Wasted Energy

New Mexico
Supercomputing Challenge
Final Report
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Executive Summary:

We have seen it all over the media, have heard about it from others, have witnessed it in itself. What, you may ask? The ever growing problem of energy sources and the lack of them. This problem has haunted us for decades, but now is the time it counts. Some wonder how we will be able to solve this problem. Proposed solutions include popular alternative energy sources, including solar, hydroelectric, geothermal, etc. There is an uncommon source that is also very valuable. This source is human waste. Our Supercomputing Challenge modeled how this unlikely contender could be the best chance we have at generations of energy.

Using the agent based program, NetLogo, we modeled how human waste can be converted to energy. At first look, it seemed an impossible way to supply ourselves with energy, but through research, we have found that it has already been put to use in small amounts. Using the statistics found through research, we compared this source with other sources. The program shows how it works, and compares it to the other sources in a way that anyone can understand.

The model itself takes statistics that were gathered through various research and programmed into the code, and simulates the usage of it. The model also takes into consideration population growth and usage increase. NetLogo also allows interactive features, which we took advantage of. You can easily visualize how this source of energy can lock our future's hope.

Introduction:

For our Supercomputing Challenge project, we analyzed the alternative energy source of human waste. We used the agent-based program of NetLogo, and modeled human waste and the gases that are generated from the decomposition of the waste. We used research gathered and the program to model how the gases given off can be converted to energy sources. We compared these to that of solar energy, wind energy, geothermic energy, and our current form of energy. We applied the modeled energy (in Joules) to different populations and usage levels.

The problem we addressed is the fact of less energy sources available. As a nation, and as a world, we need to find a new source of energy to sustain our civilizations. To solve this problem, we modeled a simulation of human waste decomposition and how it can be used as an alternative energy source. With all non-renewable resources being used to highly unnecessary extents, we find this source extremely useful. This can solve the problem of a possibility of no energy available to us and the problem (as a bonus) of over filling sewage plants.

Our model and simulation compared the results of gases given off from human waste, which were then converted to simulated energy, with other alternative energy source. We compared the different sources by how long they last with current usage statistics, pollutants possibly given off, and cost efficiency, and population sizes.

With NetLogo, we showed the decomposition of the human waste specimen and simulated the gases given off by them. We programmed the decomposition simulation so that it is decomposed by heat. This made the gases more concentrated. When the gases are released into the contained area, the program tells us how much gas is given off. That amount of gas is then put into an equation that was programmed into the code that can then give the statistics of possible sustainability.

Description:

We used the agent-based program, NetLogo. We chose this code developing program to create our model for many reasons, including our beginner experience with the program. We also chose NetLogo because it makes visualizing aspects of a concept easier to understand. We wanted to make our model easy to understand so that the public can realize the reliability of using human waste as an energy source.

Using NetLogo, we were able to develop a code that shows how human waste can be decomposed and the products there of collected to be converted into an energy source. In the beginning, we used a basic code, which included commands such as “setup” and “go”.

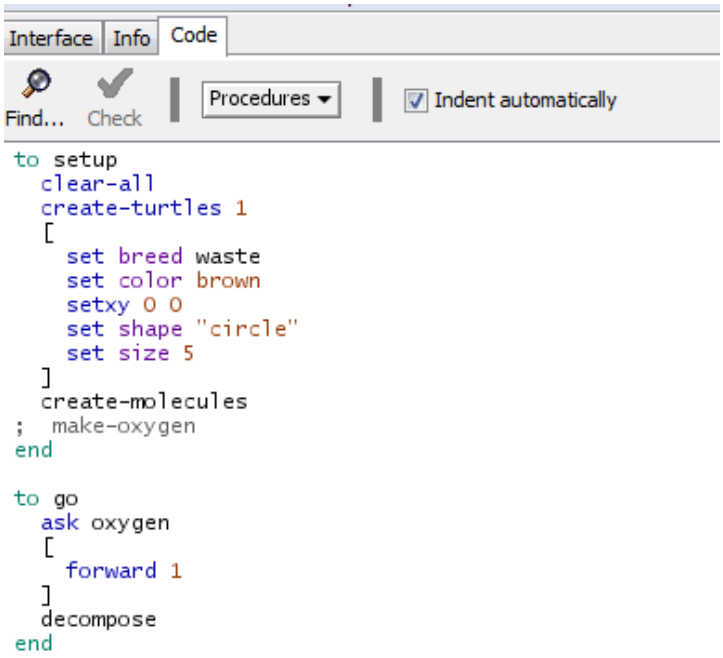

Figure 1.1: Basic Coding from first version

Our interface was also very simple with just 2 buttons including a setup button and a go button.

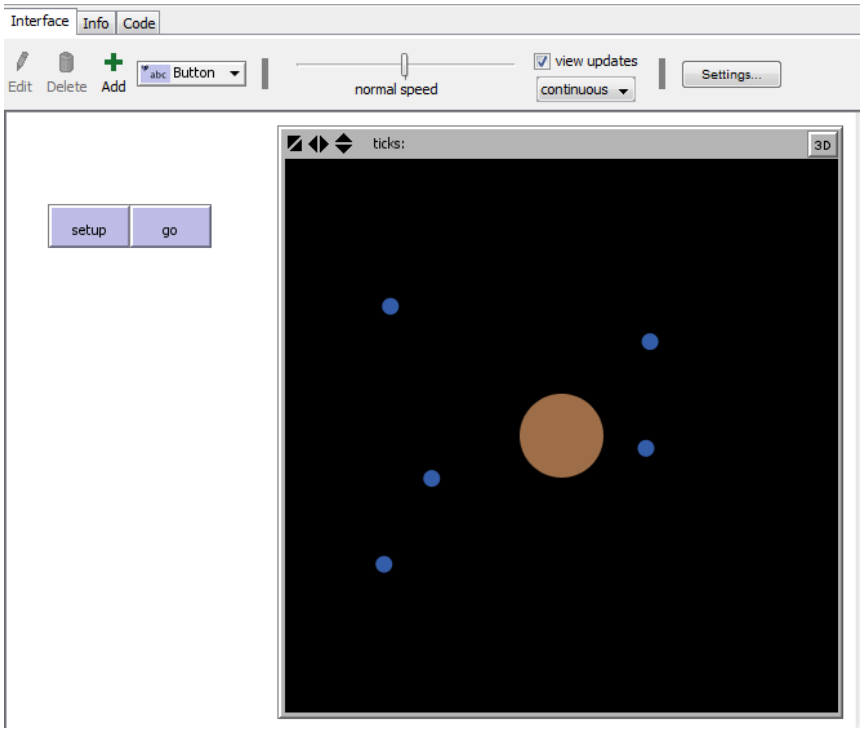

Figure 1.2: Basic interface from first version

As our program and code progressed, we modeled the decomposition and release of gases from the human waste specimen. Through research we gathered, we found that, all though about 75% of human fecal matter is made of water, the rest is made of mostly Carbon[1]. Using our program, we created a code that had the agents of the program to make the fecal matter in the center of the world (the brown circle) to decompose.

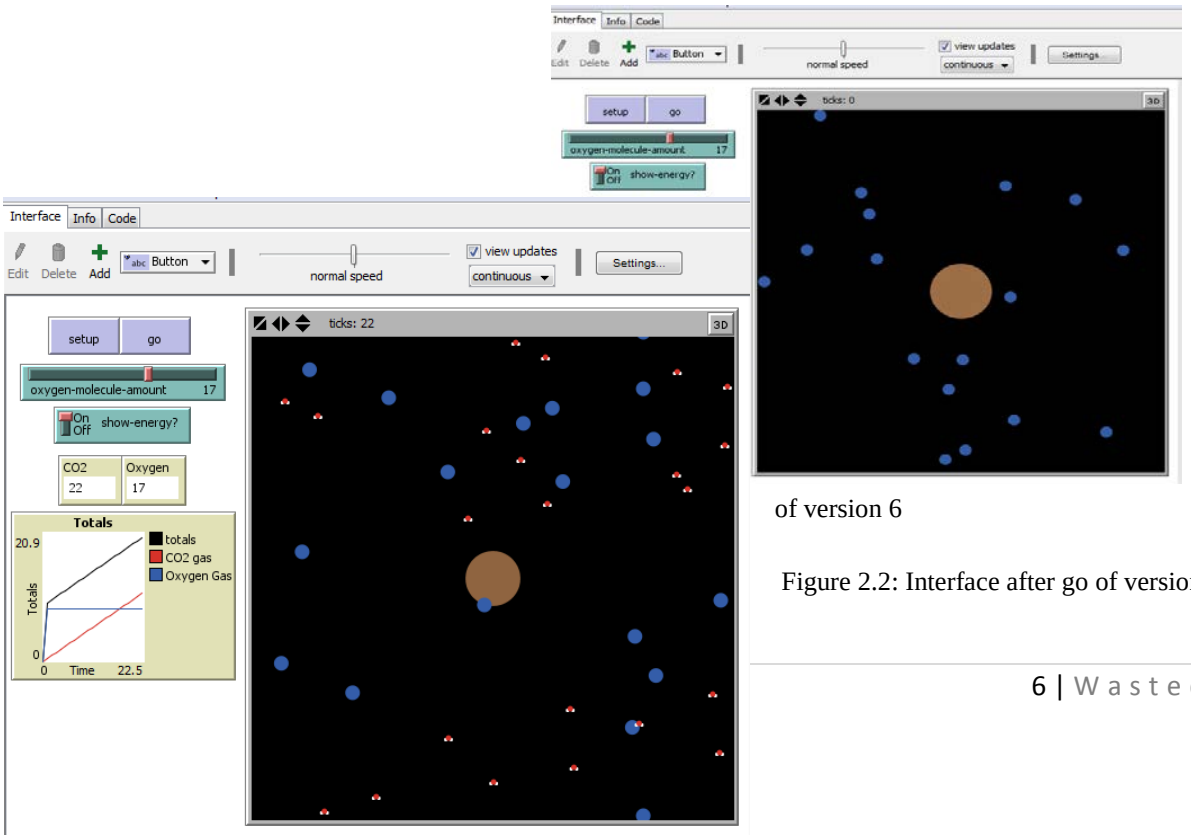

Figure 2.1: Interface start of version 6

Figure 2.2: Interface after go of version 6

Figure 2.3: Code for version 6

```
breed [waste wastes]                          ;;sets the breed of waste
breed [oxygen oxygens]                        ;;sets the breed of oxygen
breed [co2 co2s]                              ;;sets the breed of CO2 (carbon
dioxide)
turtles-own [energy]

to setup                                      ;;sets up the program.
  clear-all
  reset-ticks                                 ;;clears the world.
  create-turtles 1                            ;;creates 1 turtle which is the
waste...
  [
    set breed waste                           ;;it is green and is placed
    set color brown
    setxy 0 0                                 ;;in the center of the world.
    set shape "circle"                        ;;the shape is an waste...
    set size 5                                          ;;...that is being
decomposed                                   ;;...and is 5 times the normal size
  ]
  create-molecules
end

to go                                         ;;starts the program.
  ask oxygen                                  ;;this asks the oxygen breed...
  [
    forward 1
    set energy energy - .5                                ;;...to move forward
one patch
  ]
  decompose
  balance
  tick
end
```

```
to create-molecules                          ;;this program sets up the oxygen
molecules
  create-turtles oxygen-molecule-amount      ;;it starts off with
  [
    set breed oxygen
    set color blue
    set shape "circle"
    setxy random-xcor random-ycor
    set energy energy + 50
  ]
end

to decompose
  ask turtles
  [
    if breed = oxygen
    [
      if xcor >= -2 and xcor <= 2
      [
        if ycor >= -2 and ycor <= 2
      [
        rot
      ]
    ]
  ]
  ]
  release-gas
end

to rot
  ask waste
  [
    set shape "circle"
    if color <= 35
    [if color >= brown - .5
    [set color color - .05]
    ]

    rot-2
  ]
end

to rot-2
  ask waste
  [
    set shape "circle"
    set size size - .25
    if color <= 35
    [if color >= brown - .5
    [set color color - .05]
    ]

  ]
end

to balance
```

```
  ask oxygen
    [
      if energy <= 0 [die]
    ]
  ask co2
  [
    if count co2 >= 50 and count oxygen <= 400[
    hatch-oxygen 1
    [set color blue
    set shape "circle"
    setxy random-xcor random-ycor
    set energy energy + 50]
  ]
  ]
end

to release-gas
  if count co2 < 75
    [
      create-co2 1
  [
    set breed co2
    set shape "carbon dioxide"
    set size .75
    setxy random-xcor 3
    set energy 65
    ask co2
    [
      set heading 360
    ]

  ]
    ]
    ask co2
    [forward 1
     set energy energy - 1.25]
end
```

We then advanced in the writing of the code. This program allowed us to view the usage of fecal matter as an alternative energy source.

Expected Results:

Our expected results in this project include human waste being a valuable energy resource alternative. As it is, we have an abundant amount of it. If done in a controlled environment (which we are modeling), it may be useful for generations to come. We expect to see long usage of the human waste in the model.