

INSPIRING PRACTICES |  FINALIST 2022 |  CHILE

## #ENVIRONMENT

# Machine developed by young people reuses waste from health services

With a social and environmental focus, the project was created in the context of the pandemic to recycle material from masks and surgical gowns.

### TEACHERS

Luz María Pozo Astaburuaga  
Pilar Swett

### COMMUNITY/CITY

Santiago

### STEM AREAS

Science and Technology

### STUDENTS

Sofia Paredes  
Maria Paula Castro

### SCHOOL

Colegio Huelén

### OTHERS AREAS OF KNOWLEDGE

Sociology and  
Environmental Education

### PROJECT NAME

Las propireutilizadoras

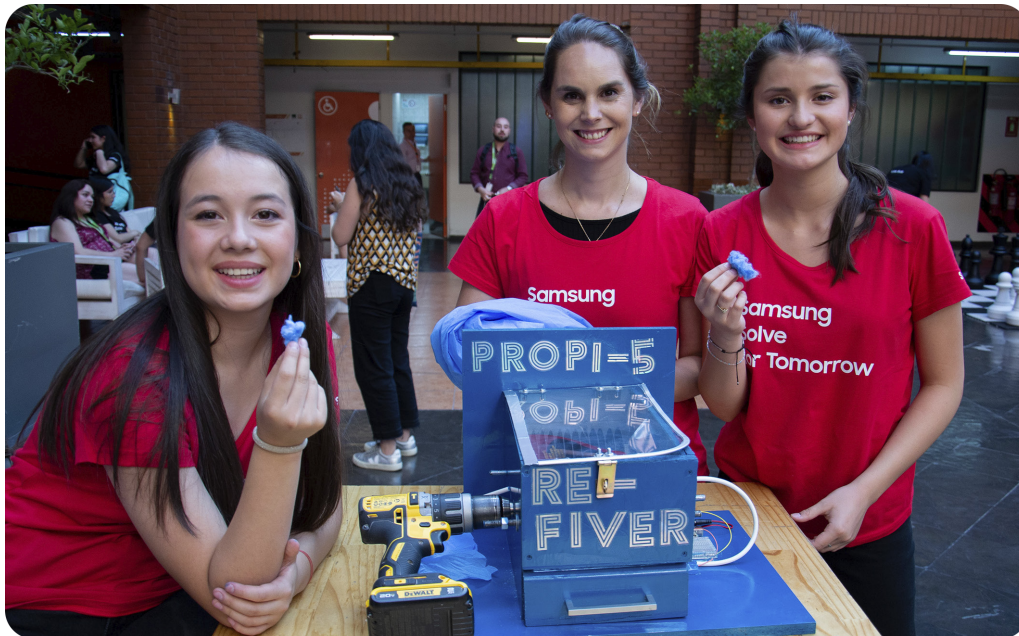
Have you ever wondered how much healthcare waste was produced during the COVID-19 pandemic? A collaborative study published in 2021 (in Spanish) showed that 3.4 billion masks or face shields were thrown away every day. Personal protective equipment is made of plastic and it is generally disposable, meaning it is not recyclable. Although it was essential for maintaining health, especially during that period, the environmental impact was severe.

Considering this social problem, two Chilean students developed a machine capable of reusing the main material from masks and surgical gowns: polypropylene. The innovation was a finalist in Solve for Tomorrow in the country in 2022. The group was entirely female. Two teachers (Luz Astaburuaga and Pilar Swett) mediated two 17-year-old students, in the fourth year of high school, the last year of compulsory schooling.

This was the school's first experience with a program like Solve for Tomorrow; they had only participated in science fairs and internal initiatives. "The proposal came from two very curious students, who were looking for ways to access scholarships or special admissions to enter scientific careers at university. Through their searches, they found the program," recalls Pilar Swett, a chemistry teacher.

# SAMSUNG

According to the teacher, the idea for the project, entitled “Las propireutilizadoras” (The Propireutilizators, in English), was born quickly. “Our school has a great social vision, with a focus on solidarity, social aid, and care for the environment. They were very surprised by the number of masks in the rubbish bins, even at school,” she explains.



All-female group made STEM prototype that reuses healthcare waste

## Making the solution more tangible

One of the students had the idea when she remembered a time she was at the hospital and had to use a lot of Personal Protective Equipment (PPE) and when she left she had to throw it all away in the trash, which was already full of other waste like this. She was shocked by the amount and wondered what volume this would have on a national and global scale.

In the beginning, they had a more complicated proposal: to reuse polypropylene, the predominant type of plastic in PPE, to create a product such as mattresses or pet beds. “They even thought about donating them to more vulnerable populations. We were looking at the different applications and the impact and we realized that it was much more viable to produce the raw material, which could then have multiple uses,” Swett reports. The teacher considers that this was an important turning point in the experience because they dedicated themselves quite a bit to making this decision.

They thoroughly investigated what had already been created on the subject, and what companies were doing to dispose of this waste. Then, they decided to create a machine that could sanitize and shred PPE to turn it into a new raw material.



## Eureka Moment!

The team didn't have much of a budget, so they had to get creative in choosing the parts. The PPEs were donated by allied health clinics. To shred, they tried using a tuna can. They cut off the bottom and put it in series inside a box (the device's case). They had the structure to cut, but they lacked the necessary strength. So the attempt failed. Until they tried it with a drill, like the one used to drill a wall, and they succeeded. The material turned to dust.



**"Teamwork was very important. Not just the four of us, but also the experts we consulted: school professionals, engineer parents, and the program mentors,"**

says the teachers.

## Innovation combines automated and manual processes

For this project, they considered using equipment classified as semi-critical and non-hazardous; that is, it did not have any type of fluid. (These are those that are used for a short time, such as a trip to the doctor.) But they needed to be disinfected. The students studied the chemical properties of polypropylene and already knew how to clean it properly, thanks to their experiences with biosecurity campaigns at school during the pandemic. But they wanted to automate the process; to do so, they enlisted the help of an engineer in learning programming.

The device's case ended up being approximately 50cm x 30cm in size and was made from a cardboard box; with a lid so that waste would not blow away. Using an [open-source](#) electronic prototyping Arduino board, the material was sanitized. It was sprayed with quaternary ammonium and automatically turned on and off with ultraviolet (UV) light.

One student's grandmother donated the money so they could buy the drill cylinder for shredding. Attached to the machine, it is manually moved to shred the PPE. 75 surgical gowns can be shredded in three hours. When finished, the powder is easy to transport.

But the work did not end there. They still had to test the efficiency of the result. "We had to burn these fibers again to see if they were moldable and insulating. We carried out tests and confirmed that the material has retained the fundamental properties to be used again in the manufacture of other products," explains the educator.

The entire project took less than two months. “I think they learned a lot about trusting and listening to their partner; valuing each other’s ideas and persevering, because it was trial and error until it worked,” Swett stresses.

## Explaining!


Polypropylene (PP) is an additive polymer synthesized from propylene, a petroleum by-product. It is a very versatile raw material, with numerous applications in industry, and is inexpensive. However, being of fossil origin, this material can take between 250 and 400 years to decompose.




## Focus on practice!

Take a look at the teacher’s guide on how to make a machine to “recycle” polypropylene from masks and surgical gowns.

## Empathy


 During the COVID-19 pandemic, two students became concerned about the excessive amount of waste from masks and surgical gowns that ended up in the trash and, consequently, in the ocean. So they thought of creating a way to reuse this material.

## Definition

 The students realized that polypropylene, a type of plastic, was the predominant material for personal protective equipment (PPE). Through scientific research, they realized that it was also the raw material needed to make mattresses, pet beds, and thermal insulation.




## Ideation

 The initial idea was to transform PPE into new products; but after some reflection, they decided to focus on creating a machine that would allow the “recycling” of polypropylene. In this way, the final product could be used for various purposes and would also be more practical.





## Prototype

 The prototype combines manual and automated processes. The housing was made from a cardboard box, with a lid to prevent waste from flying around. The material was sanitized using an open-source electronic prototyping Arduino board. It was sprayed with quaternary ammonium and automatically switched on and off with ultraviolet (UV) light.



## Testing

 The tests proved that it is possible to shred 75 surgical gowns in three hours.  The final result is a clean, easy-to-transport powder. The team then tested whether the resulting material was moldable and insulating. They confirmed that the material retains the essential properties to be reused in the manufacture of other products.