Making Greenworks Count

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Most of the time, counting is an act that happens inside one person's head. But there are also times when counting is a social process---when a community makes categories to determine what counts and sets norms to determine how much is too much, too little, or just right. Numbers tell stories and those numbers make the storytellers seem authoritative and informed. For these reasons and others, counting in public carries significant responsibility.[1]

Cities across the U.S. and around the world are crafting sustainability plans. Cities have been the most active governments to articulate such plans because so many are made vulnerable by location, age, and/or size to the impacts of climate change on sea level rise, energy scarcity, food security, waste management, heat exposure, and so on. [2] In 2009, Philadelphia released its Greenworks plan of 5 goals, 15 targets, and 167 initiatives all designed to achieve Mayor Michael A. Nutter's vision of Philadelphia as the greenest city in America. The five goals are Energy, Environment, Equity, Economy, and Engagement. The targets are displayed in the figure below, which is available online at http://www.phila.gov/green/greenworks/2009-greenworks-report.html

2008 BASELINE	2015 PROJECTION	GREENWORKS TARGET	GREENWORKS INITIATIVES WILL YIELD
TARGET 1: MUNICIPAL GOVERNMENT ENERGY USE			
3.64 trillion Btus	4.16 trillion Btus	30% < 2008–2.54 trillion Btus	1.62 trillion Btus saved in 2015
TARGET 2: CITYWIDE BUILDING ENERGY USE			
99.7 trillion Btus •	103 trillion Btus	10% < 2006–89.7 trillion Btus	12.9 trillion Btus saved in 2015
TARGET 3: RESIDENTIAL WEATHERIZATION			
3,500 projects	28,000 projects	15% of total housing–100,000 projects	72,000 additional projects by 2015
TARGET 4: ALTERNATIVE ENERGY			
0.34 million MWh	1.35 million MWh	20% of electricity–2.93 MWh	1.58 million MWh in 2015
TARGET 5: GREENHOUSE GAS EMISSIONS			
17.2 million tCO2eq ••	15.6 million tCO2eq	20% < 1990–13.8 million tCO2eq	1.77 million tCO2eq in 2015
TARGET 6: AIR QUALITY ATTAINMENT			
20 "Unhealthy" AQI days	20 "Unhealthy" AQI days	2015 < 2008–2006 numbers	10 fewer "Unhealthy" AQI Days in 2015
TARGET 7: DIVERSION FROM LANDFILL			
1.56 million tons	1.56 million tons	70% diversion rate–890,000 million tons going to landfill	0.67 million tons diverted in 2015
TARGET 8: GREEN INFRASTRUCTURE			
51,000 pervious acres	51,000 pervious acres	60% of total surface–54,200 pervious surfaces	3200 additional pervious acres by 2015
TARGET 9: OUTDOOR AMENITIES			
10,300 green acres	10,300 green acres	75% of residents with access–10,800 green acres	500 additional green acres by 2015
TARGET 10: LOCAL FOOD			
230 gardens, markets	230 gardens, markets	75% of residents w/ access–316 gardens/farms/markets	86 additional gardens/farms/markets by 2015
TARGET 11: TREE CANOPY			
2.1 million trees	2.1 million trees	30% canopy by 2025–3.1 million trees	300,000 additional trees by 2015
TARGET 12: VEHICLE MILES TRAVELED			
6.40 million VMT •••	6.91 million VMT	10% < 2005–5.76 million VMT	1.15 million fewer VMT in 2015
TARGET 13: STATE OF GOOD REPAIR			
73% of assets in SOGR	71% of assets in SOGR	80% in 2015	13% of assets raised to SOGR by 2015
TARGET 14: GREEN JOBS			
14,400 green jobs •••	18,300 green jobs	Double 2005 by 2015–28,800 green jobs	10,500 additional green jobs by 2015

Figure 1. The Greenworks Targets established in 2009

[1] For an excellent discussion, see Deborah Stone, Policy Paradox (New York NY: Norton, 2002), pp163-87.

[2] It is clear that cities are instrumental in attaining sustainability goals, especially considering the projected increases in urban populations and consumption, initiatives like Siemens "Sustainable cities" (http://www.usa.siemens.com/sustainable-cities/) and IMB's "Smarter Cities" (http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/) provide additional resources on urban strategies.

Math plays a significant role in any discussion of sustainability, which is often defined as making decisions today about resources that do not limit the ability of future generations to make decisions about resources (Thompson 2010). This sentence alone contains many forms of counting: the depletion and renewal of resources involves changes in stocks and flows, and the intergenerational dynamics across time involves the discounting of values between the present and future. In this essay, we discuss three additional decisions made about the mathematics of Greenworks:

1. Baselines
2. Absolute versus relative measurements
3. Interpolation

These three mathematical tools translate the Greenworks targets from current measurements to future estimates. The Greenworks targets were developed by baselining each target to enable meaningful comparisons between initial conditions and later measurements to assess the impact of interventions. Additionally, the baselines help define indicators to compare Philadelphia's sustainability initiatives to other like cities or to other interventions (Devuyst and Hens 2001, 184). After establishing baseline metrics, targets were established using absolute, rather than relative, measures of conditions and changes. Simply, this was a decision to look at absolute numbers rather than relative numbers (e.g. Targets 1 & 2 measure total Btus rather than Btu/Population). This method was selected because it is easier to understand and helps ensure that everyone engaged in the targets shares a common understanding. But the use of absolute numbers potentially results in problems in interpretation: is a decline in consumption from efficiency, conservation, or depopulation?

Policy makers often face this challenge of absolute versus relative measures. For example, should we measure poverty in terms of an absolute standard of living that says no one should have less than a specific amount of money or in terms of a relative standard of living that says no one should have less than a specific fraction of the average amount of money? The choices we make about numbers are ultimately choices about ideas and principles.

Finally, the third tool leverages other Philadelphia initiatives to establish Greenworks targets by interpolating from preexisting targets. For example, Targets 8 & 11 interpolate the 2015 intermediate targets from existing targets in 2030 in Green City, Clean Waters and 2025 in GreenPlan (Mayor's Office of Sustainability 2010, Philadelphia Water Department Amended 2011). As a city-wide sustainability initiative, interpolating from other sources aligns the Greenworks targets with other like-minded city plans. At its most basic level, interpolation allows one to find a number that lies within a set of data, but does not have an existing data point. For example, Target 8 (Manage Stormwater to Meet Federal Standards) is based on the green infrastructure plan developed by the Philadelphia Water Department. Green City Clean Waters, which was adopted by the City of Philadelphia in 2011, attempts to manage the 64 square miles (48%) of Philadelphia that is within the combined sewer drainage areas (Philadelphia Water Department 2013, 3-61). Over the next 25 years, PWD is required to covert one-third of that drainage area to permeable greened acres, using this as the goal for Greenworks as well, target 8 aims for 3,200 additional pervious acres by 2015.

As with most set targets and projected impacts, Greenworks is based on a set of assumptions, some relating to each target and some more generally. Each baseline was calculated using measured data to establish business as usual projections for 2015. Each Greenworks target was developed by comparisons with peers, consensus of management, and concurrence of responsible parties. The Greenworks "impact" equals the difference between the business as usual projection and the established target. General assumptions included in the 2015 projection calculation include a population increase of 75,000 (in line with Mayor Nutter's goals), rising energy prices, rising global temperature, quantifiable health benefits of open space, and urban competitive advantages with the rise of sustainability concerns (Nutter 2009, 3).

Greenworks could never have been written without the use of mathematics. But even more importantly, Greenworks could have never been understood and adopted without mathematics. Math provides a language that helps inform citizens and empower their decisions about the choices they face. Math provides an essential tool in a democracy with which complexity can be managed to broaden the participation of citizens in the forming of public policy.

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