

Productivity as an "Other Benefit"

Applying the TRC to
Integrated Design

Reid Hart, PE



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Today's Work

- ◆ Outline of the problem
- ◆ What utility program managers want
 - Reid Hart – EWEB
- ◆ A preponderance of productivity Studies
 - Dave Hewitt & Cathy Higgins, NBI
- ◆ The "real" value view
 - Theddi Chappell, Pacific Security Capital (BetterBricks)
- ◆ Proposed solution
 - Reid Hart – EWEB

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Utilities/Programs Participating in this request

- ◆ Eugene Water & Electric Board
- ◆ Seattle City Light
- ◆ Energy Trust of Oregon
- ◆ Tacoma Public Utilities
- ◆ Springfield Utility Board
- ◆ Snohomish Public Utility District
- ◆ Idaho Power

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Problem Statement

- ◆ Following the regional advice for integrating energy efficiency into quality design means:
 - Total cost may be higher (not all integrated design is “free” or minimal cost)
 - Cost for “energy portion” of project is difficult, if not impossible, to separate from other benefits
 - For certain measures, there are benefits beyond energy savings that will be received by building occupants; adding value to building or creating annual benefit.
- ◆ To be “total” TRC must accommodate other benefits on the savings side or split certain measure costs between energy savings and other reasons.
- ◆ Analysis of other benefits should be at the appropriate level required for TRC test; not the same level as kWh savings – and should not require verification.

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Example Quality Lighting Project

- ◆ Single indirect fixture
- ◆ Daylight Dimming
- ◆ Occupant Dimming
- ◆ Cubie Occupancy sensor
- ◆ \$700 fixture
- ◆ vs. 2- \$100 fixtures



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Energy vs. Staff Economics

- ◆ Incremental Cost (10 Fixtures): \$5000
- ◆ Oregon Tax Credit: (35%-fee) \$ 804
- ◆ Fed EPACT PV accelerated depr \$ 250
- ◆ Utility Incentive: (0.25/kWh) \$ 657
- ◆ Net Customer Cost: \$3289
- ◆ Annual Energy Savings \$159
- ◆ Net Benefit/Cost: 0.5 SPP: 20.7 years TRC:0.3



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- ◆ Annual Energy Savings \$159
- ◆ Net Benefit/Cost: 0.5 SPP: 20.7 years TRC:0.3
- ◆ Productivity (3.2%) ~\$14,500/year
- ◆ Net Benefit/Cost: 41.5 SPP: 0.3 years TRC:27.3
- ◆ With 0.1% productivity (< 1 min/day) TRC B/C > 1



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Productivity benefits of sustainable elements

An introduction . . .
More later from the experts

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Daylighting

◆ Daylighting and view access (Lisa Heschong)

- improves call center performance and
- increases sales by 50% in stores from.

◆ In 1999

- when classrooms were illuminated with natural light
- three states
- students improved their math and reading scores as much as 25 percent.



Other Green Features That Affect Productivity

- ◆ Better ventilation and maintenance reduce "sick building syndrome"
- ◆ Commissioning and improved controls enhance comfort
- ◆ Thermal mass and natural ventilation may improve radiant comfort impacts
- ◆ Sustainable practices may improve occupant attitude about building

What Utilities Want

For new construction or retrofit projects where measures have recognized productivity or value enhancing attributes:

- Allow TRC calculation to allow project eligibility by either
 - ◆ Increasing O&M savings
 - ◆ Reducing energy related costs
- Keep method or calculation simple.
- Do not require verification of cost or value of productivity improvements.

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Productivity Studies No Longer Speculation

What is the result of the preponderance of recent productivity evaluations?

Dave Hewitt &
Cathy Higgins



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Productivity Impacts of Energy Related Systems in Buildings

Research on the links between energy efficiency measures and occupant productivity

Dave Hewitt, Executive Director
New Buildings Institute

*RTF Presentation August 30, 2007
Portland, Oregon*



Topics Addressed Today

- Significant volume of research on productivity and the built environment.
- Market is moving ahead in adopting advanced practice buildings.
- Business views the value of some energy system changes much differently than TRC would suggest

Aspects of energy systems influence comfort, health and productivity

- Presence of daylighting as an architectural feature.
- Quality of electric lighting design.
- Personal control of electric lighting.
- Adequate or more than adequate fresh air.
- Providing a temperature within a defined range.
- Personal control of amount of fresh air and temperature.
- Presence of glazing that looks out on a pleasant view (e.g. nature).

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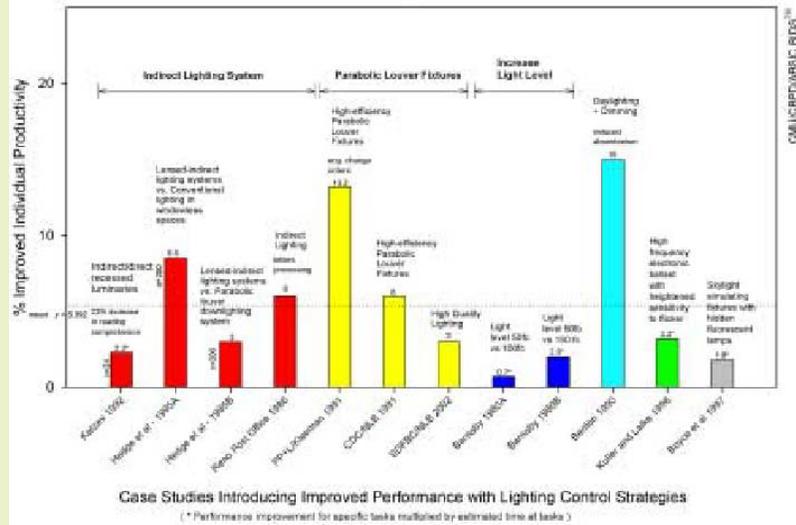
*Building Investment Decision (BIDS™)**

- 130+ studies linking environments to life cycle
 - - 20 air quality – ventilation control
 - - 11 temperature control
 - - 25 lighting control
 - - 24 privacy and interaction
 - - 20 ergonomics
 - - 19 access to natural environment
 - - 15 *whole building*
- • 1000 abstracts, 100 papers, 1 reference study
 - - Refereed journals, books, research reports, Ph.D. dissertations
 - - Laboratory, simulation, field studies, meta-analyses
 - - web sites, popular press need verification
- • Also building baseline data sets
 - • Churn costs
 - • Energy costs per building type and climate
 - • Attraction-Retention rates, costs
 - • Health costs
 - • Water, waste, emissions costs

*Center for Building Performance and Diagnostics at Carnegie Mellon

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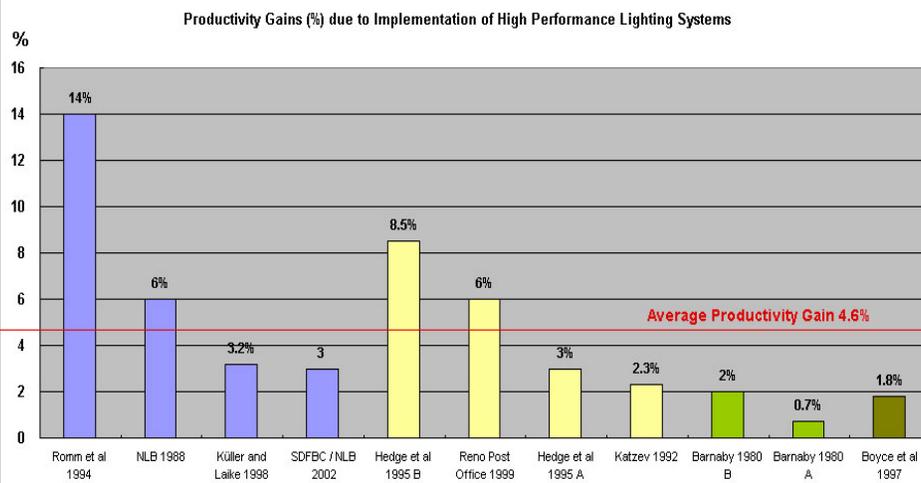
Lighting System Quality Increases Individual Productivity 12 studies demonstrate that improved lighting design increases individual productivity **average of 5%**



Source: BIDs Database at Carnegie Mellon

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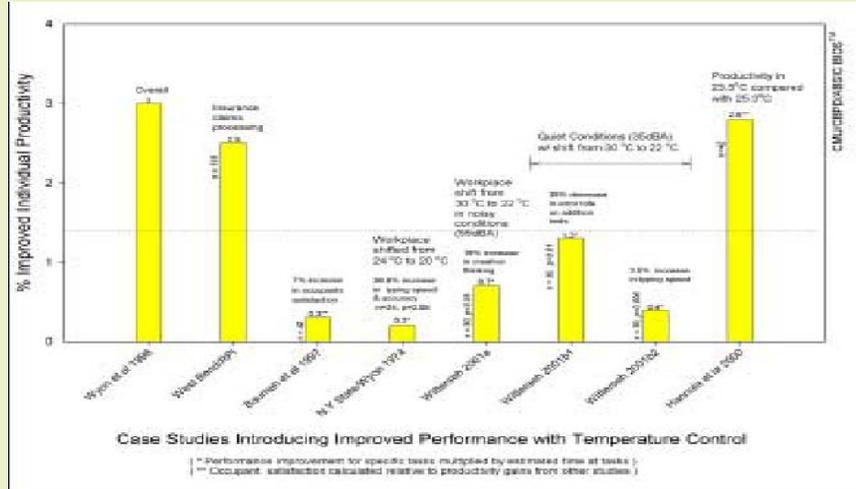
9 case studies identify a link between improved lighting design and individual productivity gains at an average of 4.6%



Source: BIDs Database at Carnegie Mellon

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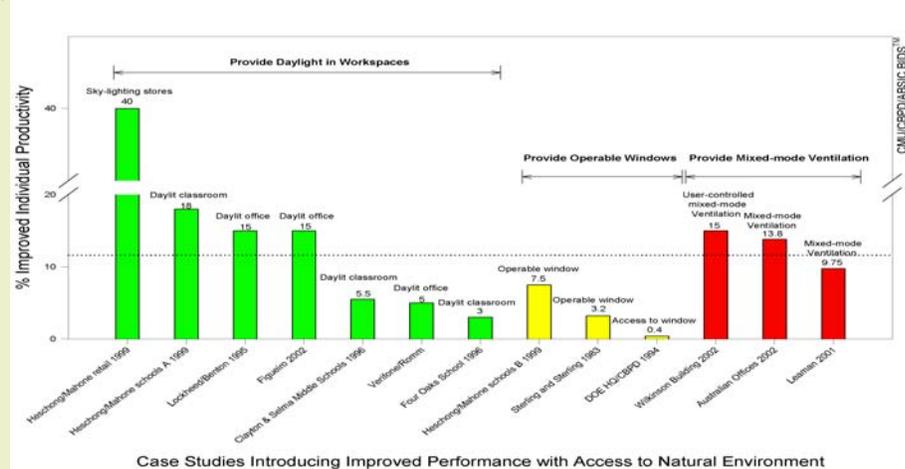
Temperature Control Increases Productivity and Reduces Energy Use



8 studies demonstrate that temperature control increases individual productivity **average of 1.2%**

Source: BIDs Database at Carnegie Mellon

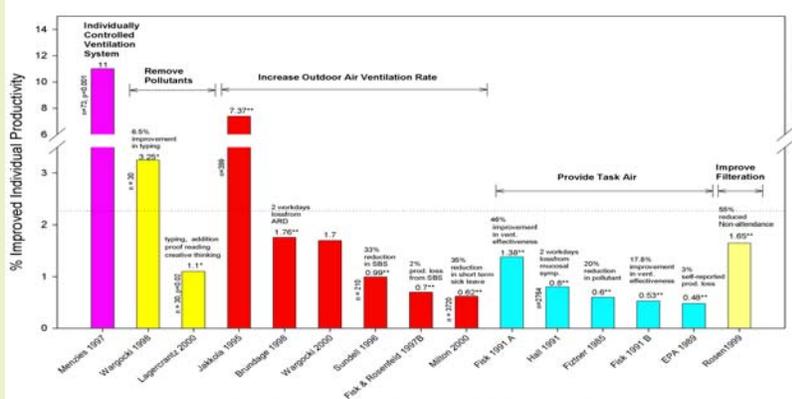
Access to the Natural Environment Increases Individual Productivity



13 international case studies demonstrate that daylight and natural ventilation increases individual productivity between 0.4-18%.

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Improved Indoor Air Quality Increases Individual Productivity



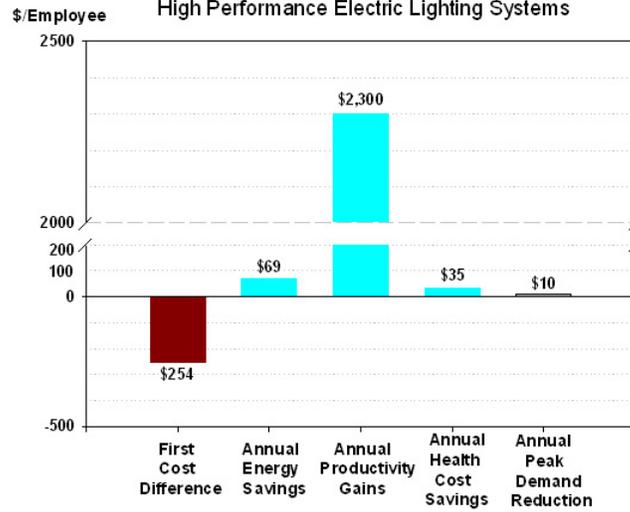
Case Studies Introducing Improved Indoor Air Quality
 (* Performance improvement for specific tasks multiplied by estimated time at tasks)
 (** Improved ventilation effectiveness calculated relative to productivity gains from other studies)

15 international case studies demonstrate that ventilation strategies increase individual productivity between 0.48-11%.

- 6 studies demonstrate 0.48-11% productivity gains with the provision of task air
- 5 studies demonstrate 0.62-7.4% productivity gains with the provision of increased outside air rates
- 3 studies demonstrate 1.1-3.25% productivity gains with the removal of primary pollutants

Source: BIDs Database at Carnegie Mellon

Paybacks from the implementation of High Performance Electric Lighting Systems



The combined benefits per employee are more than compelling

Conclusions from Reviewing Research

- This is not anecdotal evidence –literally thousands of studies on how the built environment impacts people.
- Carnegie Mellon has assembled and summarized the best energy studies in eBIDS. www.cbpd.arc.cmu.edu/ebids
- Is the question whether the data exists and is completely quantifiable, or whether decision makers are acting on the data?

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Light Right Consortium Study



The Light Right Consortium brings together interested parties and researchers to work toward a common goal—to use research as a basis for market transformation towards quality energy efficient lighting.

www.lightright.org

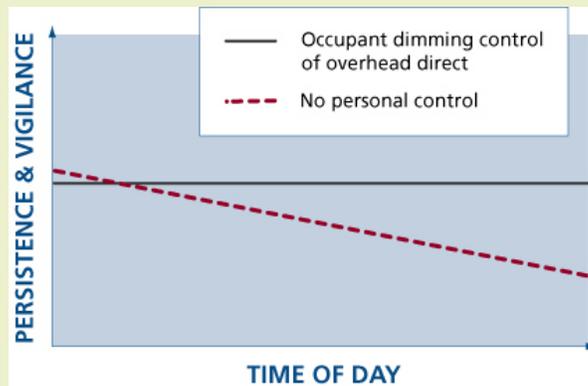
RESEARCH STUDY | Albany , NY - 2003

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Source: Light Right Consortium

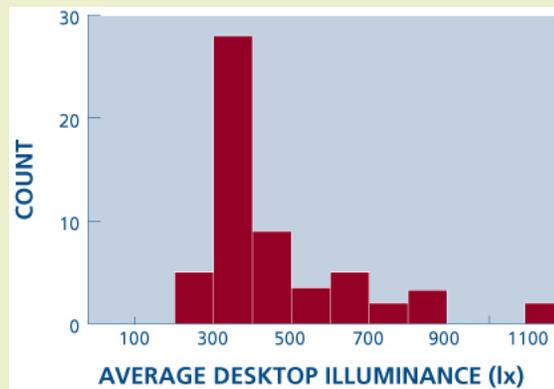
Performance Results



Occupants with dimming control had increased motivation and were able to sustain their persistence and vigilance over time, as compared to those without any control of the lighting.

Source: Light Right Consortium

Energy Results



Mean desktop illuminance chosen by participants with dimming control. Although most people on average chose lower illuminances, the diversity of preferences shows that local personal control must be made available.

Source: Light Right Consortium

Possible Links Between Lighting & Strategic Business Outcomes

FINANCIAL OUTCOMES

- Performance improvements
- Increased resale value of property
- Enhanced ability to rent space
- Reduced costs

HUMAN RESOURCES DEVELOPMENT

- Ability to attract and retain workers
- Improved well-being of workers due to improved mood and comfort

STAKEHOLDER & CUSTOMER RELATIONS

- Improved public image
- Increased ability to sell to pro-environmental customers

These categories are drawn from the Balanced Scorecard Approach, which is a framework used by organizations to evaluate their performance. (Kaplan and Norton, 1996)

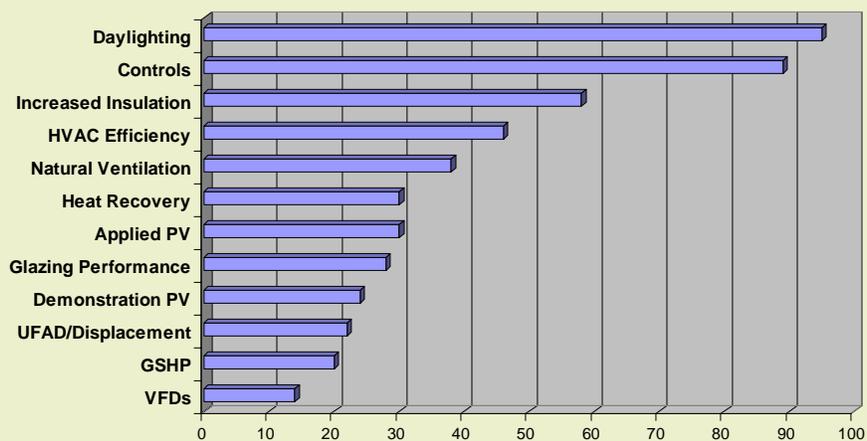
Source: Light Right Consortium

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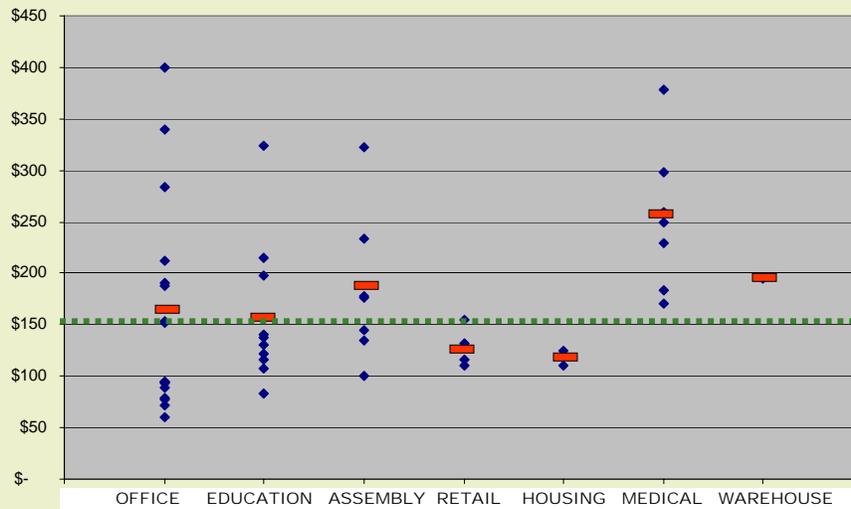
Identify the 100 Best Performing Buildings in the Country



Technologies in the Most Efficient



Cost per Square Foot



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And in the Northwest

- Market study by NEEA found that 100% of school administrators believe that the school building impacts student performance.
- Several larger regional development companies focused almost exclusively on sustainable development, with good energy features, and excellent market results.
- Risks associated with standard construction – where's the market appeal

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Conclusions

- Productivity improvements related to energy systems are real and proven.
- Business community is acting on productivity/better buildings/sustainability messages.
- Financial value of productivity/market value/employee retention is difficult to assign, but it is considerably more than zero.

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PIER Productivity Studies

- 2001-2003 Research led by Lisa Heschong, managed by NBI
- Addressed 3 market sectors through 4 studies:
 - Schools – a) Reanalysis and b) Replication
 - Retail – Sales (Replication)
 - Offices – Productivity



Public Interest Energy Research (PIER) Funded by the California Energy Commission

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School Findings

- Daylighting variable held as a **STRONG** predictor of student performance
- ~ 20% improvement in test scores – (from least daylit to most) - validates original study
- View was consistently associated with better student performance
- Glare, noise and lack of control correlated negative



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Daylighting and Retail Sales



- Daylit stores had 1-2% increase in # of transactions per month
- Daylight found to be as reliable a predictor of sales as traditional retail metrics
- Significant and positive correlation: daylight hours per year & higher sales!
- 0-6% increase in avg. monthly sales at daylit stores vs. non-daylit
- Most favorable daylit stores had sales increases comparable to original study – 40%

- 75 stores studied w/w-out daylighting
- Studied avg. sales per store for a) 10 months during the power crisis, and b) 24 months prior
- Modeled # of customers, transactions per store & differences in seasonal sales

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Office Study

2 studies on environmental conditions and productivity:



1. DESKTOP – office/computer work in open space cubicles
 - 201 participants
 - created short computerized tests of memory, alertness span, dexterity and visual acuity
 - participant assessment of environmental quality
2. CALL CENTER – cubicles
 - 100 participants
 - existing metrics of productivity

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Office Study Results

- Daylight was significant and positive in predicting better performance on a test of mental function and attention
- **View, view, view!** Size and quality of view was the most consistent variable associated with better performance
 - CC processed calls 6-12% faster (best vs. no view)
 - Desktop 10-25% better on mental function and memory recall
 - Strongly associated with self-reports of health conditions
- Increased ventilation associated with improved performance
 - Call Center – 1 CFM/ft² (>50%) = 4% improve. in hourly performance
 - Fully opened floor registers - CC = 3-10% faster calls in all models, Desktop = 17% on one test
- Glare decreased performance
- Physical comfort conditions had high statistical significance – (illumination, view, ventilation and temperature)

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Valuing Sustainability and Energy Efficiency in Real Estate Markets

Presentation by Theddi Wright Chappell,
Pacific Security Capital
August 30, 2007

Presentation Outline

My Background

Related Real Estate Market Trends

Evolving Valuation Practices

Some NW Market Indicators

Near Term Real Value – Risk Mitigation

Conclusion

My Background



Background in Real Estate and Valuation

- MAI, Member, Appraisal Institute
- RICS, Royal Institute of Chartered Surveyors
- AAPI, Associate, Australian Property Institute

- CRE, Counselor of Real Estate
- LEED AP, LEED Accredited Professional

- Currently Director of the Green Building Finance Consortium
- Ambassador for Sustainable Initiatives for the Appraisal Institute
 - Currently writing a course entitled "How to Value Green Buildings for the Appraisal Institute"



Related Real Estate Market Trends



- Green Building Finance Consortium
- Vancouver Valuation Accord
- CoreNet Global Report
- BOMA Challenge
- Sustainable Building Investment Funds
- Government and Regulatory Direction
- Tenant & Client Preferences



Evolving Evaluation Practices



Measurable Performance

- Currently, a lack of empirical data (sales)
- However, there are other measurable performance indicators such as lower or difference O&M costs, tenant improvements and enhanced capital reserves
- Reductions in these expenses flow directly to bottom line, increasing NOI; if all other factors equal, value calculated would be higher

Tenant Satisfaction

- Tenant satisfaction can = less churn
- Less churn can = less downtime
- Less downtime means less time between tenants = more rent
- Less downtime can = lower risk and higher occupancy
- More rent + higher occupancy = better financial performance
- This could = lower discount and cap rates and higher property values



Evolving Valuation Practices



Qualitative Value

What "the market" values equals "Market Value"

Not just quantitative aspects – also qualitative considerations

- What's the payback period on a granite countertop?
- What's a higher performance HVAC system "worth" to a family with an asthmatic child?
- What is ambience worth in a regional shopping center?

Research Underway

- Papers currently being written by valuation, educational, and real estate professionals all over the world addressing the topic of how to value sustainable, energy efficient properties appropriately
- Main challenge is the incorporation of factors other than economics/NOI
- John Elkington's Triple Bottom Line; economic, social, environmental. These represent three of the four "Forces of Value" already recognized as part of accepted appraisal methodology – with the fourth being Governmental



Some NW Market Indicators



We, in Northwest, do have some examples of properties marketed as sustainable and energy efficient that have outperformed their competition:

- The Henry and The Louisa in the Brewery Blocks
 - Quicker absorption, higher rents and sales prices, higher re-sales, better tenant retention
 - Most attractive attribute to tenants at Louisa = better air quality, second = energy savings
- Banner Bank Building in Boise
 - Quicker absorption in small market
 - Relocation of Class A tenants from other locations due to green and energy efficient attributes of building
 - No added cost due to innovative approach and systems integration
- OHSU Center for Health & Healing
 - A symbolic new front door to OHSU
 - Saved \$3.5 million as a result of MEP systems integration; re-invested in building
 - Befitting OHSU's mission of promoting good health, it was crucial that the building maintain optimal air quality and natural light
 - Studies underway to examine worker productivity increases



CB RICHARD ELLIS GROUP, INC.
ANNOUNCES CARBON NEUTRAL GOAL
AND PLANS FOR ASSISTING CLIENTS
WITH 1.7 BILLION SQ. FT. OF
PROPERTIES WORLDWIDE ON CARBON
REDUCTION PROGRAMS



The Energy Challenge
A New Agenda for Corporate Real Estate



Brewery Blocks sell at premium

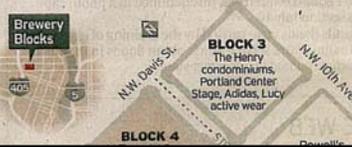
Downtown | Three blocks go for \$291.6 million, an affirmation of Portland's urban redevelopment vision

By DYLAN RIVERA
THE OREGONIAN

JPMorgan Chase & Co. will announce today that it has paid \$291.6 million for three blocks of

fers a rare combination of investment in apartments, offices and prime retail in a pioneering energy efficient design.

That price topped the already high expectations of Portland real estate ex-



Near Term Real Value - Risk Mitigation



From a real estate investment perspective, there is increasing agreement among the institutional, investment, corporate, lending and valuation communities that investment in sustainable, energy efficient projects will be viewed as a major strategy in Risk Mitigation, counteracting such factors as:

- Early/functional obsolescence
- Reputational Risk (Walk the walk)
- Environmental Risk
- Regulatory Risk
- Diminished Capital Investment
 - Bruce Kahn, ecological economist with Citicorp Global Markets
 - What happens if you don't build a high performance building? Or retrofit existing assets?



Conclusion



The value of green buildings has increasing recognition.

From Thomas Friedman's article *The Power of Green* in the NYT: President of Stanford John Hennessey's favorite quote by John Gardner, the founder of Common Care, in relation to confronting climate-change energy issues:

"a series of great opportunities disguised as insoluble problems."



The "Real" Value of Quality Construction

How "other benefits" translate into higher leases and real estate resale value.

Theddi Chappell,
Pacific Security Capital



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Proposed Method to Account for Productivity and Value

Applying the TRC to Integrated Design



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Utility Requested Policy & Proposed Methodology

1. The TRC method for new construction or retrofit projects that have energy measures with positive impacts on productivity or real estate value **should allow** reasonable cost reductions or annual productivity savings to be included.
2. Immediately allow a reasonable estimation of benefits, based on projection of similar studied benefit rates, to be included in O&M savings of the TRC.
3. Establish a committee to determine a list of certain energy saving measures that have value or productivity benefits in addition to energy savings and find a simplified method of adjusting measure costs or O&M savings to adjust TRC calculation.

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1. Acknowledge the Value of Quality in Certain Measures

- ◆ As presented by NBI & Better Bricks
 - Many energy measures add value or improve productivity.
 - The range of value or benefit is based on a preponderance of well documented studies.
- ◆ Productivity benefits have precedent in TRC calculations; RTF recommendations to BPA
 - Industrial productivity
 - Water, detergent, and waste-water cost savings
- ◆ Appropriate application of other benefits:
 - For resource stack: restrict to countable items
 - For individual projects: less definite benefits should be allowed if conservative

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RTF Recommendations to BPA, 2000

Total Societal Benefits (Value)

In addition to calculating the regional bulk power system and local distribution system benefits of conservation and renewable resources the RTF believes it is important to recognize that in many cases these measures provide other non-power system benefits. For example, more energy efficient clothes washers and dishwashers save significant amounts of water as well as electricity. Similarly, some industrial efficiency improvements also enhance productivity or improve process control. Therefore, the RTF attempted to identify whether the conservation measure or activity or renewable resource system would provide non-power system benefits. When possible such benefits were then quantified (e.g., gallons of water savings per year). For a small subset of the measures reviewed by the RTF it was also possible to provide an estimate of the economic value of these non-power system benefits. These benefits were added to the RTF's estimate of value to the bulk power system and the local electric distribution systems of conservation and renewable resources when computing Total Societal Benefits.

Total societal benefits (value) is calculated by adding regional bulk power system value, local distribution system value and environmental externalities benefits. For example, an irrigation measure with a 15-year measure life that saves 10,000 kWh per year has a present value benefit to the bulk power system of \$0.36 per first year kilowatt-hour savings (from Table 2), a present value local distribution system benefit of \$0.09 per first year kilowatt-hour savings (from Table 4) and a present value environmental externalities benefit of \$0.06 per first year kilowatt-hour savings (from Table 5) for a total societal value of \$0.51 per first year kilowatt-hour savings. Since the measure saves 10,000 kWh per year, this equates to \$5,100 total societal benefit.

In those cases where a measure also has other non-electric system benefits (beyond environmental externalities) these are added to the values determined by summing the benefits shown in Tables 2, 5 and 6 to determine total societal value. For example, resource efficient clothes washers save significant amounts of water and detergent in addition to their electricity savings. For clothes washers used in single family residences these benefits add \$0.80 per first year kilowatt-hour savings to the \$0.52 per first year kilowatt-

2. Immediately allow a method for specific projects

- ◆ Programs have difficulty finding eligible measures, especially with aggressive energy codes.
 - Need support for integrated design measure approach needed to go beyond incremental measures.
 - Integrated design is not always at minimal cost.
- ◆ Pre-approval requirements mean we need an interim method now or resource will be lost.
- ◆ Legitimate non-energy benefits are a valid part of individual project economics and need to be considered in any valid TRC test.

Allow Logical Method

Provide logical study basis for ventilation impact on productivity

Ventilation Improvement Productivity Analysis

0.4719474 Note - Drinka & Polaroid savings is only directly reduced absence

cfm/person	productivity improvement	save	base
2.4	5.1	0.00%	Base
10	21.2	0.51%	Drinka et al 1996
15	20	0.61%	Polaroid / Milton et al 2000
	31.8	3.70%	Bourbeau et al 1997 / Wargocki et al 2000
	50	6.00%	Wargaki: Call center productivity

Studies provide logarithmic curve fit

Curve fit parameters a 0.0242 b 0.0513

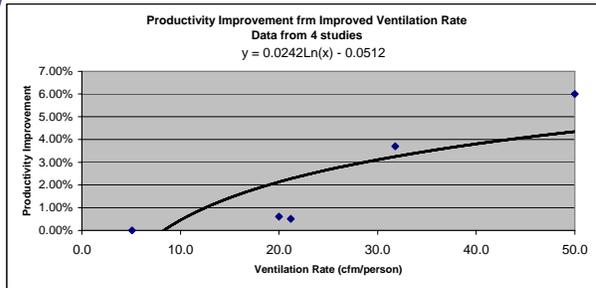
Subject Building 30% LEED ventilation improvement

20 2.12% Code Baseline

26 2.75% LEED ventilation + 30%

0.63% Logarithmic difference

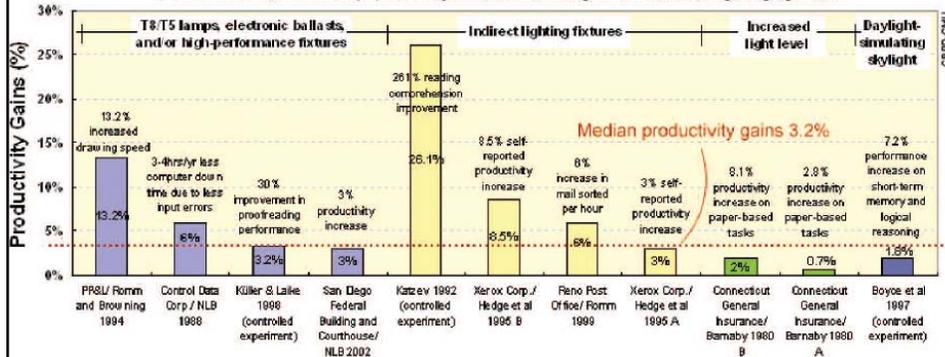
Logarithmic trend fit to find productivity improvement from 20 to 26 cfm/person (using this method, the slope of the curve is more important than absolute position)



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Improved Lighting in Offices

Productivity Gains (%) from Implementation of High Performance Lighting Systems



www.aia.org/SiteObjects/files/BIDS_color.pdf

- ◆ Median productivity Gains of 3.2% (5% avg)
- ◆ Equal to 15 minutes more work per day

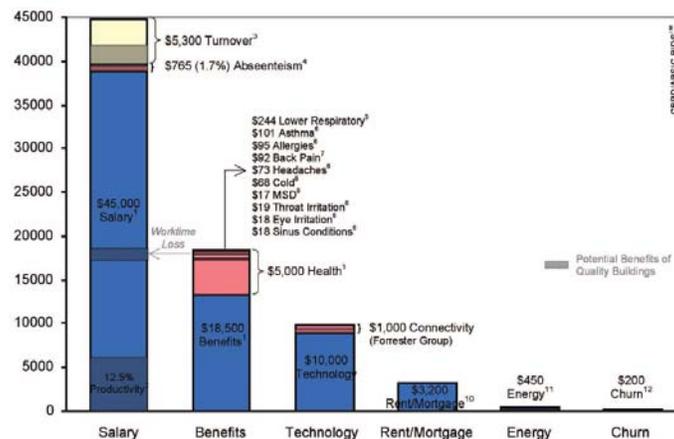
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3. Develop a simpler method . . . soon!

- ◆ TRC is a binary test,
 - what is important is IF a project passes,
 - not by how much.
- ◆ We are not interested in tracking the magnitude of other benefits like we are in tracking reliable kWh savings.
- ◆ If we apply the lower end of the reported range of savings, most all projects will pass the TRC test.
- ◆ Utility analysts and consultants are energy experts, not sociologists.

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Follow the Money \$\$



www.aia.org/SiteObjects/files/BIDS_color.pdf 24

When Cost is not all for energy savings - examples

- ◆ Exterior shading – expensive option for?
 - Reduced Cooling Load?
 - Glare reduction and comfort improvement?
- ◆ Daylighting – Comprehensive system
 - Controls payback, but not architecture
 - Improved productivity, performance or sales?
 - Lighting and cooling energy use reduction?
- ◆ Insulation – Break thermal bridge
 - Energy savings – heating/cooling load reduction?
 - Sound attenuation – radiant comfort improvement?
- ◆ Demand Controlled Ventilation; 30% > 62.1
 - Heating/cooling energy savings at peak design?
 - LEED point and better indoor air quality

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Alternate Simplified Methods

- ◆ Either approach requires
 - A list of certain productivity measures that have significant non-energy benefits
- ◆ Productivity Savings Method:
 - Add 1% presumed benefit to O&M
 - Simplified \$45,000 per staff salary costs
- ◆ Split Cost Method:
 - Reduce “energy related” cost of certain productivity measure so project qualifies
 - Similar method used by ODOE for BETC

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Utilities/Programs Participating in this request

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- ◆ Seattle City Light
- ◆ Energy Trust of Oregon
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- ◆ Idaho Power

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Today's Request by Utilities:

1. The TRC method for new construction or retrofit projects that have energy measures with positive impacts on productivity or real estate value **should allow** reasonable cost reductions or annual productivity savings to be included.
2. Immediately allow a reasonable estimation of benefits, based on projection of similar studied benefit rates, to be included in O&M savings of the TRC.

Needs Referral to Committee:

3. Establish a committee to determine a list of certain energy saving measures that have value or productivity benefits in addition to energy savings and find a simplified method of adjusting measure costs or O&M savings to adjust TRC calculation.

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