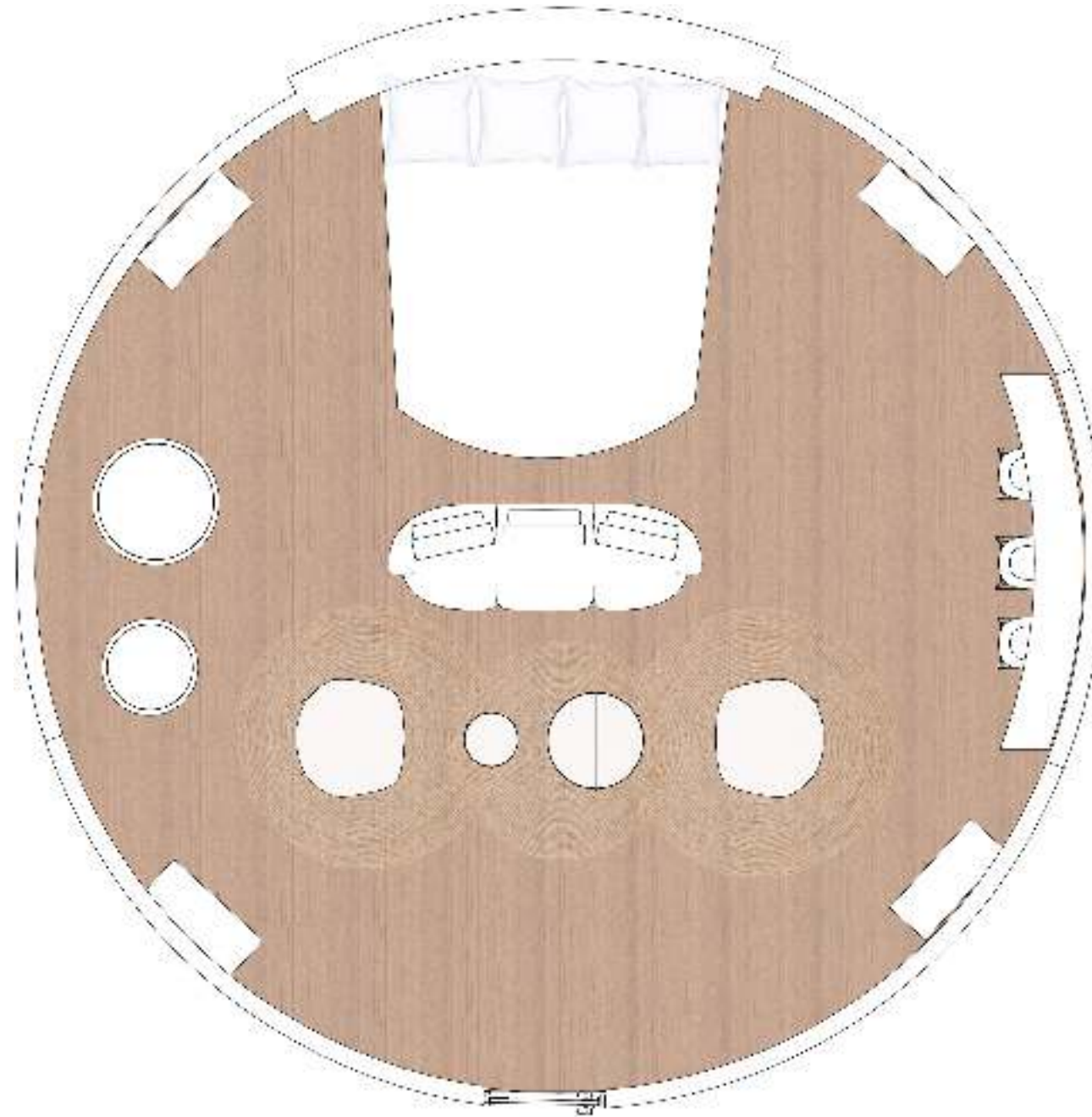
 COMMUNITY GATHER FLOOR PLAN LEVEL 1  
SCALE: 1" = 1'-0"



 COMMUNITY GATHER FLOOR PLAN LEVEL 2  
SCALE: 1" = 1'-0"



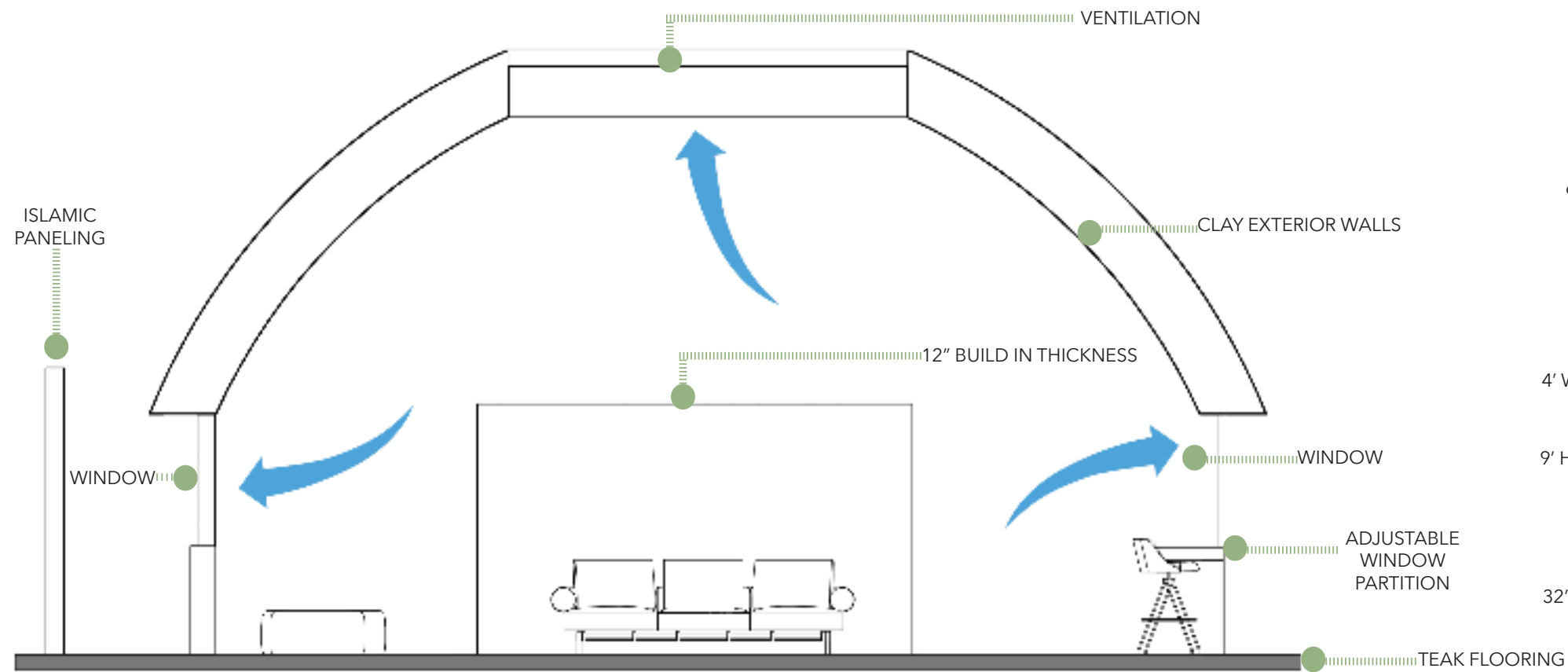
# Dome Floor Plan



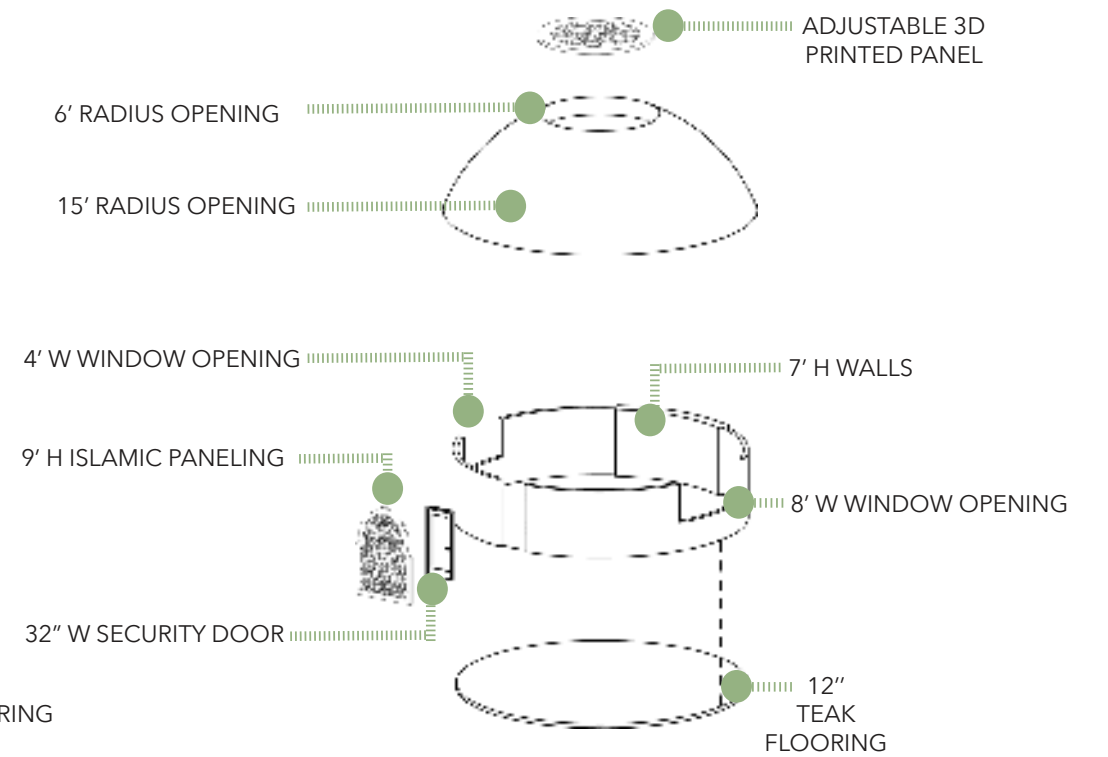
INDIVIDUAL DOME HOUSING LEVEL 1


SCALE: 1" = 1'-0"

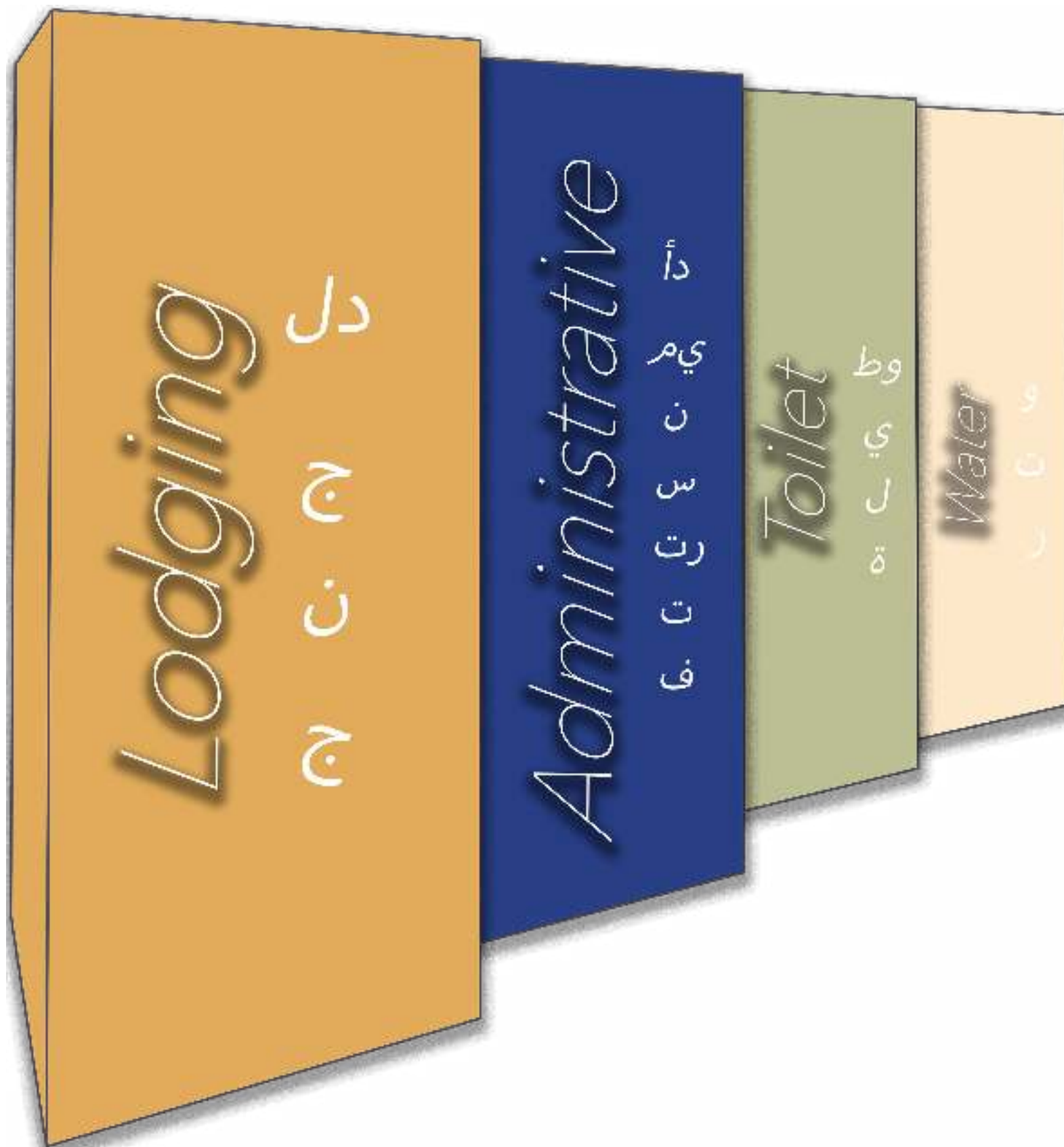
# Modular Building Techniques



 **DOME SECTION**  
SCALE: 1" - 1'-0"



 **DOME AXONOMETRIC**  
SCALE: 1" - 1'-0"



# Part 10

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