# Sustainable Energy

## Theme Introduction

global sustainability challenge

# Table of Contents

# The Problem

## Energy Access, Global Warming & Depletion of Natural Resources

Energy is the backbone of modern society, powering our cities, homes, industries, transportation and communication. Our reliance on fossil fuels, responsible for >75% of global greenhouse gas emissions is contributing to climate change, resource depletion, and environmental degradation. [Source]

Fossil fuels like coal, oil, natural gas are non-renewable. They release massive amounts of greenhouse gasses (GHG), primarily carbon dioxide (CO2) and methane (CH4). Their emissions trap heat and drive global warming, and extreme weather events. Global temperatures and air pollution are rising, and affecting our daily lives around the world. [Source]

## UN Sustainable Development Goals

### SDG 7: Affordable and Clean Energy

Move towards renewable sources, while enabling affordable and clean energy access for all

### SDG 13: Climate Action

Work together to stop global warming, resource depletion & environmental degradation

### SDG 11: Sustainable Cities and Communities

Design cities to conserve energy, educate and mobilize communities, reduce energy consumption overall, and encourage greater resource sharing.

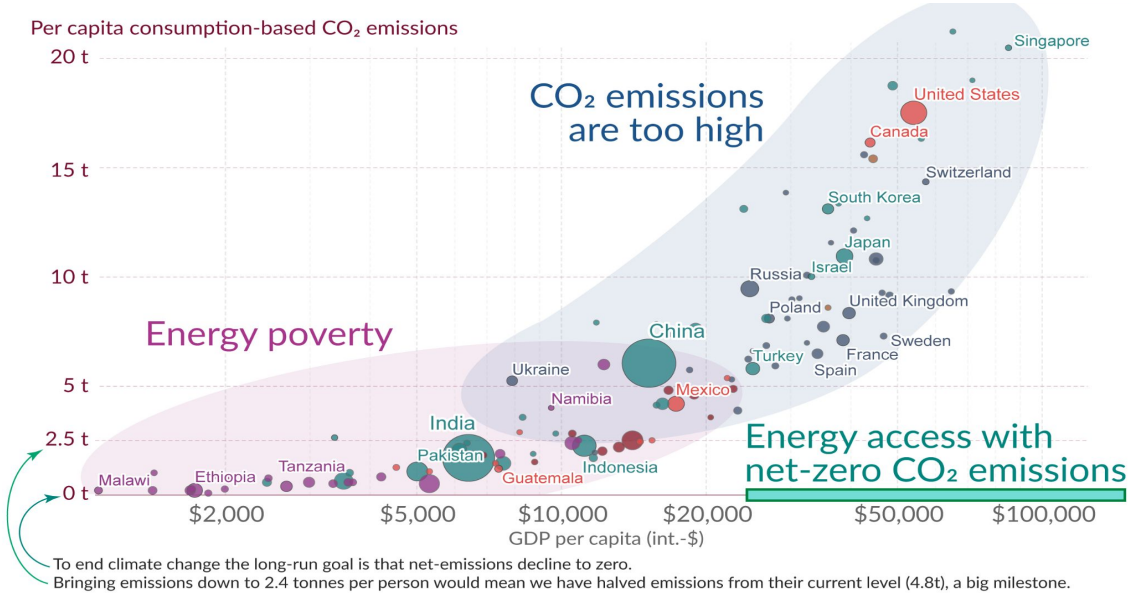
# Why does this matter?

## Increasing demand amplifies the problem of emissions and access

Global energy demand is projected to rise by 23% by 2040, driven by urbanization, industrialization, cooling and data center needs. [Source]

As countries with lower GDP per capita develop, energy demand and emissions will increase further. [Source]

This tension between rising demand, environmental constraints and energy access makes the transition to sustainable energy not just a choice, but an urgent necessity.



# Subthemes

Most energy challenges can be broadly categorized into these areas.

## 1. Energy Generation

Support transition to renewable energy and carbon neutrality. Develop more resilient and affordable energy systems, & reduce dependence on fossil fuels,

## 2. Energy Distribution

Integrating renewable energy into power grids, enabling large-scale hydrogen distribution, and advancing affordable, scalable energy storage solutions.

## 3. Energy Usage

Addressing energy efficiency, building energy optimisation, developing means to mitigate carbon emissions

## 4. Industrial Energy

Tackling renewables curtailment, cutting coal reliance, and bridging regional energy gaps.

## 5. Resource-scarce

Addressing limited land availability for renewables, modernizing aging nuclear infrastructure, and mitigating typhoon risks to offshore wind systems.

## 6. Large-Scale Transition

Reducing energy use in factories, addressing nuclear concerns, and cutting dependence on imports.

# Your role?

## Help solve the energy crisis!

Develop an innovative, scalable, and impactful solution that reduces emissions in the energy sector or enable access to clean energy, covering the sub-themes shared earlier.

They may include technical solutions, like physical products or software, as well as solutions to drive policy, cultural and behavior change.

Want more details on the problem?
Check this  Theme Overview for Students


Sounds great! Where do I start?

# Start engaging with your local community and the global GSC collective!

1 **Start Local**
Talk to your community

2 **Understand the Problem**
Deep dive to research the issue

3 **Define the problem**
Narrow down to a problem “statement”

4 **Brainstorm & Innovate**
Generate creative solution ideas

5 **Prototype and Test**
Develop and test your solution

6 **Think Global**
Adapt for a global audience!

Want more details? Check these  Tips for Students!

# Inspiration Board

Young innovators and community leaders across the world have developed solutions to solve parts of this problem.

Here are some successful solutions as inspiration for you!

Orora Global (India): Clean energy for livelihood creation

Renewell (US): Turning old oil wells to energy storage

CRecTech (Singapore): Biogas to methanol as shipping fuel

ECT Case (EU): To withdraw fossil fuel support

Climate Rangers (Indonesia): Political awareness campaign

Jua Jamii (Tanzania): Energy Efficient Affordable Homes

# Need more inspiration to start?

Here are some problem statements to help get started.

**Example 1: Shifting Peak Energy Demand**

**Example 2: Affordable Energy Storage Technologies**

**Example 3: Efficient & Clean Utilization of Fossil Fuels**

Please note that these are just examples. You should feel free to find problem statements beyond these or that go deeper into the issues.

***We encourage innovative and cross-disciplinary thinking!***

# Shifting Peak Energy Demand

## Problem Statement

The growing adoption of intermittent renewable energy sources, while crucial for decarbonization, presents a significant challenge to grid stability and efficiency. This intermittency leads to the “duck curve” phenomenon, characterized by a steep ramp-up in net load during late afternoon and early evening hours. This peak demand requires less flexible, often fossil fuel-fired plants. By incentivizing the shifting or reduction of energy demand during these critical peak periods, we could enhance renewable energy integration, improve grid resilience, and thus accelerate the transition to cleaner energy systems.

## How to find a solution?

**Step 1:** Understand the existing mechanism for peak demand management in your target region
**Step 2:** Speak with stakeholders (users, utilities, and regulators) to understand the current gaps in demand management and scope for improvement
**Step 3:** Brainstorm solutions based on your geographical needs. Understand technical levers, behavioral economics, nudge theory, and how incentives (financial and non-financial) influence energy consumption patterns.
***Solutions could be technical, behavioral or policy driven!***

## Resources

🔗 Video: What is a “duck curve”?
🔗 Article: IEA Article - Will more wind and solar PV capacity lead to more generation curtailment?
🔗Research Paper: Time-of-Use and Critical Peak Pricing

# Efficient & Clean Utilization of Fuels

## Problem Statement

Fossil fuels remain a dominant energy source globally, but their traditional utilization is associated with high carbon emissions, air pollution, and energy waste. While the transition to renewable energy is imperative, fossil fuels will continue to play a transitional role in many economies. Enhancing their efficient and clean utilization—through technological innovation, optimized processes, and policy frameworks—can reduce environmental harm, improve energy security, and buy time for the scaled deployment of renewables. This shift is critical for balancing energy demand, economic development, and climate goals.

## How to find a solution?

**Step 1:** Assess current state of energy in the target region, including fuel types, emission levels, efficiency standards.
**Step 2:** Engage stakeholders (industries, tech. providers, regulators) to identify barriers to adoption. Review successful (or unsuccessful) cases of clean fuel projects, e.g. CCUS deployment or energy efficiency programs.
**Step 3:** Develop solutions based on the local resources and economic constraints. Explore research on clean fuel tech, cost-benefit analyses of efficiency upgrades, & policy mechanisms (e.g. carbon pricing).

## Resources

- 🔗 Video: Low-carbon Liquid Fuels
- 🔗 Report: Policy Practices for Energy Efficiency
- 🔗 Video: Policy Frameworks for Low Carbon Fuels
- 🔗 Article: Carbon Capture, Utilization and Storage

# Affordable Energy Storage

## Problem Statement

The expansion of renewable energy, such as solar and wind, is vital for global decarbonization efforts. However, their inherent intermittency poses challenges to grid stability, reliability, and efficient utilization. Energy storage technologies are critical to address this intermittency. Unfortunately, the high upfront costs and limited accessibility of many existing storage solutions (e.g., lithium-ion batteries, pumped hydro) hinder their widespread adoption, particularly in developing regions and for price-sensitive consumers. Developing and deploying affordable energy storage technologies is essential to accelerate renewable energy integration, enhance grid resilience, and facilitate an equitable transition to low-carbon energy systems.

## How to find a solution?

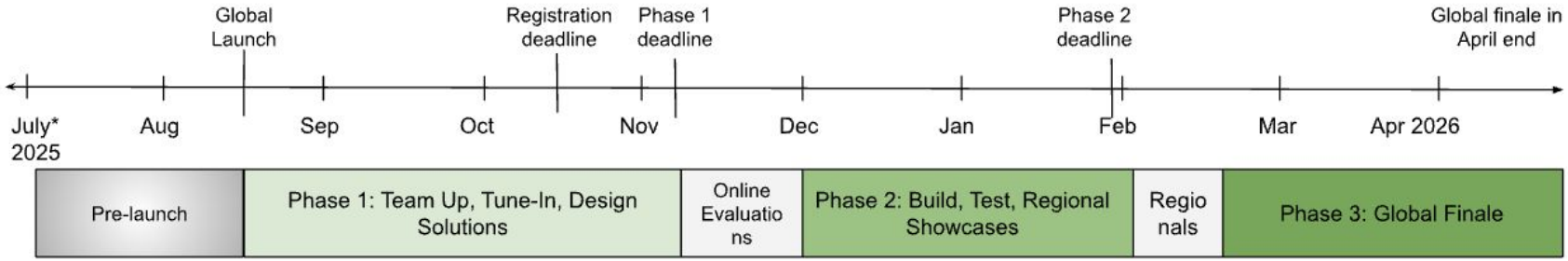
**Step 1:** Analyze the current landscape of energy storage technologies, including costs, adoption rates, and existing policy support or subsidy programs.
**Step 2:** Engage with stakeholders to identify key barriers to affordable storage adoption & opportunities for innovation.
**Step 3:** Develop region-specific solutions based on energy mix, usage pattern, economic conditions (e.g., areas with high solar potential may prioritize small-scale storage). Review research on cost reduction pathways: materials innovations, business model or policy to lower adoption barriers.

## Resources

🔗Article: Energy Storage Overview (IRENA)
🔗Video: Large Scale energy Storage Technologies
🔗Article: Cost Projections for Utility-Scale Storage (NREL)

# Challenge Phases

## What to expect




**Phase 1: Team Up, Tune In, Design Forward**
Start a team. Choose a subtheme, understand the problem space, and define a problem statement. Generate possible solution approaches. Design the solution. Create a mockup of the idea (sketch, video, etc.).

**Phase 2: Build, Test, and Showcase**
Build and test a concrete representation of the idea (e.g. working prototypes, testable pilots). Iterate and refine your solution. Showcase at the Regional Finals.

**Phase 3: Global Finale**
Iterate and refine your solution and pitches. Showcase at the Global Finale.

# Deliverables

## Submitting an application

- **Phase 1:** Sign up on the challenge portal here. Fill out the submission questions on the challenge platform including problem statement, research process and findings. Upload a detailed solution concept including a video of the idea and any mockups or sketches.

- **Phase 2:** Fill out the submission questions on the challenge platform to outline your concrete solution further, provide insights from user testing, and implementation plan for real-world impact. Present a 5 min live pitch (demos encouraged) at Regionals.

- **Phase 3:** Present a 3-5 min live pitch (demos encouraged) at the Global Finale.

# Judging Criteria

## What we are looking for

- **Problem Definition & Relevance**. Clarity and importance of the problem based on research, user/stakeholder insight, and local/global context.
- **Innovation & Multidisciplinarity**. Originality of the idea and how creatively it combines disciplines, tools, or strategies.
- **Feasibility & Execution**. Realism of the solution, strength of the plan or prototype, iteration based on testing and feedback.
- **Impact & Scalability**. Potential for real-world climate or community impact; adaptability and growth beyond the initial context.
- **Communication & Storytelling**. Clarity, engagement, and persuasiveness of the team's pitch, presentation, and supporting materials

# Thank you!

Join the challenge today: **globalsustainabilitychallenge.org**

global sustainability challenge