# Project Drawdown

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# WIP: Application of the United Nations Sustainable Development Goals through Drawdown


## Abstract

This paper describes a pathway forward to implementing the United Nations Sustainable Development Goals (UN SDGs) through Drawdown solutions for reversing global warming during a collaborative international pilot study abroad program led by The Pennsylvania State University (Penn State). The activities are based on selected STEM challenges and opportunities in Latin America with site-specific case studies for engaged scholarship and intellectual development in partnership with Universidad Nacional de Ingenieria in Lima, Peru (UNI). We envision that this initiative will also provide a platform to revise courses in our undergraduate curriculum to meet the new ABET Criteria for Student Outcomes (2019-2020). This paper describes the changes and new activities added to an earlier version of this program that was offered between Penn State and UNI last year. The article also reports the motivation behind the program revisions, the integration of SDG's with Drawdown, and the strategy for obtaining the approval and support of the university faculty. The assessment of newer hands-on projects added to the program and future activities are presented. The impact of this program on students' professional growth and career development are discussed, as well.


## 1. Introduction

The concepts of global citizenship [1,2] and sustainability [3] are essential in transforming undergraduate education in the United States in order to handle the challenges of the 21st century. Indeed, Higher Education institutions need to identify, create, and provide engagement opportunities for students in all fields. In 2016, the leadership of The Pennsylvania State University (Penn State) developed a strategic plan with six foundations: ***Enabling Access to Education*****,** ***Engaging Our Students*****,** ***Fostering and Embracing a Diverse World*****,** ***Enhancing Global Engagement*****,** ***Driving Economic Development*****,** **and** ***Ensuring a Sustainable Future***. These strategic areas of focus embody existing and emerging strengths and opportunities identified during Penn State's planning process. Supporting themes intersect with college-level unit plans and pull from the human capital, infrastructure, and programs they represent. Penn State's strategic plan contains five thematic priorities: *Transforming Education, Enhancing Health, Stewarding Our Planet's Resources, Advancing the Arts and Humanities, and Digital Innovation*. The program reported in this paper considers Penn State's foundation: ***Ensuring a Sustainable Future,*** that aims to directly and assertively confront the global challenges of climate change and sustainability in all their complexity**.** The contents of the program have elements of the thematic priority: *Stewarding our Planet's Resources*, that strives to create comprehensive solutions to mitigate the dangers of climate change and **address the challenges of providing safe and abundant water, clean and renewable energy sources, and plentiful and nutritious food**.

## 2. Overview of the program

The first efforts of the program were reported in previous work [4] with a description of the overall philosophy and objectives. Both faculty and students from Penn State and UNI provided valuable recommendations to improve the program. The current, six-week program is called 'Cross-Cultural Engagement Program," and Penn State students can earn seven credits as part of this program, by taking three required courses: 1) *Cross-Cultural Engagement Pre-departure* (1 credit), 2) *Global Engineering Culture and Society* (3 credits), and 3) *Spanish Language and*

*Culture* (3 credits). The program represents a joint educational initiative, focusing on cultural immersion, international exchange, and STEM activities between Penn State and UNI. In this program, up to 20 Penn State students can travel to Universidad Nacional de Ingenieria (UNI) in Lima, Peru, from May through the middle of June, annually. Between 10 and 15 students from UNI can also participate in this program as part of the *Global Engineering Culture and Society* course. Students from both institutions work with open-ended projects that stimulate intercultural competence, interaction, and collaboration. This paper describes the objectives, development, revisions, and implementation of the course: *Global Engineering Culture and Society.*

## 3. Course: Global Engineering Culture and Society

After a pre-departure virtual introduction to participants from both countries, students and faculty from Penn State traveled to UNI for a six-week immersive program. The course was partitioned into three modules to facilitate faculty participation from Penn State as well as UNI. Module 1 lasted for one week and focused on the Social, Political, and Economic Challenges of the United Nations Sustainable Development Goals (UN SDGs). This module will be assessed separately in the future, but we provide its contents for completeness. Module 2 lasted two weeks and addressed UN SDG-11 Sustainable Cities and Communities, whereas Module 3 lasted for three weeks and focused on many aspects of the UN SDGs through Drawdown solutions [4]. Each module was taught by a faculty member from Penn State and a faculty member from UNI together to ensure that cross-cultural and pedagogical aspects were fully integrated into each module. Modules 1 and 2 served as an introduction to the UN SDGs with a direct application to Peru. The main components of Module 2 were reported previously [4] and were slightly modified (based on both faculty and students' feedback) for the second offering of the program. The critical aspects of Module 2 are briefly reported here for completeness and a summary of the students' reflection essays of this module are presented in Appendix 1. The rest of the paper focuses on Module 3 that concentrates on the Application of the UN SDGs through Drawdown.

### 3.1 Learning objectives of the course:

At the conclusion of this program, students should be able to:

- Describe how the UN SDGs relate to Peru; Apply intercultural knowledge in communication scenarios connected to the *Strategic Vision and Themes of Peru*, and the US National Academies' Grand Engineering Challenges;
- Determine how to approach a technical problem from transnational and interdisciplinary perspectives, with an emphasis on Peru and Latin America;
- Utilize a systems approach defining a techno-scientific problem, and illustrate how a systems approach can be employed to devise sustainable engineering solutions that benefit specific communities and humanity at large.

### 3.2 Module 1 (Week 1): Social, Political, and Economic Challenges of Sustainable Development Goals

***Summary:*** The module provides an introduction to the overall program and the context in which we will work together to understand and implement the UN SDGs.

***Objectives:*** (i) understand the ways in which the UN SDGs apply to the social, political, and economic context of Peru; (ii) develop an understanding and a framework for how to

think outside of one's own cultural context; and (iii) learn cross-cultural communication skills to prepare for effective collaborations with international student counterparts.
***Evaluation:*** Class sessions will be collaborative and experiential with a focus on conversation and engaged critical thinking. Students can expect to be challenged to "unlink" themselves from their own culture in a variety of ways. Daily Reflections: 50% of grade**,** Final Oral Presentation: 50% grade

### 3.3 Module 2 (Weeks 2 and 3): Using Sensors to Collect Environmental Data

***Summary:*** The module applies the UN SDGs to specific needs and applications in Peru introduces the National Academy of Engineering Grand Challenges and the concept of Engineering for Humanity.
***Objectives:*** (i) describe how the UN SDGs and associated engineering issues relate to Peru; (ii) approach a technical problem from transnational and interdisciplinary perspectives; and (iii) devise engineering solutions that benefit specific communities. Students also experience how to learn "just in time" engineering tools like *Mblock* [5] and *Blynk* [6] to solve topics under UN SDG-11 Sustainable Cities and Communities.
***Evaluation:*** Lab evaluation: 45%, *Three* oral reports: 30%, *One* final paper, and oral presentation (teams of 2 or 3) with solutions that include at least two elements of concepts/tools learned during the lectures and labs: 25%.

The daily schedule of activities for this module and a summary of the students' reflection essays of this module are presented in Appendix 1.

### 3.4 Module 3 (Weeks 3 – 6): Sustainable Technologies for Water-Energy-Food Challenges

***Summary:*** This module develops awareness of water-energy-food (WEF) challenges around the world, and enables students to consider the nuances of culturally appropriate Drawdown solutions to specific sites in Peru.
***Objectives:*** (i) understand how WEF-nexus challenges relate to the UN SDGs; (ii) visit local sites in Peru which are confronted with WEF challenges and collect appropriate data to enable an assessment of feasible Drawdown strategies for their resolution; (iii) create conceptual designs of at least two integrated Drawdown solutions for the sustainable production of clean water, nutritious food, and/or renewable energy in the context of site-specific challenges; and (iv) Exercise writing and presentation skills effective for professional practice.
***Evaluation:*** In-class activities: 10%, Homework: 10%**,** Labs: 20%, Reports: 30%, Presentations: 30%

Project Drawdown is a non-partisan research and communication organization that has developed 100 solutions to reverse global warming. The 100 solutions are organized by seven topic areas: Buildings and Cities, Electricity Generation, Food, Land Use, Materials, Transport, and Women and Girls. By using Project Drawdown's 100 technical, ecological, and social solutions [7,8,9,10] for reversing global warming as a framework to implement the UN SDGs in a developing country, the new program presents several advantages. First, it provides students with the ability to identify and formulate engineering problems in a global, economic, environmental, and societal context. Second, it provides an academic setting to produce solutions to meet a spectrum of considerations

for real communities, including public health, safety, and welfare. Third, it enables the application of ethical and professional responsibilities in engineering situations to make informed decisions.

In order to be competitive, aspiring engineers must be taught to: 1) explore alternate solutions; 2) embrace creativity in their designs; 3) extend their learning into other disciplines; and 4) develop innovative solutions to the world's most pressing challenges. These skills and mindset are summarized in Table 1 presented in Appendix 2 using the new ABET Criteria for Student Outcomes (2019-2020). Every single item shown in Table 1 was accomplished in Module 3 of the *Global Engineering Culture and Society* course. The daily schedule of activities for this module, final project rubric, and samples of the students' final project are also presented in Appendix 2. In this module, the overall quality of each team's project exceeded our expectations. Although language and cultural barriers were evident at the start of each project, these hurdles quickly dissipated when the students focused on brainstorming solutions for their respective projects.

**4. Qualitative Evaluation Methodology and Impact on Student Outcomes**

There were seventeen students from Penn State and an average of 10 students from UNI that participated in this program in May-June 2019. Thirteen out of the seventeen students were Engineering students, one from Biology, one from Journalism, one from Management and Information Systems, and one from Biobehavioral Health. About 90% of the students were first-year college students. All students from UNI were Mechatronics Engineering students from different years.

To evaluate the outcomes of the program, multiple sources of data need to be collected. These sources will include quantitative data on student retention, annual student surveys, student reflective essays, and focus groups after the completion of the program and during the academic semesters at Penn State. For this paper, summaries of reflective essays are presented in Appendix 1. We also intend to evaluate other outcomes in the future with this population of students using these guiding questions: 1) What impact did the program have on student outcomes such as retention and GPA?; 2) Did the international experience, in combination with other experiences, prove to be a transformational factor for the participants; and 3) What benefits did the students perceive that the program provided for them regarding academic, global citizenship, sustainability, social, and professional outcomes?

In the future, we will also collect data regarding students' professional development such as internships, undergraduate research, and summer leadership opportunities that each student experiences over the remainder of their semesters at Penn State.

**5. Implementation of Sustainability at the Pennsylvania State University**

In developing and implementing sustainability in each academic department, the leadership of Penn State is in the process of creating Sustainability Councils across all Colleges. The central goal of the College of Engineering (COE) Sustainability Council is to provide strategic guidance and support to effectively integrate sustainability into the teaching, research, and outreach activities of each department in the College, while realizing the College's aspirations to improve research impact. To achieve this goal, we are first aligning ourselves with the departments to encourage faculty to emphasize sustainability as part of the curriculum, and secondly, we identified faculty research areas that align with the UN SDGs. To this end, we support and promote current

efforts to expand the value of our research and innovation and recognize that we may not be calling it *sustainability*. It is a natural progression to incorporate the UN SDGs into our undergraduate curriculum as we revise courses to meet the new ABET criteria for 2019-2020 depicted in Table 1 in Appendix 2. The ultimate goal is to address all 17 UN SDGs across our 13 departments in the COE at Penn State. Realizing the potential for increasing the faculty workload by adding a new component to the curriculum, we developed and revised the program reported in this paper as an example, and identified faculty who volunteered to teach the modules of the *Global Engineering Culture and Society* course. Furthermore, we identified faculty who championed the idea of developing a Freshman Seminar with the elements of this course in the COE.

## 6. Challenges of the Program

The main challenge of this project, if applied on a large scale, is funding. The cost of the travel, housing, subsistence, several educational tours, and many venues in Peru for the seventeen students and three chaperones was approximately $120,000. One possible avenue to mitigate this challenge is to explore partnerships with similar programs at other universities. We intend to explore these types of broader collaborations since it could create newer and unique opportunities for students. To positively affect a larger group of students, a significant grant or other donors would be required. There is a new challenge that the COVID-19 pandemic has created for international programs that we need to address as a global community in order to continue supporting these types of learning activities. One aspect that needs careful consideration is that with a larger group it is possible to lose the effect of the small group relationships which are essential to this type of program.

Another challenge of the program is the miss-alignment of academic semesters between Penn State and UNI. This situation creates a conflict for UNI students to participate regularly every day on this program. The leadership of UNI is in the process of including the UN SDGs in their curriculum through Drawdown solutions to overcome the local schedule of courses. Nevertheless, the participation of mixed students in itself is a very positive experience for both Penn State and UNI students. This program can accommodate 30 Penn State students and 15 UNI students. The authorities of UNI are planning to develop assessment tools to measure the impact of this program with UNI students.

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**Appendix 1**

A. Daily Schedule of Module 1 of the *Global Engineering Culture and Society Course.*

***Module 2 Schedule:*** **Using Sensors to Collect Environmental Data**

| Week 2 & 3 | Subject | Assignment |
|---|---|---|
| Class 2.1 | United Nations Sustainability Millennium Goals, The National Academy of Engineering Challenges (Application to local city) | Oral Report 1: Traffic Problems |
| Class 2.2 | Embedded Systems Overview. Components of an Embedded System and Applications. Introduction to Programming using *mBlock* | Lab 1: Turn On LED of Arduino Board and turn on RGB ports |
| Class 2.3 | Sensors and Actuators: Acquisition and Control | Lab 2: Turn On LED using an actuator and a potentiometer |
| Class 2.4 | Programming Applications. Brainstorming on what problem you could tackle in Anonymous | Oral Report 2: Brainstorming results |
| Class 2.5 | Internet of Things | Oral Report 3: Present your project idea |
| Class 2.6 | Signal Acquisition using IoT concept and tools: *Blynk* | Lab 3: Use *Blynk* to control sensors and actuators |
| Class 2.7 | Project Development | Outline Final Report |

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| Class 2.8 | Project Report | Final Oral Report |

*B.* Perceived Benefits of the course *Global Engineering Culture and Society*: Results of Student Reflective Essays on Module 2

In addition to completing their homework, labs, and projects, students were asked to complete several open-ended questions asking about the impact of Module 2.

Summarized results from two of the questions follow.

1. Name three things that you learned from this module with regards to the United Nations Sustainable Millennium Goals (SDG). Do you feel this module gave you a sense of how to contribute to solving these SDGs?

Fourteen out of seventeen said that they knew about the UN SDG in one way or another but were not 100% familiar with the contents. Three mentioned that they were surprised how much they can contribute to these goals and how important sensors are in finding some solutions to the SDG. All students appreciated working with local students in finding solutions.

"Over the last couple weeks there were many things I learned in terms of the United Nations Sustainable Millennium Goals. The first being how diverse the goals themselves are. The goals are so diverse that it proves to the world people of all occupations and backgrounds must work together to accomplish these feats. There is no engineers vs non-engineers or any such comparisons when working to accomplish these goals."

**"**I really enjoyed working with the Arduinos to have hands on experience with embedded systems. The program examples showed me how sensors can work to solve these problems. The experience also gave me a better idea of how I can take these concepts myself and use them to make a difference."

"Being able to interact and work alongside the students from UNI has continuously reminded me of the value in diversity and being a global engineer as international cooperation and understanding has become increasingly important. Also being able to talk with the UNI students about their current engineering projects as well as their aspirations for future careers has introduced me to completely amazing and innovative ideas. It makes me excited to see what I will do and become in the future as an aerospace engineer. I also hope to be involved in international projects."

"In the beginning I wondered where we were going with the programming on MBlock (what kind of project/what the programming could do) but the SGDs tied it all together. Overall, there were not any questions I felt I couldn't ask within this program. The integration of students from the UNI made us Penn State students establish a comfort level within the local City, and within the engineering program. Also, the combination of the professors teaching the engineering class, and the help from the UNI students made it so that all of our questions could be answered if needed. The assistance and inviting environment made learning easy, even as a Journalism student in an engineering class."

2. Over the past 2 weeks (Module 2), how has your participation as a student in this program changed your perception of how you can impact your profession or community in the future (local, national or global)?

The entire group of students mentioned some aspects of the learning community, cultural differences, global experience, and international collaborations.

"The past two weeks have shown me how exciting it is to collaborate on an international scale with different cultures. It has enforced my interest in the Spanish language and desire to become fluent. I originally thought having the second language would be an asset to show employers and I wouldn't mind if I don't end up using the language in my future career; however, I now have a deeper desire to seek out engineering positions that require proficiency in Spanish and/or international collaboration/travel."

"This module has helped me realize how simple some solutions are, and ways that I can impact my community in small ways. Besides physical things, I come back with a newfound sense of appreciation and gratitude for the life I live and all the opportunities that I'm handed. But, besides all that sappy stuff I now know that there are little things I can create with embedded sensors that can help shape the lives of others, water filters included. When I go to Africa my junior year I hope to be able to use this new knowledge to solve some issues that are apparent in whatever country I end up in."

"After these two weeks I have realized that as students we can still do so much to support people locally and potentially find a solution that helps people all over the world. It is interesting to talk to the UNI students and listen to what they are working on. So many of them are developing solutions that are going to help so many people. This has opened my eyes to how I can make an impact as well."

"I believe my cooperation in this program has showed just how much of an impact that my major will have globally. My major is Management Information Systems. My major is very beneficial for this program because it has involvements in terms of managing large amounts of data and maintaining secure data transmission between different technologies. This program has given me more of a reason of why my major is very helpful."

All students mentioned that this program gave them a better understanding of their profession. Many indicated the humanitarian contribution to the world of their careers and the realization that they can start contributing now to the global community.

**Appendix 2**

A. Daily Schedule of Module 3 of the *Global Engineering Culture and Society Course.*

***Module 2 Schedule:*** **Sustainable Technologies for Food-Energy-Water Challenges**

| **Weeks 4 – 6** | **Subject** | **Assignment** |
|---|---|---|
| Class 3.1 | Introduction to the Food-Energy-Water Nexus;<br>**Food**: Components of Sustainable Agriculture | Activity 3.1 &<br>Homework 3.1 |
| Class 3.2 | **Food**: Sustainable Agriculture Site Visit | Lab 3.1:<br>Food data collection |
| Class 3.3 | **Food**: Work on design, report, & presentation | Team work |

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|---|---|---|
| Class 3.4 | **Food**: Deliver report & presentation | Team presentations |
| Class 3.5 | **Energy**: Renewable Resources | Activity 3.2 & Homework 3.2 |
| Class 3.6 | **Energy**: Solar Community Site Visit | Lab 3.2: Energy data collection |
| Class 3.7 | **Energy**: Work on design, report, & presentation | Team work |
| Class 3.8 | **Energy**: Deliver report & presentation | Team presentations |
| Class 3.9 | **Water**: Resources, Treatment, & Reuse | Activity 3.3 & Homework 3.3 |

B. Table 1: New ABET Criterion 3: Student Outcomes (effective 2019-2020)

| | Innovation and Creativity |
|---|---|
| (1) Ability to **identify, formulate, and solve complex engineering problems** by applying principles of engineering, science, and mathematics | **Design** alternate, innovative solutions which improve on existing principles |
| (2) Ability to apply engineering design to produce solutions that meet specific needs with considerations of **public health, safety, and welfare as well as global, cultural, social, environmental, and economic factors**. | **Quantify the effects** of designs on real communities and the environment |
| (3) Ability to communicate effectively with a **range of audiences** | **Educate** affected communities and associated stakeholders |
| (4) Ability to recognize ethical and professional responsibilities in engineer situations and make informed judgments, which must consider the impact of engineering solutions **on global, economic, environmental, and societal contexts** | Consider the effects of designs on **real communities** and the environment |
| (5) Ability **to function effectively on a team** whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. | Work with individuals from a variety of backgrounds to **utilize diverse experiences and skill sets** |
| (6) Ability to **develop and conduct appropriate experimentation, analysis, and interpret data**, and | **Explore unique solutions** |

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| use engineering judgment to draw conclusions. | |
| (7) Ability to **acquire and apply new knowledge** as needed, using appropriate learning strategies. | **Research** strategies from other disciplines and apply them to design |

C. Rubrics of Sustainability Conceptual Design Project

Produce a concise and compelling report to describe your team's conceptual design for incorporating at least two of the Drawdown Solutions into the framework for development of sustainable communities, either in a global context, or specifically in urban/rural of Peru. Your design should be creative and innovative, yet realistically attainable given appropriate technical knowledge, dedicated leadership, and available funding. The sections that should be included in your report are:

a. **Cover page** – include your project title, course number and name, university, team member names, and date.
b. **Title** – repeat the title on the first page of the report. It should be descriptive, engaging, and no more than 10 words long.
c. **Abstract** – The "elevator pitch" for your project. A one paragraph summary (250 words max.) of the report which briefly describes the current challenges in the world related to your chosen focus topic(s), your team's specific recommended innovations to address those challenges, and how application of your innovations will help meet the UN Sustainable Development Goals of 2030 and the Engineering Grand Challenges of the 21st Century (if applicable), particularly in the context of systems within the food-energy-water nexus.
d. **Global Challenges** – Provide a concise description of the current challenges in the world (or Peru) related to your chosen focus topic(s), with statistics and at least five reputable references.
e. **Alternative Solutions** – Introduce a list or a table containing of all the potential Drawdown solutions (and any others!) that could be used to improve sustainability of your chosen topic(s), emphasizing which ones you have chosen to focus on for this project (ex., with bold, italics, etc.). Then provide written justification for your selected solutions over the others, based on site- specific constraints (environmental, financial, political, social, etc.), or severity of the global need. Provide references to support your claims.
f. **Conceptual Design** – Provide a detailed description of your team's overall proposed design for your selected target location(s) (i.e., general global application or urban/rural of Peru). The use of graphics/schematics/photographs to explain your approach are highly encouraged.
g. **Required Input Variables** – Provide a table containing all of the required inputs for your design to proceed to the next level (i.e., what information would be needed to put your approach into practice?). This may include: number of people affected; required land area; availability of water/sunlight/materials; energy costs; etc.
h. **Anticipated Costs and Funding Strategy** – Describe the items anticipated to require start-up funds needed to mobilize your plan (in general terms: for materials, labor, electricity, etc.), and suggest how those funds can be raised (specific community members, governmental organizations, non-profit organizations, philanthropy groups, etc.) – be as specific as possible for the target location(s). Then propose a strategy for maintaining funding into the future (i.e., demonstrate how your plan is fiscally sustainable).

i. **Conclusions/Recommendations** – A brief description (no more than one paragraph) of your major design recommendations, expected benefits, and financial plan. Conclude with a list of the UN Sustainable Development Goals and Engineering Grand Challenges which your design addresses (if applicable).
j. **References** – A detailed list of all of the references you cite in the report, using the format of any major journal (ex., *Environmental Science & Technology*).
k. **Appendix** – Any supporting material that was too lengthy or detailed to fit into the body of the report. Remember to refer to this material within the text of the report, otherwise it's as if it doesn't exist. Also include a breakdown of how each member of your team contributed to the report.

**Deliverables:**

1. **Topic check (15 points)**
2. **Final Report (100 points)**
   Format your report with 12 point font, 1.5 spacing, 1" margins, and page numbers. Bold the title and all section headings. Oxford commas are recommended to avoid ambiguity in technical writing, and are highly preferred by your instructor. All tables and figures must be numbered, given a descriptive title/caption, and referred to by their number in the text. Table titles should be placed on top of tables, whereas figure captions go beneath figures.
3. A confidential **Group Evaluation Form** must be submitted by each member of each team to Canvas by the stated deadline for the Final Report. Failure to do so will result in a 5% penalty.

**Grading Rubric:**

Professional presentation quality and accurate technical content are essential in engineering reports, and therefore both will be evaluated in all components of the Design Project. The grading rubric for the Final Report is provided below. Teams that go above and beyond the stated requirements may earn bonus points for exceptional work.

## *D.* Student Results: Sample of Students' Abstract of Projects presented in Module 3

**Sample 1: Converting Solar Energy into Education**

Currently, many rural communities in the Andes region of Peru do not have access to electricity. Instead, they use fuel sources such as firewood and kerosene to cook and provide light, which is detrimental to human health and to the environment. In addition, a considerable education gap between boys and girls exists in these rural areas, a region that has inadequate education to begin with. In this report, we propose one process to address both of these issues. First, solar panels will be provided to all rural Andean communities. Local people will be educated about solar energy to maintain the solar panels themselves and learn about sustainability. Access to electricity frees up girls specially to focus on education rather than physical labor. In the long term, the people will be able to thrive in their communities without outside assistance, and potentially produce excess solar energy for other purposes. This proposed process to convert solar energy into education addresses the UN sustainable development goals 5, 7, and 11, or gender equality, affordable and clean energy, and sustainable cities and communities, respectively. The process does this by utilizing increased access to a sustainable energy source, solar energy, to create opportunities to improve the education of women and girls.

**Sample 2: Sustainable Intercropping and Silvopasture Farming in the Peruvian Amazon.**
The clearing of trees for plantations has played a huge role in the deforestation of the the Amazon, and the expansion of palm oil is responsible for a large portion of it. The silvopastoral system is a concept of agroforestry that promotes biodiversity and sustainability within a farm by having multiple species of crops and animals simultaneously. This program aims to transform the existing monocropping oil palm plantations into silvopastoral farms with intercropping as well as provide educational opportunities for local residents, especially women. Our solution enables the unsustainable palm oil farms to sequester greenhouse gases, take full advantage of natural resources while maintaining the eco-balance, and increase their total profit. The benefits of our concept meet four of the UN sustainability goals, responsible production, climate action, gender equality, and life on land.

**Sample 3: Empowering Women through Agroforestry**
The Team proposed a sustainable solution for the region of Remote City in Peru through extensive research, analysis, and collaboration. The goal of The Team was to find a way to merge two Drawdown Solutions: Agroforestry and Educating Girls. Remote City in Peru is the second largest region in Peru, however it is one of the least populated areas. The majority of Remote City's population lives in the region's capital, Puerto Anonymous, but others live in small indigenous communities in the various jungle regions This is one of the reasons that illegal mining is so popular. There are many subsequent actions due to illegal mining, such as child labor and human trafficking. The Team aimed to provide a feasible alternative to reduce the percentage of illegal mining and its subsidiaries. The Team actively used four of the United Nations' Sustainable Development Goals and indirectly used one. The proposed solution will help conquer Quality Education, Gender Equality, Decent Work and Economic Growth, Life on Land, and Climate Action, respectively.

**Sample 4: Traveling Educational Program for Preventing Malnutrition in Rural Peru**
Peru, as a nation suffers from many challenges, malnutrition being one of them. 38% of indigenous children in Peru are malnourished (Fighting Malnutrition, 2018), which is defined as being the condition that develops when the body does not get the right amount of the vitamins, minerals, and other nutrients it needs to maintain healthy tissues and organ function (Gale, 2019). Chronic disease is also prevalent due to improper sanitation habits and the repercussions of an improper diet. This country could benefit from a reworking of their existing diet. To fix these problems a traveling food program should be implemented to educate the people on proper sanitation procedures, give them new ways to balance their diet using the food they have, and also empower the women and community as a whole to feel as if they have control over their situation. This innovation will help to accomplish the UN Sustainable Development Goals of 2030 by addressing the specific goals of zero hunger, good health and well-being, gender equality, and responsible consumption and production. Ugly Food in a Beautiful World (UFBW) will work directly with the people of the communities it enters by holding free cooking seminars. It will employ the professionals needed to give the people of the community the knowledge they need to incorporate a healthier, plant-based diet, learn proper sanitation techniques, and also give them the tools they need to reduce food-waste. UFBW will also work to spread damaged foods to areas that need it and also provide incentives such as free cans for those who attend the workshops.