University of Virginia
Environmental Footprint Reduction Plan
Phase 1 - Greenhouse Gas
Environmental Footprint Reduction Plan

Key Objectives

• Demonstrate continued University leadership in sustainability and environmental impact reductions

• Define a realistic goal for significant reductions in our institution’s greenhouse gas emissions

• Detail specific strategies by which to achieve this goal
Environmental Footprint Reduction Plan

Phase 1
Greenhouse Gas

Phase 2
Water Use

Phase 3
Waste

Phase 4
Nitrogen
Metric Ton eCO$_2$

Metric Ton = 1,000 kg
  = 2,205 lbs

Equivalent CO$_2$
Measure of CO$_2$ and other gases that contribute to global warming expressed in terms of Carbon Dioxide

1 MT eCO$_2$

- $\times$ 13 watts 24h/7d = 15.2 years
- $\times$ 60 watts 24h/7d = 3.3 years
- $\times$ 33 mpg City/Hwy = 3460 miles
- $\times$ 16 mpg City/Hwy = 1740 miles
**Scope 1 Emissions**
Direct Emissions generated by University-owned equipment and activities. Includes: heating plants, fleet, University Transit Service, jet, fertilizer application, refrigerants.

**Scope 2 Emissions**
Emissions generated through the production of electricity purchased by the University.

**Scope 3 Emissions (Partially Known)**
Emissions generated by sources related to, but not controlled by, the University. Includes: employee commuting, solid waste, wastewater, etc.

**Unknown Scope 3 Emissions**
Data not yet available for: University-sponsored air travel, procured goods and services, construction activities, etc.
GHG Emissions Trends
Emissions Sources
Minimize and Mitigate Emissions Growth from New Construction

Catalyze Efficiency and Conservation Efforts

Increase Renewable Energy Generation and Use

Reduction Strategies
UVa Greenhouse Gas Reduction Target

By following the strategies contained in this section, the University will lower GHG emissions to year 2000 levels by 2020, five years ahead of the goal identified by Governor Kaine in Executive Order 59. This represents a 20% reduction from 2008 emissions. Furthermore, the University will have established a framework and process for reducing emissions, enabling additional reductions in the years beyond 2020.
GHG Emissions Targets

1. UVa Emissions (EFRP)/Obama 2010 Budget
2. Executive Order 59/Virginia Tech
3. IPCC 2020
4. IPCC 2050
5. ACES Waxman/Markey

UVa Emissions (Business as Usual)

Less Aggressive Reduction Goal

More Aggressive Reduction Goal

6. Cornell
7. Dartmouth
8. Harvard
9. Columbia
10. Princeton
11. Yale
12. Brown

Tuttle House 37,800 SF -266 MTeCO₂
Lile House 28,400 SF -169 MTeCO₂
Alderman Road V 67,500 SF +1084 MTeCO₂ (+6750 MTeCO₂)

Difference: + 649 MTeCO₂

Strategy 1 Example
<table>
<thead>
<tr>
<th>GHG Reduction for Alderman Road V</th>
<th>649 MTeCO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>(874 MTeCO₂)</td>
<td></td>
</tr>
</tbody>
</table>

| Total GHG Emissions from Housing | 23,563 MTeCO₂ |

<table>
<thead>
<tr>
<th>Percentage Overall Reduction Needed</th>
<th>2.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(3.7%)</td>
</tr>
</tbody>
</table>

- 649 MTeCO₂ =

7081 MMBTU Produced/Year
$2,200,000 Cost
$134,820 Annual Savings (2009)
16 Year Simple Payback

**Strategy 1 Example**
Emmet/Ivy Garage

- CFL lighting retrofit and photocell programming
- Less than 2 year payback

-336.8 MTeCO₂

Strategy 2 Example
Renewable Energy Targets

- **2008**
  - Non-Renewable: 94.8%
  - Biofuels: 0.11%
  - Va. RPS: 5.1%

- **2015**
  - Non-Renewable: 87.4%
  - Biofuels: 2%
  - Solar/Geo: 2%
  - REC max: 2%
  - Va. RPS: 6.6%

- **2020**
  - Non-Renewable: 78%
  - Biofuels: 5%
  - Solar/Geo: 5%
  - REC max: 2%
  - Va. RPS: 10%

**Strategy 3**
Redevelopment Potential
### Capital Program

<table>
<thead>
<tr>
<th>Priority</th>
<th>Project</th>
<th>Average</th>
<th>High</th>
<th>Bien</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>North Chiller Plant</td>
<td>$53,750,000</td>
<td>$57,340,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td></td>
<td>Chillers Replacement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>North Grounds Boilers &amp; Chillers</td>
<td>$19,000,000</td>
<td>$22,000,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td></td>
<td>Replacement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Alderman and Clemons</td>
<td>$12,000,000</td>
<td>$14,000,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td></td>
<td>Chillers Replacement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$84,750,000</td>
<td>$93,340,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Newcomb Road Chiller</td>
<td>$9,000,000</td>
<td>$10,000,000</td>
<td>2016-2018</td>
</tr>
<tr>
<td></td>
<td>#1 Replacement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Steam Tunnel Repairs</td>
<td>$20,000,000</td>
<td>$23,000,000</td>
<td>2012-2014</td>
</tr>
<tr>
<td>6</td>
<td>Combined Heat and Power</td>
<td>$120,000,000</td>
<td>$200,000,000</td>
<td>2014-2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Consumption Trends

University - wide Electricity Consumption Trends 1980 - 2009
Energy Consumption Trends

- 132 million kWh
- 69,000 MTeCO₂
- $8.2 million

University-wide Electricity Consumption Trends 1980 - 2009
Energy Consumption Trends

Heating Plants Consumption Trends 1980 - 2008

BTUs per GSF

BTUs per GSF-HDD

Calendar Year

BTU per Gross Square Foot

0 20K 40K 60K 80K 100K 120K 140K

0 5 10 15 20 25 30 35 40 45 50

142,800,000 gallons of water
Trash & Recycling Trend

Recycling Performance

- Total MSW
- Recycled MSW
- Landfilled MSW
- Total Diverted (%)
- MSW Recycled Mandate (%)

Calendar Year:
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

Tons:
- 0
- 2,000
- 4,000
- 6,000
- 8,000
- 10,000
- 12,000
- 14,000
- 16,000
- 18,000
- 20,000

Percent:
- 0
- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50

Graph showing trends in waste management from 1991 to 2008.
Conservation Accomplishments

- Centralized Approach
  - Cooling
  - Heating
  - Electric Demand

- Energy Management Systems / Controls

- Lighting

- Insulation, Steam Traps, Weather Stripping....
Conservation Accomplishments

- Energy Projects (FY09 Alone)
  - $1.1 million cost avoidance
  - 1500 MTeCO2

- MR4 Delta Force Retro-Commissioning
  - Spent = $434,000 [$346,000 (DM) + $88,000 (Energy)]
  - Avoided Cost = $408,000
  - Simple Payback = 1.06
  - 1281 MTeCO2
Looking Forward

- Delta Force
  - Jordan Hall Addition
  - Chemistry Building and Addition
  - Multistory Building
  - +14 million GSF of “opportunity”

- Many Conservation Initiatives:
  - Lighting Retrofits, Scheduling & Setbacks, Controls, Insulation, Leaks.....

- Communication:
  - Sustainability Kiosk, Student Staff & Conservation Advocates, Building Sustainability Coordinators, Events...
Looking Forward

- Smart Grid DOE Grant Proposal
  - UMD, Johns Hopkins, Howard, Georgetown, GMU, JMU, UFL, and UVa
  - DVP, BG&E, Pepco
  - Research, Measurement, Demonstration

- Biomass Energy DMME Grant Proposal
  - Use up to 20% wood pellets
Environmental Footprint

- Redevelopment / Growth
- Conservation
- Renewable Energy, RECs, Carbon Offsets, Premium (Green) Power Purchasing
Renewable Energy

- Biomass
- Photovoltaic (PV) Electricity
- Solar Thermal
- Geothermal
  - Electric Generation
  - Heating & Cooling
- Wind
- Other Bio–Energy
## Carbon Footprint by Energy Source

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>MTeCO2/Unit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>0.052908</td>
<td>MMBtu</td>
</tr>
<tr>
<td>Distillate Oil</td>
<td>0.727996</td>
<td>MMBtu</td>
</tr>
<tr>
<td>Coal</td>
<td>1.926778</td>
<td>Ton</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.000569</td>
<td>kWh</td>
</tr>
</tbody>
</table>
# Carbon Footprint by Energy Type

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>MTeCO2 per MMBTU</th>
<th>Compared to N. Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water</td>
<td>0.049758989</td>
<td>Calc</td>
</tr>
<tr>
<td>Steam</td>
<td>0.061527856</td>
<td>Calc</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.166668862</td>
<td>CACP, V6.4</td>
</tr>
<tr>
<td>Coal</td>
<td>0.077077100</td>
<td>CACP + HV Calc</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.052908294</td>
<td>CACP</td>
</tr>
<tr>
<td>Distillate Oil</td>
<td>0.072799623</td>
<td>CACP</td>
</tr>
<tr>
<td>Natural Gas Base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distillate Oil</td>
<td></td>
<td>38%</td>
</tr>
<tr>
<td>Coal</td>
<td></td>
<td>46%</td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td>215%</td>
</tr>
</tbody>
</table>
If You Had $1 Million, How Would You Spend It?
# What Can You Buy For $1 Million?

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
<th>Annual MeTCO2</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic</td>
<td>150 kW – Area of Newcomb Roof</td>
<td>96</td>
<td>44 Years Compounded at 3%/Year</td>
</tr>
<tr>
<td>Conservation</td>
<td>MR4 Type Retro-Commissioning</td>
<td>2950</td>
<td>&lt;2 Years</td>
</tr>
<tr>
<td>Re-lamp</td>
<td>270,000 lamps (T8 at 25 W v T8 at 28–32 W [10 hrs/day, 365 days])</td>
<td>2800</td>
<td>3 to 6 Years (3 Years for electricity only. Can likely get price discount on lamps.)</td>
</tr>
<tr>
<td>Coal to Natural Gas</td>
<td>Main Heat Plant (Need Gas Pipeline)</td>
<td>3340</td>
<td>Never has a payback AND you need to spend $1 million every year AND $25 to $30 million for pipeline.</td>
</tr>
<tr>
<td>1REC=1MWh</td>
<td>$5 to $50 / REC 20,000 to 200,000 MWh</td>
<td>11,400 to 114,000</td>
<td>Never has a payback AND you need to spend $1 million every year.</td>
</tr>
</tbody>
</table>
CarbonFootprint Reduction Plan = Energy Reduction Plan

- Strategically Important
  - Greenhouse Gas Emissions / Carbon Footprint
    - Environmental Impact
  - Manage Cost
  - Manage Risk
  - Students, Faculty, Staff, Public
<table>
<thead>
<tr>
<th>Priority</th>
<th>Project</th>
<th>Average</th>
<th>High</th>
<th>Bien</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>North Chiller Plant Chillers Replacement</td>
<td>$53,750,000</td>
<td>$57,340,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td>2</td>
<td>North Grounds Boilers &amp; Chillers Replacement</td>
<td>$19,000,000</td>
<td>$22,000,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td>3</td>
<td>Alderman and Clemons Chillers Replacement</td>
<td>$12,000,000</td>
<td>$14,000,000</td>
<td>2010-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$84,750,000</td>
<td>$93,340,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Newcomb Road Chiller #1 Replacement</td>
<td>$9,000,000</td>
<td>$10,000,000</td>
<td>2016-2018</td>
</tr>
<tr>
<td>5</td>
<td>Steam Tunnel Repairs</td>
<td>$20,000,000</td>
<td>$23,000,000</td>
<td>2012-2014</td>
</tr>
<tr>
<td>6</td>
<td>Combined Heat and Power</td>
<td>$120,000,000</td>
<td>$200,000,000</td>
<td>2014-2016</td>
</tr>
</tbody>
</table>