

WHY BUILDING OPERATORS MATTER TO GHG EMISSIONS REDUCTIONS

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ACKNOWLEDGEMENTS

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Resources
Board

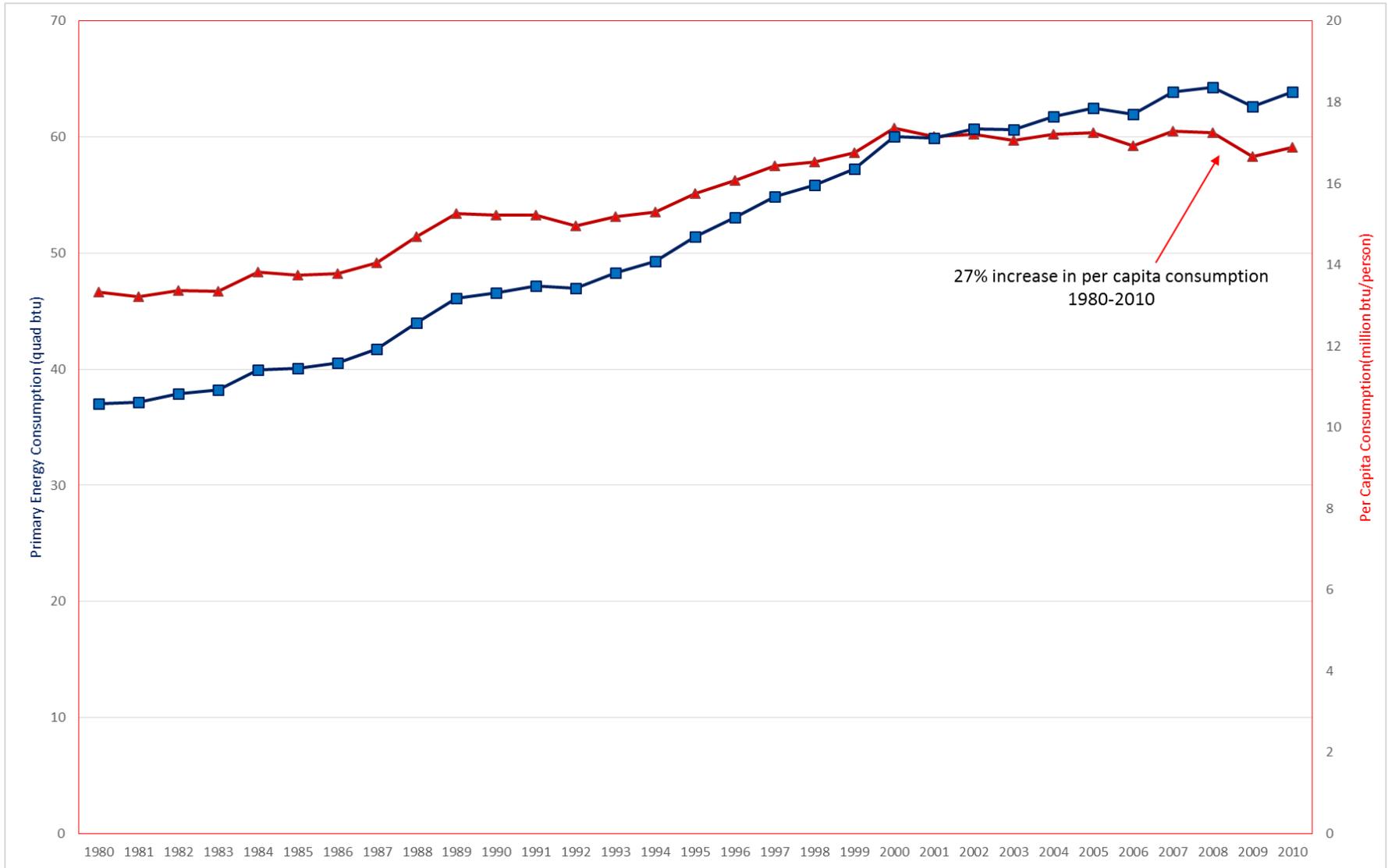
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Research
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AND MANY INFORMANTS & SUPPORTERS

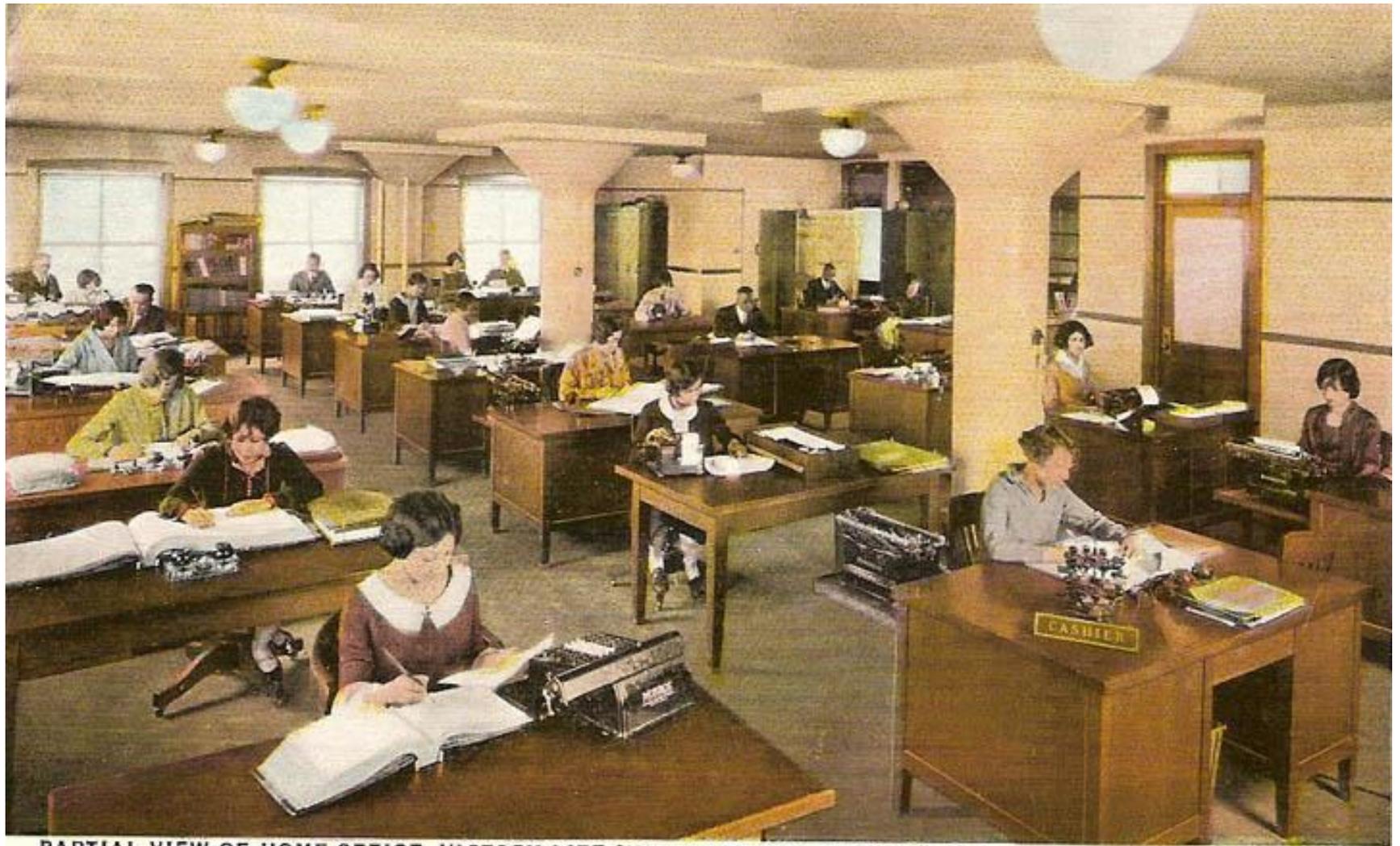
ENERGY USE IN U.S. COMMERCIAL SECTOR



Data sources Buildings Energy Data Book 2011, US DOE (2012) & US Census Bureau

USUAL APPROACH





PARTIAL VIEW OF HOME OFFICE, VICTORY LIFE INSURANCE CO., CHICAGO, ILL.

114300



Investments

- ✓ Low energy costs
- ✓ Leaders disinterested
- ✓ Inadequate knowledge
- ✓ ROI criteria
- ✓ Mixed incentives

Behavior

- ✓ Occupant actions
- ✓ Occupant demands
- ✓ Staff training
- ✓ Too much control

**Efficient
Technology**

Controls

Automation

**Cx,
RCx**

Incentives

**Costs &
Prices**



**Occupant
Engagement**

**Occupant
Expectations**

**Operator
Training**

**Rules &
Guidelines**

Leadership

✓ **Fails to see the building as a system**

- ✓ Relationships between people and each other
- ✓ Between people and things

✓ **Forgets the purpose(s) of a building**

✓ **Fails to take enough account of actual functioning and conditions**

- ✓ “Design-Performance Gap”
- ✓ Negotiations & conflicts: operators and occupants adapt, cope, tolerate, despair, override ...



U.S. Department of Energy
Office of Inspector General
Office of Audit Services

Audit Report

The Department of Energy's
Opportunity for Energy Savings
Through the Use of Setbacks in its
Facilities

DOE/IG-0817

July 2009

**Why we
wanted to
study
building
operations**



RESEARCH STEPS



Stories

- Lighting Controls



OPAQUE CONTROLS
Interactive Labeling

OPERATOR INITIATIVE

Fully Engaged 24/7 Paying Attention



REACTION w/o COMMUNICATION

- "Trusted old Technology" ... says the contractor.
- How DO CONTRACTORS MANAGE TRUST?
- Being conservative while being an adopter...



- State office Bldg "All t-stats will be set down" → OVER-COOLING
- NOT UNDERSTANDING CONTEXT "the RIGHT thing... for the WRONG reason!"



- Mini-fridge Initiative



How to SAY NO
Appealing to common sense

- Auto-ON-OFF

OPERATOR OVER-RIDES
MANUAL vs. AUTOMATIC CONTROL

Air Conditioning Install....



- CBE Survey "General Satisfaction" WILLING to COMPLAIN ABOUT SMALL THINGS
- Schools: Teachers don't have high expectations
- EXPECT A CERTAIN AMOUNT of FAILURE
- POWER of VALUING COMMUNITY

- Terminal reheat... combatting CADILLACS: BIG SYSTEMS for SMALL LOADS
- ... simultaneous heating + cooling...

- Summer in D.C. offices...



Outline

Building Operator Job

How are Buildings Working Now?

Complaints

Making Changes in Buildings

Seeing Energy

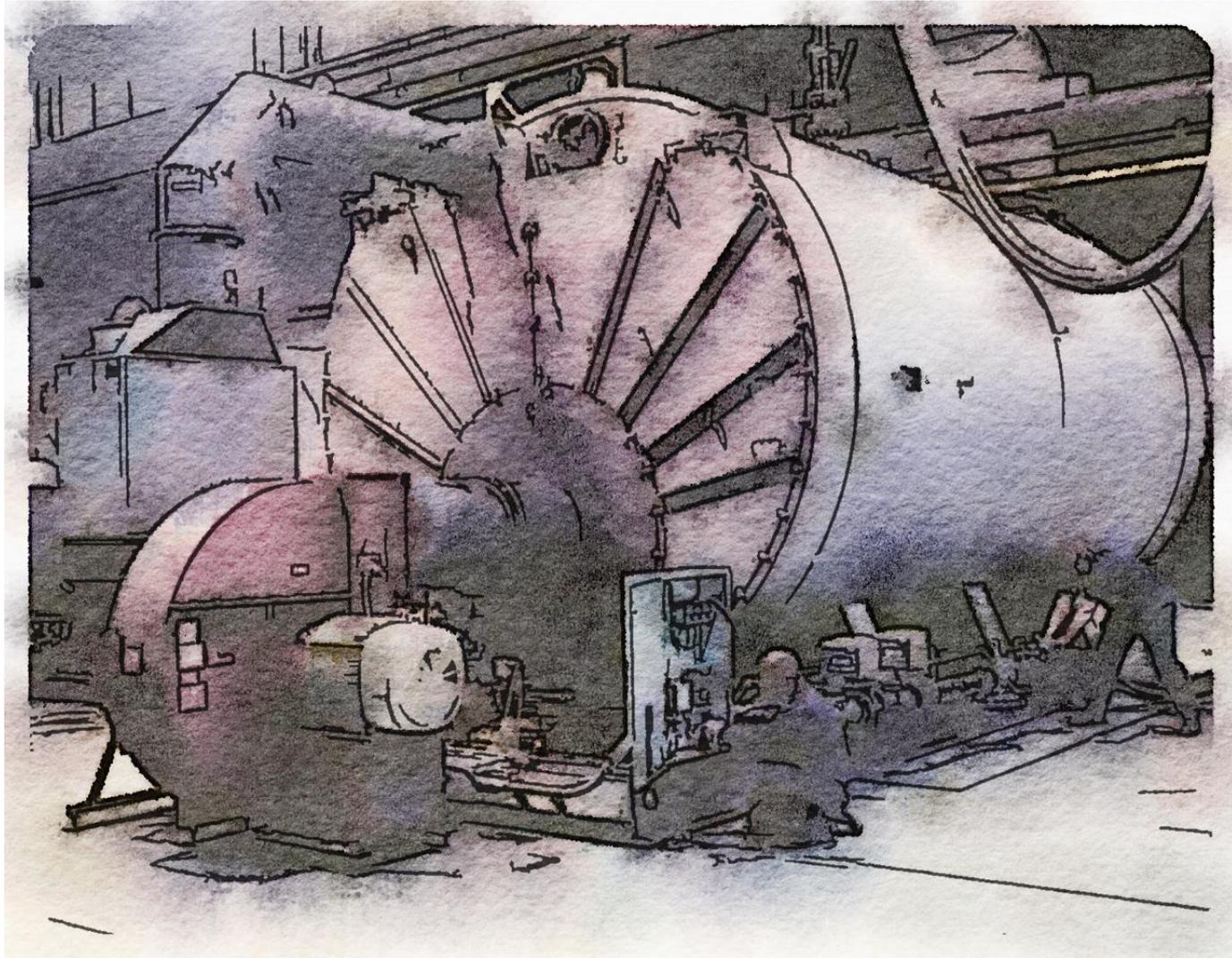
Technology and Its Problems

Operator Status, Scope & Visibility

Recommendations

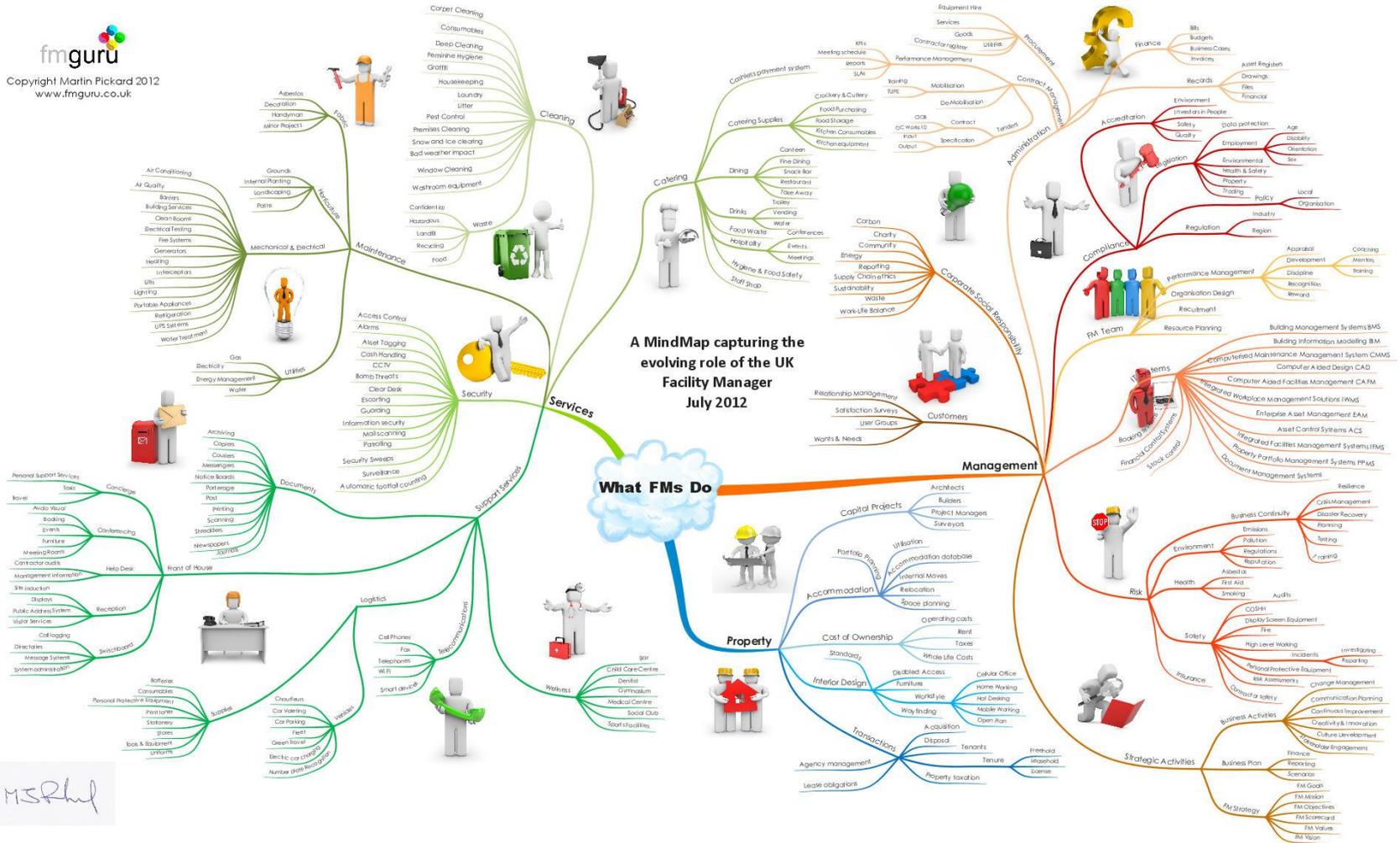
Context & Next Steps

**WHAT IS THE
OPERATOR
JOB?**



A MindMap capturing the evolving role of the UK Facility Manager July 2012

What FMs Do



MSPH

**HOW ARE
BUILDINGS
WORKING NOW?**

Designer: a statement and thing of beauty

Occupant: a place to do a job

Operator: a place to keep equipment working, occupants & managers content; a ship

Owner: a way to make money

Property manager: make money by helping owner make money

Tenant: a place to locate employees, serve customers

Passerby: shade, facilities, etc.



Utility: an account to which to sell/provide energy

Vendor: a place to sell & service equipment

Energy policy: a site to reduce energy use

Behavior change program: a place for moral transformation

R&D: a site to test new technologies

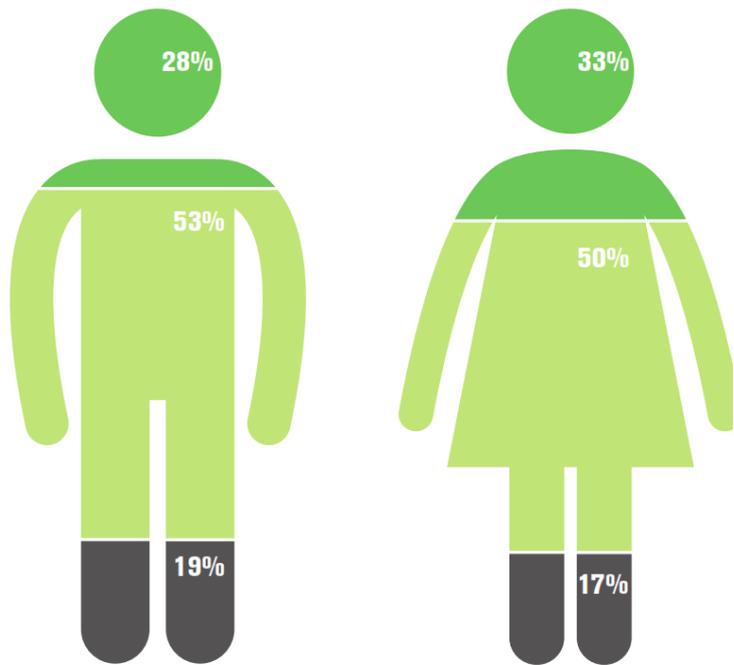
Environmental advocate: a source of pollution

Anthropologist: a way to order space

COVER FEATURE



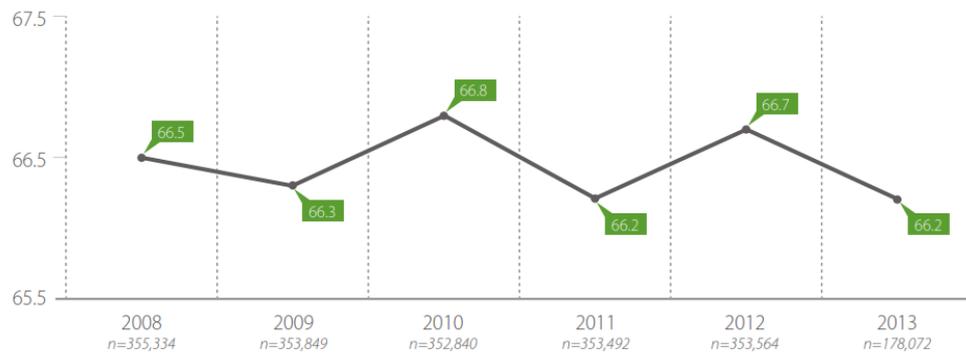
A. Leaman, "The great escape," *Ecolibrium*: June 2009



ACTIVELY DISENGAGED NOT ENGAGED ENGAGED

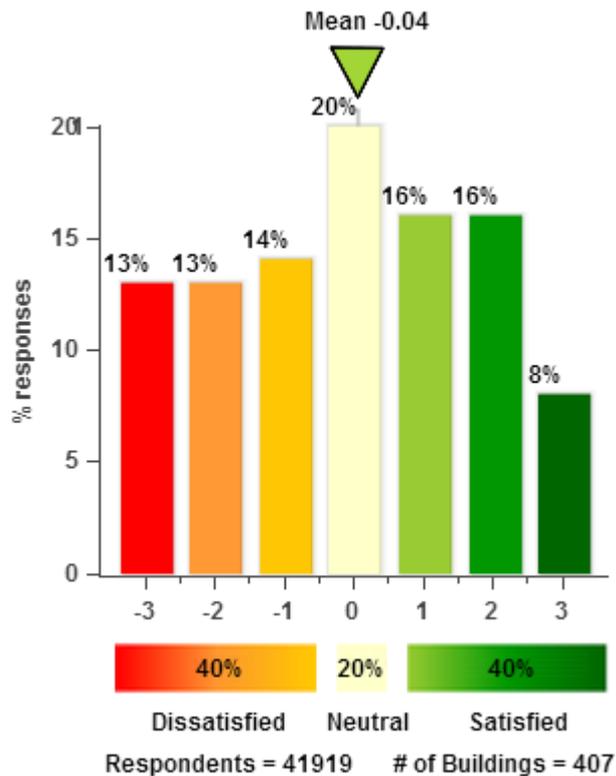
State of the American Workplace, Gallup 2013

NATIONAL WELL-BEING SCORE, 2008–2013

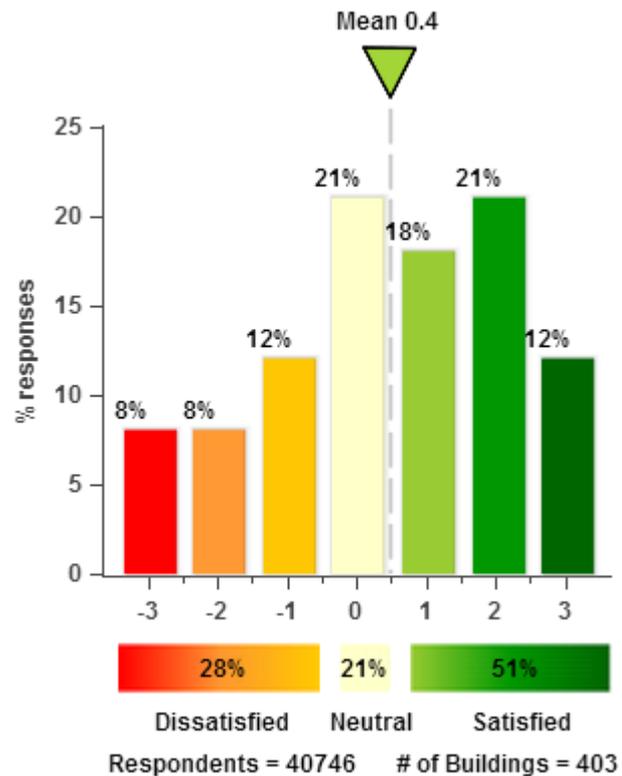


LIFE EVALUATION	44.5	48.1	49.8	48.8	49.5	48.2
EMOTIONAL HEALTH	79.1	78.7	79.3	79.0	79.4	79.2
WORK ENVIRONMENT	51.4	49.1	48.2	47.2	47.8	48.0
PHYSICAL HEALTH	76.9	76.6	76.9	76.7	77.0	76.4
HEALTHY BEHAVIOR	63.7	63.1	64.1	63.4	64.5	63.7
BASIC ACCESS	83.6	82.2	82.3	81.9	82.3	81.9

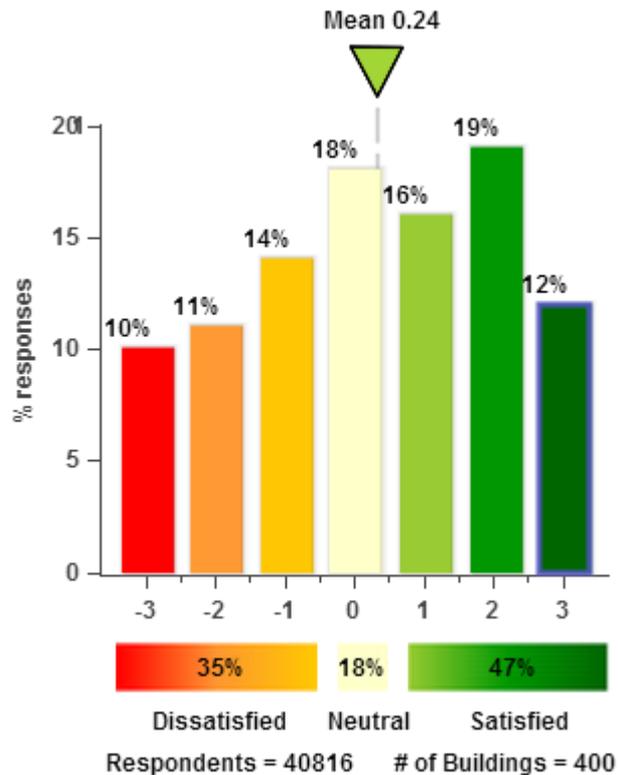
Gallup-Healthways State of American Well-Being 2013



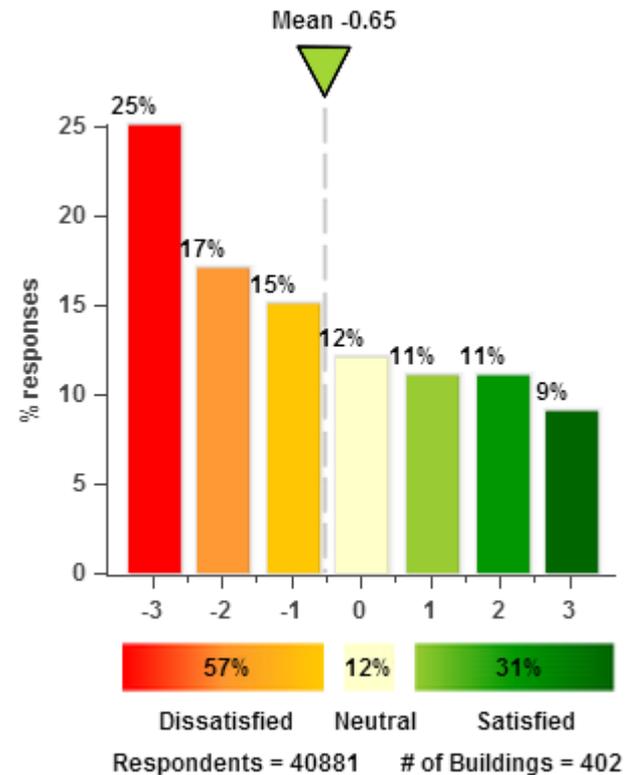
Temperature



Air Quality



Noise



Speech Privacy

COMPLAINTS

FOREST FIRES AID THE ENEMY



Crush out your cigarette

U. S. DEPT. AGRICULTURE, FOREST SERVICE

STATE FOREST SERVICE

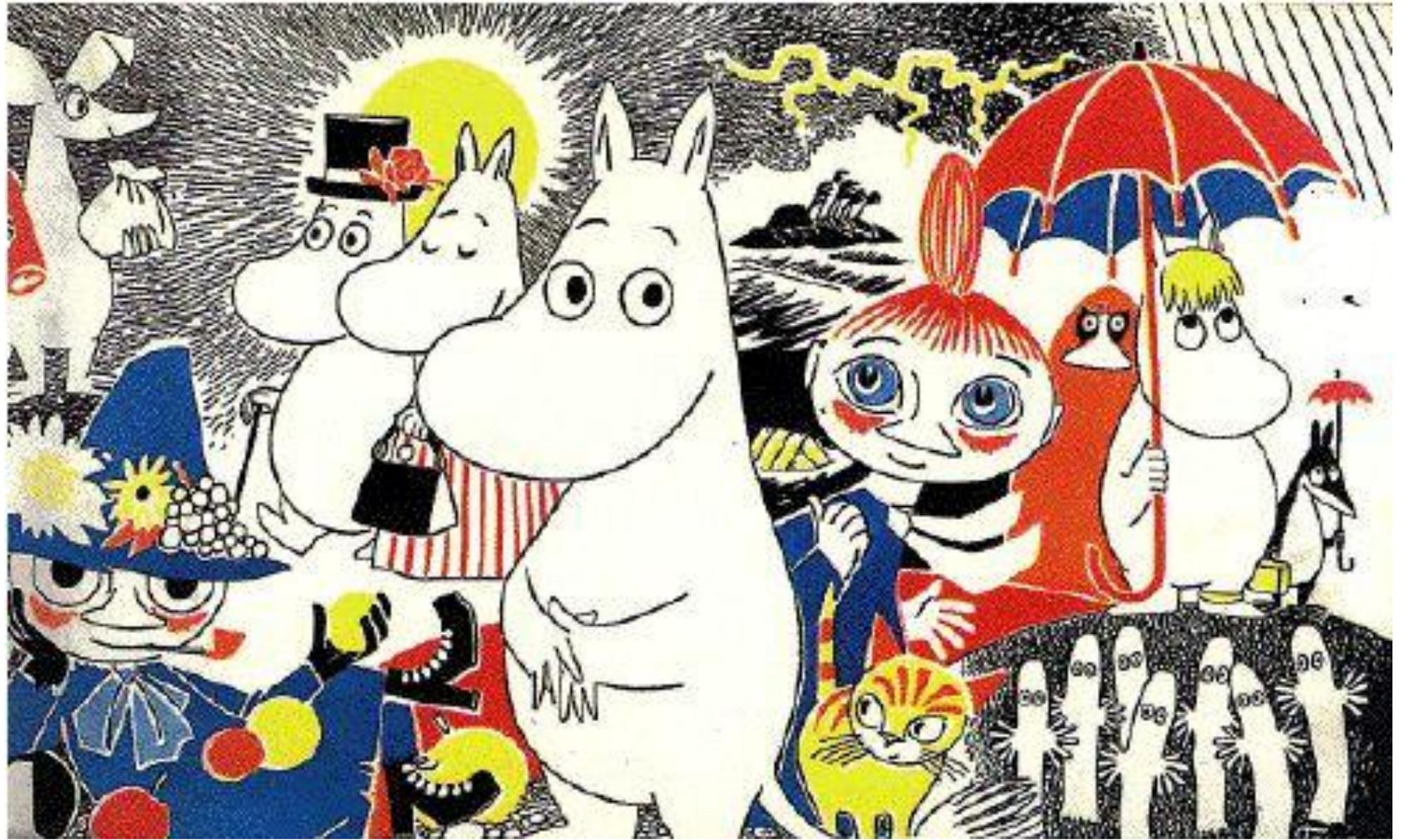
U.S. GOVERNMENT PRINTING OFFICE : 1943 - O - 512108

- ✓ WORK ORDERS
- ✓ COMPLAINTS
- ✓ BUILDING ROUNDS

“Building operators respond to occupants always in reactive mode, and that is dictated by their need to solve problems as needed. They don’t need to fix problems until broken, and you don’t know that equipment is broken until occupants tell you. To do more than that requires teams that are managed tightly.”

WHAT IS A GOOD BUILDING?

Large Owner-Occupied Office, Outsourced Operations team	Medium Local Government	Large State Office Buildings	Medium Multi-Tenant Mixed Commercial
“A good building has no complaints”	“A good building does what it was designed to do. It maintains good air quality, good temperature for people to do what they need to do without worrying about being too hot or too cold, and has components that won’t break too often.”	“A good building has creature comforts, uses energy wisely, has good space planning, nice landscaping, and is accessible and safe. It is as efficient as possible. It has occupancy sensors that turn on lights as you walk through.”	“The best building is one that doesn’t have a crew.”



“Most of my decisions are to accommodate occupants. If an occupant says, ‘I need this to change,’ I do it. I don’t balance with energy use. Maybe this is wrong.”

“Tenants don’t care about energy costs. They want comfort. We can’t compromise. Our hot/cold calls have diminished by sticking to our knitting.”

“If a thermal complaint is called in, we look at the BMS. If everything is green, then it’s okay.”

“Just showing up seems to help. Often we don’t fix problems because there is no problem.”

COMPLAINTS / CONDITIONS / CONSUMPTION

Hot & cold calls #1

Occupants say not just too little,
but also too much

Many occupants do not complain
(even if uncomfortable)

Regular use of narrower deadband
vs. specs

Start/stop/off hours vs. readiness

Conservatism, [complaint aversion](#),
hospitality likely accrete

“Easier to adjust lighting” ...
immediate & less sensitive



This is a placebo

MAKING CHANGES IN BUILDINGS



“Anything you do that’s visible to others gets a reaction and often a complaint.”

“I try to do the things that aren’t visible because then you have the opportunity to tweak the results before occupants know of the change.”

“If you do something that affects 3000 people you might get five complaints, but you have to stand your ground. You can’t let five people dictate things.”

**SEEING
ENERGY**



123 E. Main Street
Anytown, USA 12345-0000

7 **Account Number:** 123456-7
9 **Total Amount Due:** \$29,911.87
10 **Due Date:** 02/07/2000

Prepare for the summer storm season.
carries a full line of surge protection
and UPS products.

3

000000000000



1 **John Q. Customer**
555 Any Street
Eagan, MN

2 **PO Box 64427**
Anytown, MN 55116-0427



4 555 Any Street

PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

RETAIN THIS PORTION FOR YOUR RECORDS



123 E. Main Street
Anytown, USA 12345-0000

5 **Account Number:** 123456-7

7 **Statement Date:** 01/14/2000

9 **Total Amount Due:** \$29,911.87

10 **Payment Must be Received by**
to avoid LATE CHARGES

Office Hours: 7:00 a.m. - 4:30 p.m.
Customer Service: 463-6212 7a.m.-7p.m.
Report Outages: 463-6201 24 hours
Toll Free Number: 1-800-3409
District: 4

Billing Summary

Actual

Previous Balance 12/30/1999:	\$ 32,218.45
Payments received through 01/14:	\$ 32,218.45 CR
Late Charge:	\$ 0.00
Adjustment:	\$ 0.00
Balance as of 01/14:	\$ 0.00
Total Service:	\$ 29,911.87
Total Loans:	\$ 0.00
Total Amount Due:	\$ 29,911.87

11 ***Automatic payment of \$29,911.87 will occur on 02/07/2000

Electric Service Premise No. 94492 Usage Period 12/13/1999 to 01/14/2000 - 32 days Service Address - 555 Any Street

Meter	Present	Previous	Multiplier					
L057813448				Fixed Charge				\$25.00
L057813448	6539.00	Regular 5895	720	Energy	463680.00	kWh @ \$0.041300		\$19,149.98
L057813448	1.55		720	Demand	1116.00	kW @ \$9.600000		\$10,713.60
KVARH	1259.00	Regular 1081	720	Reactive	128160.00	kvarh		\$0.00
Pfact	0.96			Power Factor				\$0.00
L057813448				Res & Tax Adj.	463680.00	@ \$0.000900		\$417.31 CR
Rate Schedule 43				Total Electric				\$29,471.27

Taxes and Fees Premise No. 94492 Service Address - 555 Any Street

FRAN		City Fee	\$ 0.00
STATE		Sales Tax	\$440.60
Total Taxes and Fees			\$440.60

Energy Generation & Delivery Cost for Your Rate Class

Generation	46%
Transmission	10%
Distribution	44%



COMPARISONS	DAYS SERVICE	AVG. DAILY KWH	ELECTRIC CHARGES
CURRENT MONTH	31	14957.4	29471.27
PREVIOUS MONTH	37	13913.5	31743.88
SAME MONTH YEAR AGO	27	15046.0	22472.58

16

“I had a mentor who told me a trick. He said that you make or break the energy bills, but nobody knows that and they don’t pay attention.

But if you can make changes, create savings, and document it all, you’ll be a hero and you’ll always be employed.”

TECHNOLOGY AND ITS PROBLEMS

CUTTING NOT BLEEDING

“It takes 15 years for a new technology to work.”

““The industry is evolving fast. We don’t know who to turn to for advice for testing or vetting systems.”

“Publish case studies on what works. Typically we want to see a technology that has a track record. We don’t have that much insight in the market so we need some assurances.”

“Provide consistent funding, incentives for technologies that work.”

BUILDING MANAGEMENT SYSTEMS



Liked
but

Many capabilities unused

Opaque; can make things worse

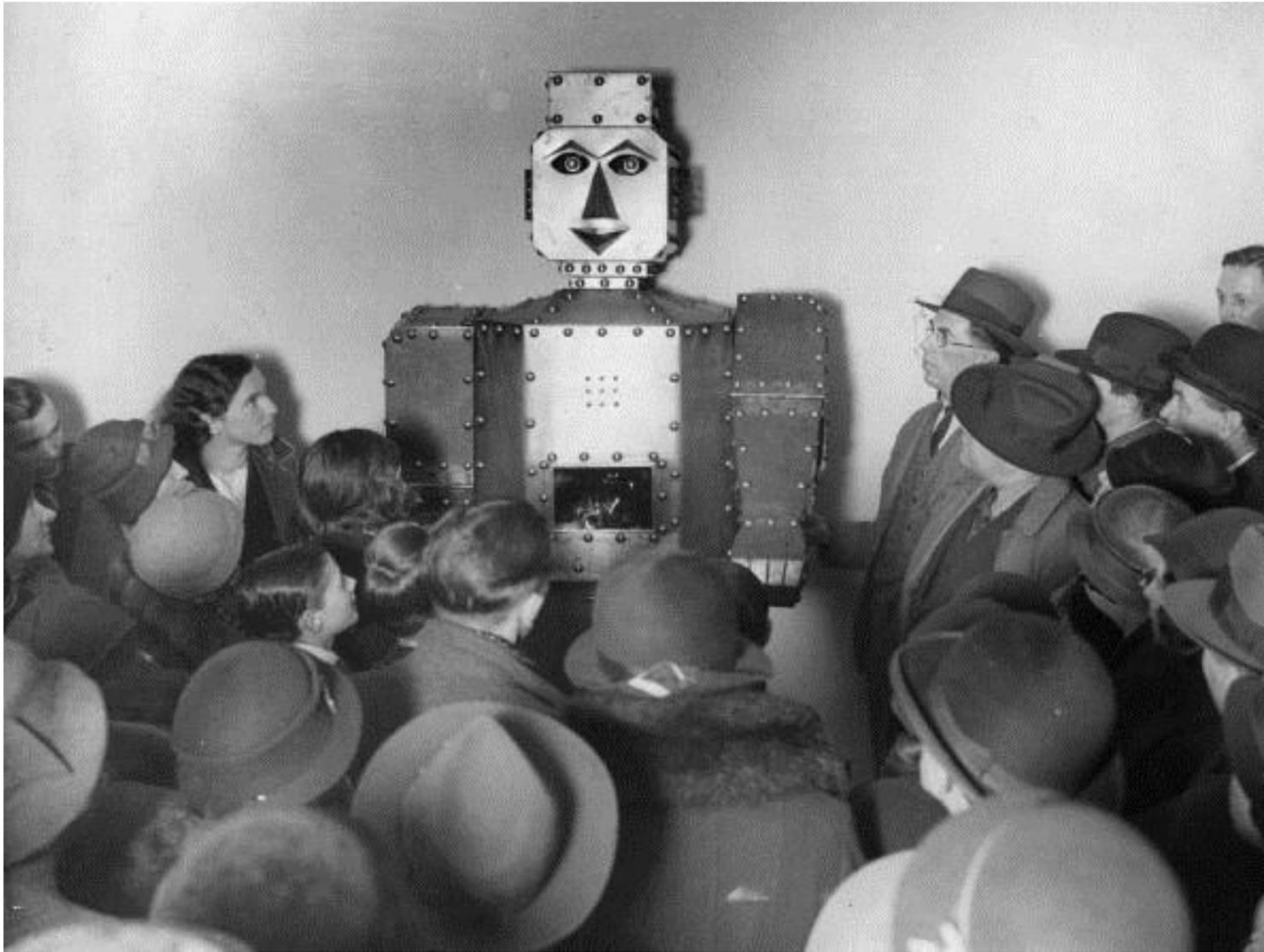
Problems not easily rectified

“Rolodex engineer”

Low levels of training provided

Usability in real buildings?

**OPERATOR
STATUS, SCOPE,
VISIBILITY**



"Fortune teller robot", Selfridges Store London, 1934

“Building maintenance is perceived as second class...No one wants to know about it until there’s a problem.”

“Operators often get the feeling that they aren’t worth much from their bosses.”

“Professionalize the technicians and their role. You need to get the boiler room people into the board room.”

Building

Operations is not a simple technical job; much inertia and for good reason

Complaints & avoiding & quieting them is a defining element, may ramp up energy use

Staffing, O&M budgets, EE funding, tools, may often be inadequate

No one person or group is in charge of saving energy, even if saving it is relevant

Energy waste avoided but energy data, energy analysis limited

Occupant satisfaction low; limited knowledge about building systems

Sector

Energy consumption in buildings is increasing despite efficiency

In theory, operational changes could yield 15-30% savings in many buildings

At a loss due to mixed/split incentives problem

At best selective attention to operators, operations

Improvement

Is possible

Needn't be limited to star buildings

Is based on recognizing & help creating "authentic" incentives

FOUR AREAS OF RECOMMENDATIONS

1. INCREASE VISIBILITY & SUPPORT PROFESSIONALIZATION OF OPERATORS

Resources, leeway, motivation, and power to reduce energy consumption may often be very limited.

- ✓ Support training, possibly certification, as a means to professionalization of the field
- ✓ Help define the building operations profession
- ✓ Promote building operations as a green job
- ✓ Include operators as true partners in programs, policy, research, and building design

2. IMPROVE TECHNICAL SUPPORT FOR MANAGING ENERGY

The invisibility of energy, the multiple influences and points of control, risk aversion & a natural priority on providing adequate energy services are basic challenges to reducing energy use. But there are realistic ways to surmount.

- ✓ **Realistic, trustworthy sharing of experience on what works**
- ✓ **Consistent policy support for what works**
- ✓ **Make rebates for energy efficiency investments easier to apply for and more broadly available**
- ✓ **Help develop better energy use data and use of this data**
- ✓ **Work on BMS usability in real buildings**

3. MORE NUANCED INTEGRATION OF IEQ & ENERGY EFFICIENCY

Occupants are often not very satisfied with their workplace. Attention to indoor environmental (and air) quality should be coordinated with energy efficiency efforts. Relying on occupant complaints is too crude a basis.

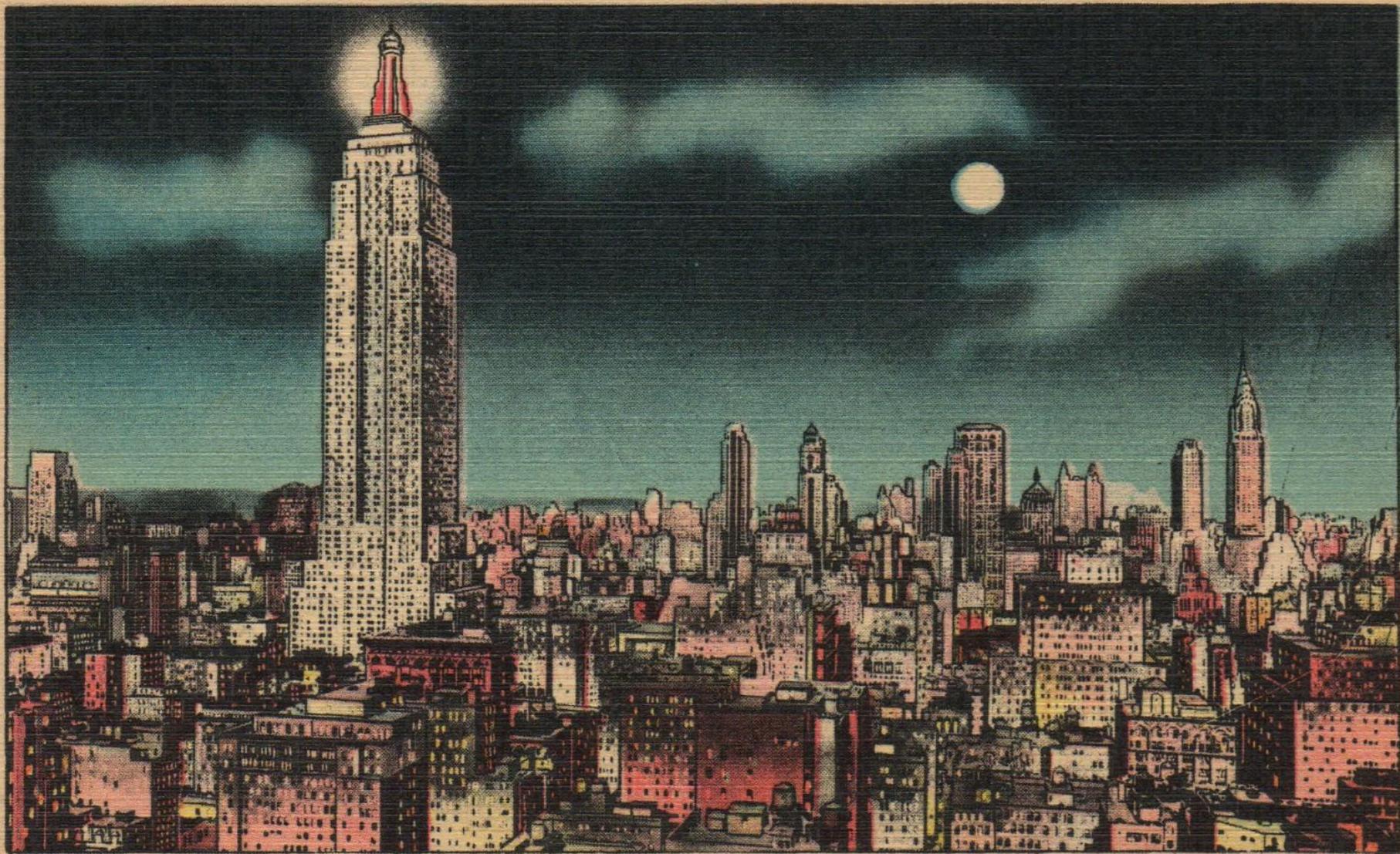
- ✓ Better assessment of occupant satisfaction, e.g., through surveys**
- ✓ Improve understanding of actual conditions & the ability to take these into account**
- ✓ Educate & respond to occupants in a way that helps create value**
- ✓ See improved IEQ and workplace satisfaction as an incentive for reduced pollution**

4. SEE BUILDINGS AS SOCIAL SYSTEMS

Buildings are not just collections of individuals or things but dynamic systems of relationships amongst people, things, ideas.

- ✓ Recognize existing incentives, relationships & conditions**
- ✓ Conduct research in real buildings**
- ✓ Observe. Pay attention to cracks, things that go wrong, and things that go right.**

47 — EMPIRE STATE BUILDING AND SKYLINE AT NIGHT, NEW YORK CITY





Questions, comments, info:

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IMAGE CREDITS

Slide 5: Own image (Portland OR)

Slide 6: Home Office, Victory Life Insurance Co.

[http://www.officemuseum.com/IMagesWWW/Victory Life Insurance Co General Office Chicago IL OM.JPG](http://www.officemuseum.com/IMagesWWW/Victory_Life_Insurance_Co_General_Office_Chicago_IL_OM.JPG)

Slide 7: Static from *Playtime*

Slide 8: Bank of Italy, Fresno (+Waterlogue), Wikimedia Commons, [Bobak Ha'Eri](http://en.wikipedia.org/wiki/File:2009-0725-CA-Fresno-BankofItaly.jpg), <<http://en.wikipedia.org/wiki/File:2009-0725-CA-Fresno-BankofItaly.jpg>>

Slide 13: Graphic recording produced by Katie Ackerly during the project Stories Workshop

Slide 16: Johnston Boiler (http://www.johnstonboiler.com/images/new/1800-2500_HP_PFTS-BOILER.jpg) + Waterlogue

Slide 17: "What FMs do", fmguru, <http://www.fmguru.co.uk/>

Slide 19: Own image (Novato CA)

Slide 20: From A. Leaman 2009, "The great escape," *Ecolibrium*.

Slide 21: Gallup: State of the American Workplace (2013); Gallup Healthways State of American (2013)

Slide 22-23: Survey data explorer, Center for the Built Environment, University of California Berkeley

Slide 25: "Forest fires are the enemy," <http://www.fs.fed.us/greatestgood/images/gallery/fire/Fire/photos/photo13.shtml>

Slide 28: Moomin comic book cover http://en.wikipedia.org/wiki/File:Moomin_kuva.JPG

Slide 30: <http://www.todayifoundout.com/index.php/2012/07/most-thermostat-controls-in-large-office-buildings-dont-usually-do-anything/> (+ Waterlogue)

Slide 32: Banksy or Meek graffiti, <http://www.reverbNation.com/verbaltactics>

Slide 38: HOA switch, http://www.davidsonsaless.com/catalog/files/Ecommerce%20Pictures/Salzer/M221-61026-08_1.JPG

Slide 41: "Fortune teller robot," Selfridges Store London, 1934, <http://cyberneticzoo.com/robots/1934-fortune-teller-british/>

Slide 49: Empire State Building and Skyline at Night, <https://ephemeralnewyork.wordpress.com/tag/vintage-postcard-empire-state-building/>