**Narrative**

**Poop, Play, Power!**

**Introduction: A Perpetuating Poop Problem**

As much as we love our fur babies, we must admit dog poop causes serious environmental issues. Besides unpleasant sight and smell, harmful pathogens can be found in dog poop and when it is left unpicked it becomes a source of water pollution. Some pet parents may argue that they have done their part in protecting the environment by picking up after their pets. Although it may have helped preventing the dog waste getting washed directly to a local waterway, all those plastic bag goes into a trash bin will eventually end up in a landfill. This still leads to uncontrolled release of methane gas. Methane gas is a harmful greenhouse gas and is known to be 30-70 times more potent than carbon dioxide. In the context of this project, 4,500 residents from the new development are expected to have a dog population of 585. If the dog waste is left untreated, approximately 200 kg of dog poop would enter the landfill each day and approximately 47, 500 cubic meters of biogas would be released into the atmosphere each year.

The project aims to collect all dog waste anticipated from the new development and human waste from park visitors and will transform poop into renewable energy, capturing 47, 500 cubic meters of biogas per year to create approximately 100 MWh of electricity per year. By including biodegradable household waste from the new development, our annual electricity production can reach 300 MWh. The project will transform current perspectives on poop as a problem to poop as a solution and a resource, by creating affordable and clean energy, support clean water and sanitation, fostering a sustainable community, and practicing responsible consumption and production. Poop, play, power is a placemaking solution that combines a dog park, a restroom with a waste digestion structure, and playground to generate renewable energy, to engage landscape as land art, and to create a place to foster community and educate the next generation about energy consumption.

**A Perpetuating Poop Problem**

Today, most of us take flushing the toilet for granted. We have manufactured a system to dispose of our poop and wastewater through a network of underground pipes and tunnels to be discharged and treated at a local sewerage treatment plant kilometers away from our homes. At the sewerage treatment plant, wastewater is treated systematically through a series treatment tanks. The treated wastewater then goes back into our water systems and completing the cycle.

Although disposal and treatment of human waste has improved over time, pet waste has not. Harmful pathogens such as e coli, giardia, and salmonella can be found in dog poop. Poop left unpicked from can lead to uncontrolled release of methane gas into the atmosphere and can also lead to contamination of local waterways. When it rains, unpicked poop dissolves and washes away down city storm drains. Storm drains are separate from sewer lines, they do not lead to a sewerage treatment plant and typically lead to an outfall at a local body of water.

**Powerful Poop: Current Solutions and Inspirations**

There are many innovative solutions that utilize poop for energy. “Poo Poo Power'' is a device that turns poop and biodegradable poop bags into electricity. Homebiogas® is a portable and compact digester designed to break down organic waste to create renewable biogas and fertilizer. A portable gas stove can be hooked up to the digester directly and liquid fertilizer can be harvested and provide nutrients for the garden. Park Spark Project is a methane digester targeted directly for pet owners. It collects dog waste and the energy generated is burned in a lamppost to create light.

These current solutions inspired us to design a park where visitors can interact with the full process of transforming waste into energy as a community. We also took inspiration from burial mounds and quaking bogs. Burial mounds are associated with the burial of the dead and have been discovered in all shapes and sizes, from round mounds to effigy mounds in shapes of animals or spiritual beings. For us, the burial mounds represented a culture and tradition, but we also found beauty in the unnatural landform and the variation of space and perspective it creates between and at different elevations of the mounds.

Quaking bogs is a bog with a thick layer of vegetation on top of a lake or pond. The bog mats in a quaking bog are thick enough for people or animals to walk on top, creating a bounce or quaking movement that animates the landscape. Overtime raised bogs are created through years of decaying vegetation accumulating in the center, creating a natural, dome-like landform.

**Poop, Play, Power!**

The design consists of 3 main elements: the dog park, the restroom with a waste digestion tank, and the active mounds. The public restroom is sandwiched between an underground digestion tank and a storage dome. The public restroom is the central node of the design and renewable energy process. The toilets connect directly to the digester tank below and anaerobic bacteria in the tank digests poop and turns it into biogas.

Stirring and heat are important parts of this renewable energy process. A turbine in the digestion tank stirs the mixture to help biogas rise to the top, while heat is added to maintain an optimized digestion temperature. Both actions require energy, this energy is harvested from the active mounds.

The active mounds are equipped with play equipment designed with piezoelectric sensors to create energy from kinetic motion. Various playground equipment includes trampoline, seesaw, slides, springers, and spinners. To contribute to the energy generating process, visitors are encouraged to play on the active mounds and enjoy the light and sounds activated by their own motion. Through this interactive process, we hope people of all ages become more conscious about energy consumption.

The dog park provides a place for residents of the new development to walk their dogs and dispose the dog poop in the digestion tank. Biodegradable bags will be supplied throughout the park and can be composted with the dog poop.

The biogas is stored in the dome above the public restroom. The dome is made from an elastomeric material and is reinforced with polyamide fabrics for high tensile strength and abrasion resistance. The volume of biogas generated is made visible by the inflation of the dome. The dome is designed to inflate and deflate as energy is produced and used. At night, the dome is lit up and light art can be projected onto the dome.

There are three end products from this process: biogas, liquid fertilizer, and solid remains. A generator is connected to the digester and transforms biogas into electricity to power park lights, light shows, and other park features. A portion of the electricity is stored in batteries for emergency use and the rest of the is connected to the grid to help power nearby households. After proper sanitization, the liquid fertilizer can be used to fertilize landscaped areas of the park or given away to Kleingarten owners. The solid remains are buried throughout the park creating land arts of different shapes and sizes over time.

The three elements together create a space for residents of the new development to play, contribute, and socialize. A plaza space is created using the in between spaces between mounds and allows opportunities to host local events where residents can bring and sell or trade excess produce or flowers from their Kleingarten. The park can also serve as a rest stop for cyclists traveling through the future Rhine-Neckar Green Corridor.

The available volume of the dome is approximately 200 cubic meters and is designed to store energy produced from approximately 585 dogs and 500 restroom visitors per day with extra room for household biodegradable waste. A total of 400 cubic meters of methane gas will be captured per day and approximately 850 kWh of electricity is produced. In one year, approximately 197,000 cubic meters of biogas is captured and approximately 300 MWh of electricity is produced.

The design can be scaled to create a network of Poop, Play, Power rest stops throughout the future Rhine-Neckar Green Corridor and can also be scaled to include food waste and other biodegradable household waste by using household style digesters. A network of this design would foster sustainable cities and communities throughout Mannheim, help combat climate change through reduction of greenhouse gas emissions, provide affordable and clean energy for residents of Mannheim, promote clean water and sanitation through proper disposal and treatment of dog poop, and practicing responsible consumption and production by turning waste into energy.

Poop, play, power is expected to cost around 7 million euro. The park would only require grounds maintenance plus daily cleaning of the restroom. Maintenance of the digestion tank can occur biannually and on a as needed basis.

**Environmental Impact Summary**

The population of Mannheim in 2020 is approximately 309,119. There is an average of 0.13 dog per person. The estimated dog population for Mannheim in 2020 is approximately 39,735 dogs. If we continue to ignore and leave pet waste untreated, the 39,735 dogs would generate approximately 13,510 kg of poop a day releasing approximately 4,100 cubic meter of methane gas. However, if we start treating and utilizing poop as a source of renewable energy, we can produce approximately 8,600 kWh of electricity per day with dog poop alone. That’s enough to power about 1,265 households or 1,500 electric vehicles. The processed solid remains can be reused as bio-based fertilizer and contribute to healthy plant growth. It can also be added to soil to increase organic matter, soil health, water retention, and improving overall soil structure. Meanwhile, we are preventing harmful pathogens from getting into our waterways.

Besides the direct physical environmental impact, we expect our proposal to outcome on another level. Our goal is to raise energy consciousness through energy literacy. We hope to engage people, encourage them to make smart energy choices, and reduce energy consumption on a daily basis. We would like to see our proposal being applied as a prototype throughout the city to inspire communities to come together and create more sustainable urban living for our planet. People will never look at poop the same way again!