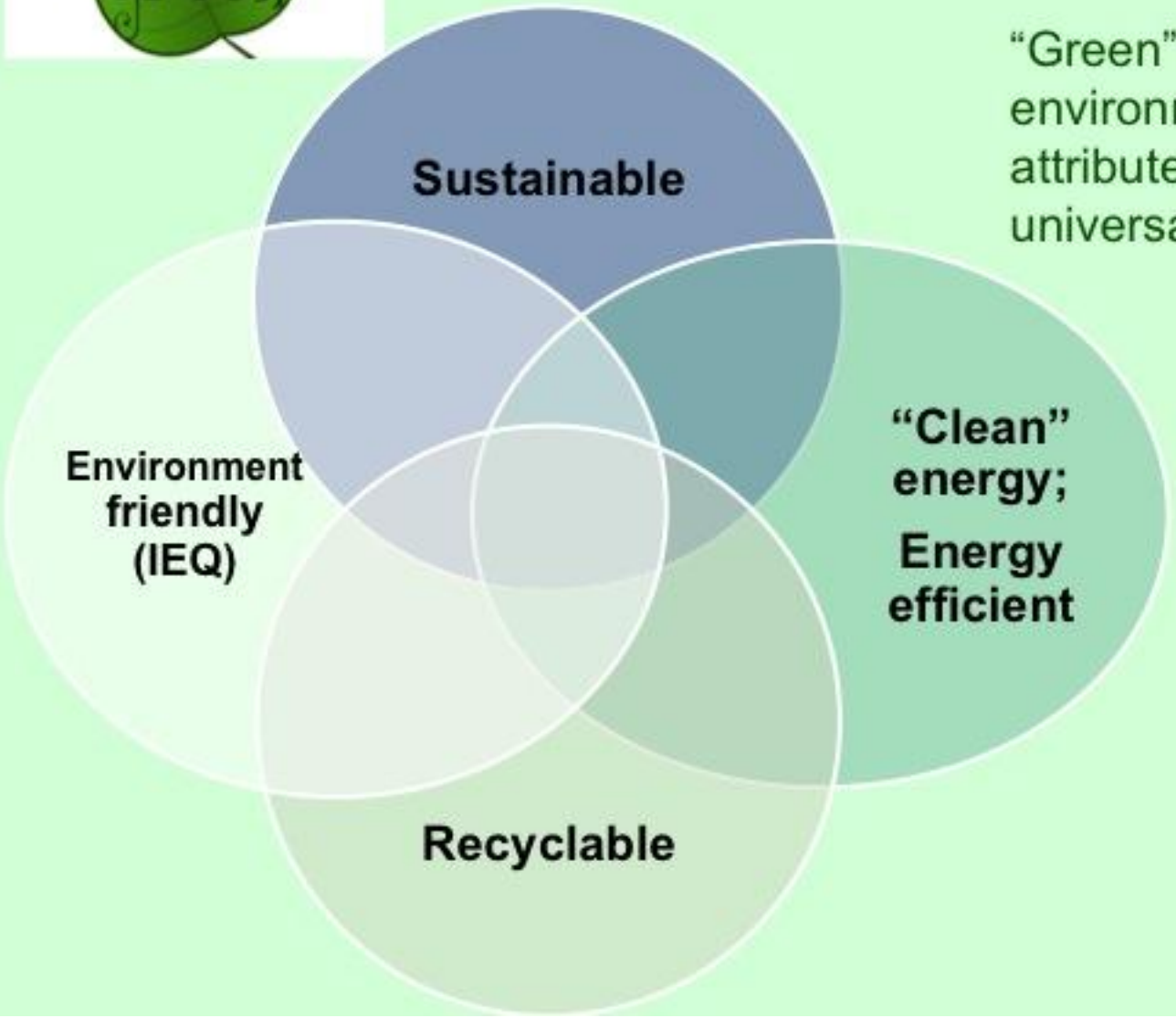
"Green & Clean?"



"Green" refers, in some way, to environmentally-preferable attributes, yet there is lack of universal definition of the term.

All that is Green is Good…. ?
(in principle, Yes.)

- **Leadership in Energy and Env Design (LEED):**
  - **Where Energy Eff'cny Collides w/ Human Health** (http://www.ehhi.org/reports/leed/) , 2010
  - **Still in need of clear federal definition of "green building standards"**
  - **Points weighted to energy efficiency as opposed to protection of Indoor Env Quality (IEQ) from hazardous chemicals**
  - **Is not automatically sufficient to protect human health; may give false impression of a Healthy Building**

Definition of *CLEAN*

Merriam-Webster

m-w.com

– *a* : free from dirt or pollution

– *b* : free from contamination or disease

Are the terms "Green" and "Clean" synonymous?

The Rise of "Green Cleaning" in last decade

- What is "green cleaning"?
- Concept of cleaning for health while protecting the outdoor environment is central to the Green cleaning

Sales of Green cleaning products for the consumer market:

- ✓ $17.7 million in 2003
- ✓ $64.5 million in 2008
- ✓$339 million in 2009

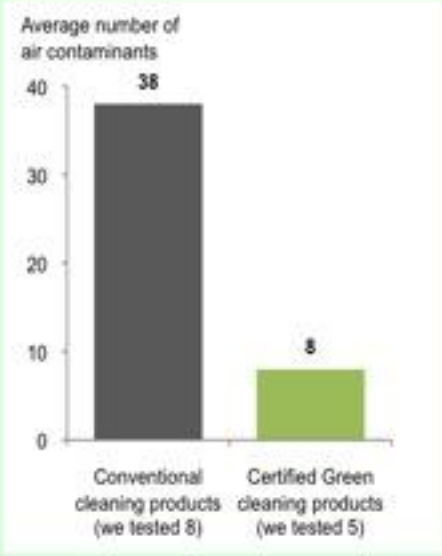
- ✓ $2 billion by 2014 (Packaged Facts 2010)

Marketing Green and the Rise of Greenwashing

2010 TerraChoice report:
> 32 percent of green products carry a false green label; Look for “certified” products

Report: Greener School Supplies…

- "Green" cleaners not failsafe
  - Although conventional cleaners release more VOCs as compared to green cleaners, some contain compounds of risk to children's health
  - *Terms "green" and "clean" and "effective" should be compatible*
- In the absence of evidence in the form of *efficacy* data, the designation of "green" products is a work in progress…..



Environmental Working Group 2010
http://www.ewg.org/files/2009/10/school-cleaners/EWGschoolcleaningsupplies.pdf

Help on the way…?

Federal Trade Commission Proposes Revised "Green Guides" (2010)

Review of guidance "Guides for the Use of Environmental Marketing Claims".

Release of final Guides expected (2012).

Laura Koss, Division of Enforcement, lkoss@ftc.gov

ftc
eco in the market

"Clean" depends on Building Type

- Health Care Facilities
- Homes
- Schools
  - Children Are More Vulnerable
  - Lack of Funding
  - IEQ in schools is poor:
    - Ventilation inadequate
    - Temperatures elevated
  - Deficiencies in school design, construction, and operations

Cleaning Research

•Recent research in hospitals: “visual assessment is not a reliable indicator of surface cleanliness or of cleaning efficacy” (Cooper et al 2007)

Developing research

- **School studies to date; little information as to assessment of cleanliness**
  - Rapid spread of viral disease in crowded classrooms is associated with level of cleanliness of high contact inanimate objects

Cole, 2011

Schools…
A Growing Challenge to Clean

- Limited maintenance/janitorial staff
- Outdated cleaning equipment
- Inadequate cleaning products
- No direct information on cleanliness
  - What is “clean”; how to measure?
- Poor staff training

Univ of Tulsa Research on "Clean" in Schools

- Compile *onsite* School measurement data to represent core basic "clean" indices that may impact indoor environmental quality (IEQ)
  - Data from 2008-2011:
    - Ventilation rates from 140 classrooms, 70 schools
    - Settled dust quantified from 140+ classrooms
    - Surface contaminant load (ATP and RODAC)
  - ***Ultimate goal: Establish relation between "Cleaning effectiveness" and health of students***

Research Plan 2008-2012

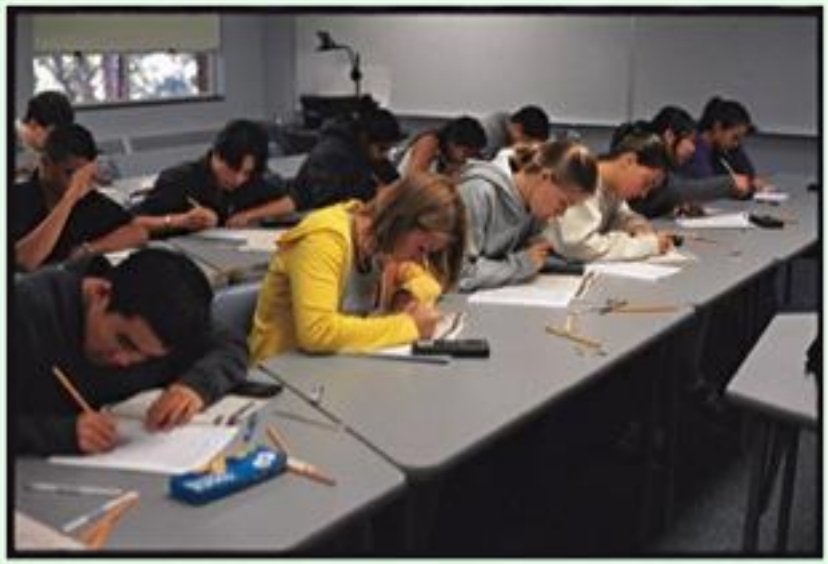
1. PHASE I: Identify marker for “cleanliness criteria” in schools.
2. PHASE II: define typical ranges & criteria for K-12 Schools
3. Phase III: Validate measurement criteria in varied geographical locations
4. Phase IV: Explore relationships between pre-cleaning data and academic performance and health

ATP Bioluminescence

- ATP is the energy force for all life forms and used as a marker for presence of biomass.
- ATP bioluminescence has been used as an estimation of contaminant load in hospitals and food industries (not certain how translates to school environments).
- Method is rapid, portable, and affordable.

Schools cleaning data

- ***Power analyses based on prelim data indicated > 25 schools needed***
  - Data collected from 27 schools in SW school district
  - 6480 ATP (3 different systems) and 2121 RODAC (bacterial marker) before and after cleaning measurements



Classroom desks

- 5th grade classrooms
- 5 desktops/ classroom (2 rooms)

Cafeteria Tables

- 10 tables per school

Bathroom stall doors and sink-surround area

-10 interior stall door sites

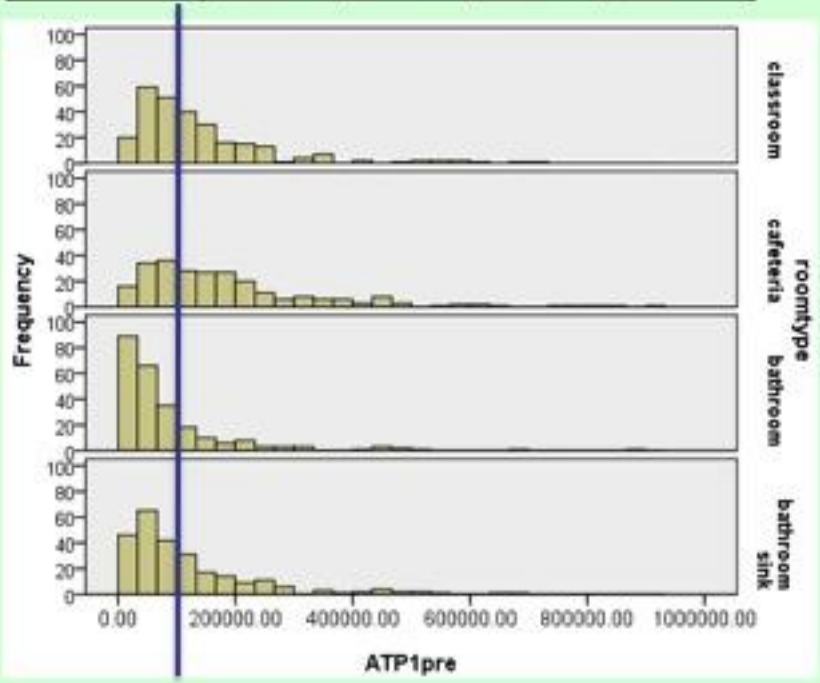
-10 sink surround areas

Results: evaluation based on pre- and post- cleaning data

Report

logATP1pre

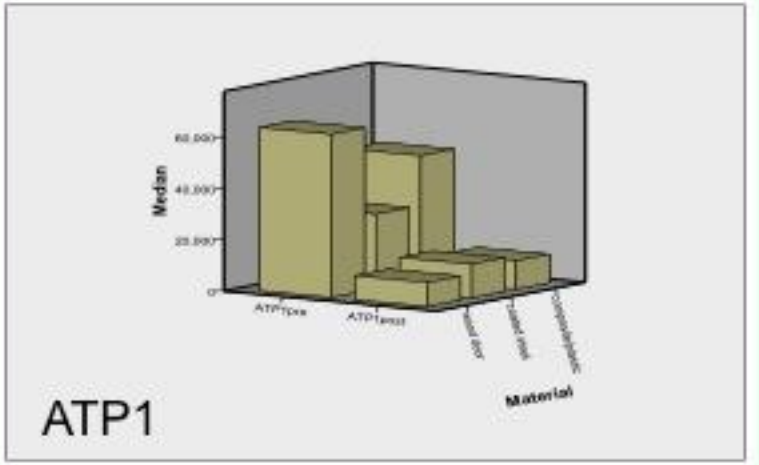
Roomtype	N	Mean	Minimum	Maximum
classroom	270	5.0028	3.16	6.02
cafeteria	268	5.1952	3.90	6.51
bathroom	268	4.6217	3.24	5.94
bathroom sink	269	4.9159	3.77	6.45
Total	1075	4.9340	3.16	6.51

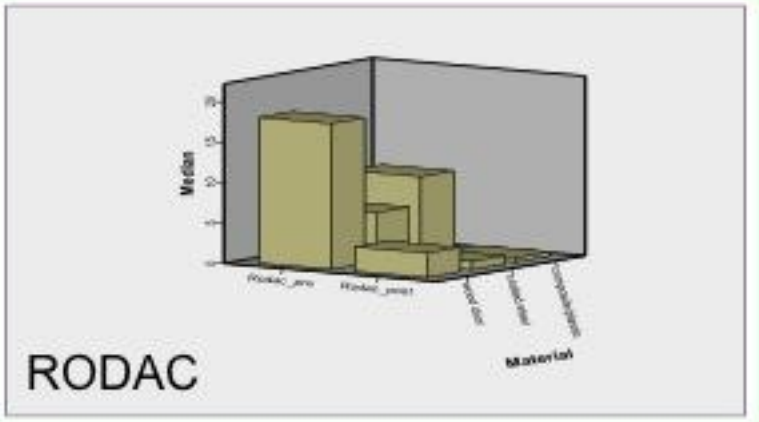


- Log normal ranges for each ATP method
- Based on these data *"Typical" ranges can be established for each type surface*

ATP & Culturable Bacteria

- Reduction of culturable bacteria (RODAC) parallel w/ ATP reduction after cleaning





Specifications by surface type:

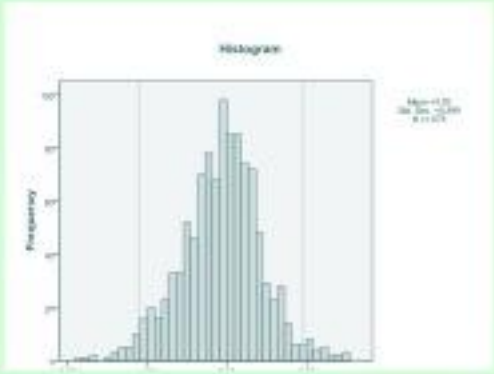


Table 1A.2 Descriptive statistics of ATP_ pre-cleaning measurements by surface

	Percentiles								
	2.5*	5	10	25	50	75	90	95	97.5*
Classroom desks – weighted ave	----	----	----	----	----	----	----	----	----
Classroom desks – log scale	--	--	--	--	--	--	--	--	--
Cafeteria tables – weighted average	----	----	----	----	----	----	----	----	----
Cafeteria tables – log scale	--	--	--	--	--	--	--	--	--
Stall doors – weighted average	----	----	----	----	----	----	----	----	----
Stall doors – log scale	--	--	--	--	--	--	--	--	--
Sink Surroundings – weighted ave.	----	----	----	----	----	----	----	----	----
Sink surroundings – log scale	--	--	--	--	--	--	--	--	--

←| *Outliers |→

NEXT PHASE of SURFACE CLEANING STUDY

Preliminary results May 2012

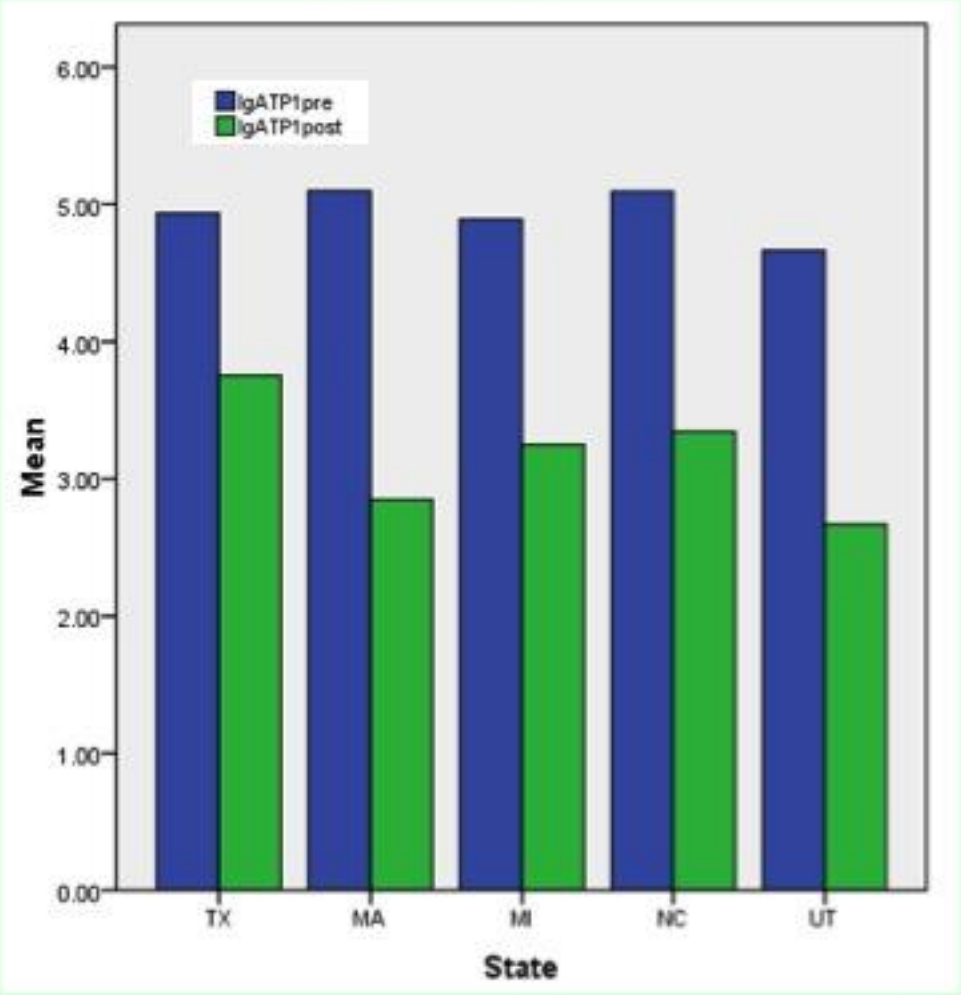
Aims

- Validation of the results obtained in First Phase
  1. comparing the results gathered in Phase I to data collected from 20 schools representing four school districts in West, Midwest, Southeast and Northeast regions of the United States
  2. cursory preliminary analyses on the association between health and absenteeism in relation to ATP / RODAC data before cleaning

PART 1: Validation of ATP as a measure of surface cleanliness

- The data collection phase of the project was completed during the winter 2011-2012 season
- ATP samples using three commercially available systems were collected based on sampling protocol developed in Phase I

ATP readings by state/district



ATP1

Preliminary conclusions
Part 1

- Pre-cleaning ATP levels were within expected ranges both by school and by the type of surface

Part 2: Limited initial analyses on cleanliness, absenteeism, and health

- Phase II data - three separate datasets:
  1) health data from school nurses
  2) background information about 5th grade students: health symptoms and absenteeism due to illness
  3) surface screening data including ATP and RODAC readings

Correlations between mean log-ATP1 pre-cleaning and student health / absenteeism

		ATP1 Classroom	ATP1 Cafeteria	ATP1 Sink	ATP1 Bathroom	ATP1 School
Total days absent	Pearson correlation	.012	-.296	-.241	.189	-.092
	Spearman correlation	.111	-.135	-.233	.265	.088
Absent due illness	Pearson correlation	.071	-.243	-.089	.080	-.062
Gastrointestinal	Pearson correlation	**.449***	.267	.297	.346	**.436***
Abdominal pain /	Pearson correlation	.524**	.339	.049	.334	.400*
stomach ache	Spearman correlation	**.454***	.337	.045	.316	**.402***
Respiratory	Pearson correlation	.222	.212	.060	.414*	.328
	Spearman correlation	.235	.364	-.028	**.405***	**.401***
Upper respiratory	Pearson correlation	.132	.305	.170	.268	.309
	Spearman correlation	.079	.349	.207	.175	.267
Cough	Pearson correlation	**.406***	.299	.050	.350	.359
Sore throat	Pearson correlation	**.505****	.177	.165	**.434***	**.417***
Temperature / Fever	Pearson correlation	.156	.149	-.003	.212	.179
	Spearman correlation	.046	.152	.041	.273	.213
Headache	Pearson correlation	.518**	.303	.064	.353	.398*
	Spearman correlation	**.504****	.341	.044	.377	**.435***

Note: Items in "bold" are statistically significant ($p < .05$)

Preliminary conclusions Part 2: Health Outcomes

- Significant correlations observed between . . . P readings and health symptoms
- ***More detailed analyses needed***
  - **The sample size (27 schools) is very useful to observe prelim associations; however may be limited to fully study these associations in multivariable models**

Basis for a Clean Standard

- Define "clean" based on objective measurements (ATP); should also emphasize attention to other influences (e.g. ventilation, settled dust, and thermal conditions represent conceptually *different* key IEQ factors)
  - Data indicates that ***ALL*** should be accounted for in characterizing classroom conditions (composite index)
- Characteristics should also reflect their relevance to *health & learning*