Closing the loop: using hero stories and learning stories to remake energy policy

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Abstract
Hero stories are a popular way of describing how great a new technology or strategy is. Whether it is a silver bullet (one technology) or a silver buckshot (a combination of things), energy-efficient technologies and strategies often promise "triple bottom line" benefits to our economy, society, and environment. The UK government has developed a hero story to guide its future by proclaiming that all new homes in the country *will* be zero carbon by 2016. This hero story, where we are saved by clever technologies, is inspiring, positive, and familiar. In this story, we don't need to do anything because the technology will do it for us. But how real is it? The counterpart to the hero story is the learning story[1], where things are not quite as simple as they first seemed. In a learning story, protagonists are normal people who need to rise to a challenge. They are not saved by Superman, they have to save themselves. The learning story in energy policy lies in the between the technical potential and what is achieved in practice. The learning story is what commissioning tells us, and what post occupancy evaluation reveals. The learning story can be difficult and contentious. It is less soothing than the hero story, as it asks for participation, reflection, and does not provide a single truth. This paper uses real world examples from retrofit and new build projects to show how implicit narratives can create conflict when the tellers (e.g., researchers) have to tell one kind of story but have data for the other. By recognizing that both kinds of stories are important, the paper provides recommendations for policymakers, researchers, implementers, and users to resolve conflicts and tensions between different kinds of tales. It also argues for the continued importance of the learning story in energy policy.

Introduction
Amory Lovins has called energy efficiency "a free lunch you're paid to eat." However, researchers who study energy demand and consumption know that there is a gap between what efficiency promises to deliver and what happens in the real world. This gap is not just on aggregate, it exists within individual projects. In this paper, we use data from three very different cases to remind the reader that this gap exists pretty much everywhere: in a "green" academic building in the US; in a European renewable and rational use of energy project spanning hundreds of buildings in the UK, Corsica, the Netherlands, and Spain; and in a UK deep retrofit programme involving 119 housing units. Reasons for this "gap" abound. There are high implicit discount rates; market failures of various kinds; sundry barriers to optimal practice; and people who are – can you imagine? – downright ignorant of the energy implications of their actions. Yet every year there are more demonstration projects and research efforts trying to overcome the odds.

Given forty years of experience with super-efficient technologies that are never quite what they seem, why is there still so much effort devoted to trying to prove to yet another new audience that efficiency works? Albert Einstein defined "insanity" as doing the same thing over and over and expecting a different result. Are efficiency advocates crazy, or is there another motivation for the continual cycle of efforts that don't quite do

1. The lead author is indebted to a facilitator of a 2007 World Business Council for Sustainable Development workshop for this terminology. His name is not remembered, but his terminology is.

what they promise? This paper uses different kinds of stories as a framework for explaining why energy efficiency advocates seem to do the same thing over and over again.

Our paper starts by describing some possible narratives that could explain the apparent insanity of energy efficiency technology demonstration projects. Next, we provide a brief description of common story types that are relevant for the energy field in different ways, with a particular focus on "hero stories" and "learning stories," although we also discuss "horror stories" as a foil for hero stories. We then present some case studies to show how these story types are used in practice, showing how hero stories are far more common than learning stories. The case studies also show that our stories are fragmented, confusing, and incomplete. This results partly because of differences in the types of stories that can be told, as well as our inevitable lack of omnipotence. The "story" of a building is a variable subject that evolves over time. It is continually influenced by physical and social contexts from its initial conception to its eventual demolition or selective perpetuation. As part of our discussion, we sketch the relationship between story types, building lifecycle stages, research options, and policy interventions. Finally we make recommendations for resolving the fragmentation of the narrative arc in energy research. We argue that telling more learning stories will balance and develop the inspiration provided by hero stories, rather than undermining their importance. We also suggest that we may need to develop our ability to tell yet another kind of tale – the love story – to explain why better buildings are worth the effort.

Possible Narratives

Let us first assume that we are not crazy, and there is some method to the madness. The authors argue that narrative devices can help us understand and perhaps even change the patterns common in our field. To begin with, let's look at some possible explanations for why people still set the scope for demonstration projects higher than what history tells us is likely to be achievable. What kinds of characters do this sort of thing? With what motivation?

THE BIG PRINT GIVETH, AND THE SMALL PRINT TAKETH AWAY[2]

If efficiency advocates aren't crazy, maybe we are simply shysters making empty promises to achieve personal gain. In a song called "Step Right Up", singer/songwriter Tom Waits riffs on a salesman's extraordinary promises for an undetermined product. It is the sound of a con-man, where everything is a bit too good to be true:

> That's right, it filets, it chops, it dices, slices … Never stops, lasts a lifetime, mows your lawn […] and it picks up the kids from school, it gets rid of unwanted facial hair, it gets rid of embarrassing age spots, it delivers a pizza, and it lengthens, and it strengthens, and it finds that slipper that's been at large under the chaise lounge for several weeks …

Sound familiar? Green building, renewable energy and efficiency projects that promise economic, social, and environmental benefits aren't far off the mythical product in Wait's song. People are getting disillusioned with promises of triple-bottom lines and win-win solutions. It can start to feel like a swindle, a boondoggle.

Sometimes it may be a boondoggle. The well-publicized failure of a US cylindrical solar tube manufacturer called "Solyndra" created headlines and a political scandal. President Obama visited the plant, his administration backed the company with a grant of $535 million, and the company went bankrupt in August 2012 (Greene 2012). There is currently a criminal investigation underway to see whether the company misled the Obama administration about its financial health. Another recent article in the same vein cites the high cost and poor performance of many "green" schools, including one that consumes 19 % more energy than a conventional school and 65 % more than planned (Frank 2012).

The moral of these stories might be "things are not always what they seem," or "be careful whom you trust."[3] But does one financial failure and some badly performing buildings mean that green energy and energy efficiency advocates are crooks who routinely oversell the value of their products?

Most people expect their actual mileage to vary from the fuel efficiency ratings of their car. That isn't seen as a swindle, it is just the way things are. It says "your mileage may vary" right on the label (at least in the US), even though it doesn't tell us how much variation to expect.

If we *do* oversell, how much excess promise is reasonable, and how much is negligent?

WALKIN' ON THE SUN[4]

Perhaps "negligent" is too harsh. If energy efficiency isn't an intentional swindle, perhaps we are just too excited by our own ideas to apply them judiciously. In the Greek myth of Icarus, a father and son needed to escape from a king who was holding them captive (a cruel payment for performing the significant service of building the Labyrinth). The father made wings out of wax and feathers for himself and the boy so that they could fly away from the employer-turned-captor. The father warned the boy not to fly too close to the sun or too close to the sea. In his excitement at being able to fly, the boy flew too close to the sun, the wax melted, and young Icarus tumbled into the sea and drowned. This story is a lesson in the value of moderation, as well as heeding advice given by someone wiser. The consequences of excess can be dire.[5]

Are efficiency advocates more like Daedelus, the inventive father, or Icarus, the excited son? Do we know how to take a middle path between the sun and the sea, and not be tempted to throw caution to the wind? Can the vigorous and careless pursuit of energy efficiency expose us to danger and death?

Actually, it can. In 2010, an Australian program to install foil insulation was suspended after it was associated with four deaths and two significant electric shocks due to improper installation (Maiden 2010). Compact fluorescent lightbulbs have been shown to emit carcinogens when switched on (Ward

2. Lyric from "Step Right Up" by Tom Waits, off the 1976 album *Small Change*.

3. Or maybe it is "watch out for fluctuations in the price of silicon." Another interpretation of the facts in this case suggests that the drop in the cost of silicon interfered with Solyndra's business plan by giving their competitors an advantage.

4. Song title from the band Smashmouth, from the 1997 album Fush Yu Mang.

5. http://wiki.answers.com/Q/What_is_the_meaning_of_the_story_of_Icarus.

2011), and they contain mercury, which needs to be disposed of properly (but often isn't).

So maybe there is a bit of Icarus in us.

WE COULD BE HEROES[6]

A more positive interpretation of effort spent in pursuit of unlikely success is the "hero story." Heroes are neither frauds nor fanatics. They are noble, selfless do-gooders who help the needy. They believe a better world is possible and are willing to surmount incredible odds to achieve it. This is equally true in biblical stories (e.g., Moses holding back the Red Sea – with the help of a powerful ally – to allow safe passage to Israel) and comic books (e.g., Superman leaping tall buildings to save Lois Lane).

This characterization of an efficiency advocate is more appealing than the others. But where is the adversary to be conquered? Energy waste isn't exactly a supervillain. And inefficiency isn't exactly evil. So can we be heroes if the force to be reckoned with is actually … ourselves?

IN PRAISE OF STORIES

The characters and characterizations above introduce the central theme of this paper: the relationship between energy research and story telling. Whether we like it or not, people communicate with and through stories. Characters appear in the most unlikely places, evolving out of the adjectives and verbs we use to describe phenomena that we study. For example, an anthropologist has shown how the language in high school health science textbooks regarding the interaction of an egg and sperm can be read like a romance novel, replete with gendered roles and heroic deeds (Martin 1991). This kind of anthropomorphism exists in many, if not all fields, although it is often eschewed deliberately in the sciences in an attempt to preserve neutrality. The editor-in-chief of the journal BioEssays has called for an end to "anthropomorphic terminology" that evokes "*will*, *direction* and *strategy* in evolutionary processes."(Moore 2011) We respect his effort, but given that humans are human, we suspect that most people will continue to see will, direction, and strategy in the world around them, even if they study phenomena at the cellular level. Such anthropomorphisms help the researcher to tell a story, which is – simply put – much more interesting than articulating a sequence.

In this paper, we argue that recognizing relationship of stories to energy research is important and useful for several reasons. First, it is unavoidable. Science is not neutral, and policy is certainly not. Given that stories *will* be told, is there something we can learn from thinking consciously about storytelling, rather than unconsciously telling a story? Whether the audience is policymakers or the public, people react to familiar narratives. Are the stories we tell good ones? What embedded messages do they contain? Could they be more coherent and compelling? The authors believe that there is something energy research and policymaking can learn from storytelling that will help us get the energy efficiency story straight(er), develop our characters, and most importantly, engage our audience. These improvements are essential to motivating changes in practice, as well as perpetuating them.

6. Lyric from the song "Heroes" by David Bowie and Brian Eno from the 1977 album of the same name.

A Brief Description of Story Types

In this section, we set out a brief description of three different types of stories, as well as their common uses. Readers should be aware that this is a quick tour of story types, based mainly on web searches rather than an expert assessment of the finer points of folklore. Nevertheless, this foray into the realm of narrative helps to ground our discussion in a broader context. Following this discussion, we will turn to the ways in which each of these story types manifest in the energy field through three case studies.

HERO STORIES

Hero stories have a proud lineage, tracing their origin back to Greek myths and beyond. Joseph Campbell's *A Hero with a Thousand Faces* (1968) is often associated with this storyline, which he called the "monomyth" or the "hero's journey." It has been called the "universal story", and here is the basic plot:

> A hero ventures forth from the world of common day into a region of supernatural wonder: fabulous forces are there encountered and a decisive victory is won: the hero comes back from this mysterious adventure with the power to bestow boons on his fellow man. (Campbell 1968, p. 30)

Campbell maps the hero's journey as a circle with dual layers of progress, an outer journey (see Figure 1) and an inner journey (see Figure 2). These journeys have various stages, and they start and finish in the ordinary world. But many of the tests and challenges occur in a supernatural or "special" world. In the archetypal hero story, the hero accomplishes feats in an imaginary world, but somehow manages to save his or her own. The psychological cycle of the inner journey is familiar, but seems more personal and less heroic. There are no magical elements, but there is a pattern of learning, which we will return to later in the paper.

The outer hero's journey is the one we are most familiar with, as it shows well in films. Thrillers often make some part of the real world into a "special world", a private crucible for the hero to battle the villain. Think, for example, of all the situations where communications with the outside world are severed: by cutting the phone line, crushing a mobile, or jamming broadcast frequencies. The classic action film "Die Hard", for instance, takes place in an ordinary office building (after the phone lines are cut). Within this normal but now separate world, the hero battles villains in spaces that are interstitial and unusual: elevator shafts, HVAC ducts, the roof, floors that are under construction, and service spaces. These battles are the crux of the traditional hero story, but they barely exist in the energy hero story.

The energy hero story has some recognizable elements of the traditional structure. Chief among them is that most of the heroic acts occur in the special world of the future, or the imaginary world of technical potential. This is an imaginary world shared by energy researchers, where building physics reigns supreme over users who act in supernaturally predictable and average ways. Whether it is a silver bullet (one technology) or a silver buckshot (a combination of things), energy-efficient technologies and strategies often promise to be the magic elixir that will save us from climate change. Or is it from spending too much money on heating? Or avoiding waste? Anyway, the

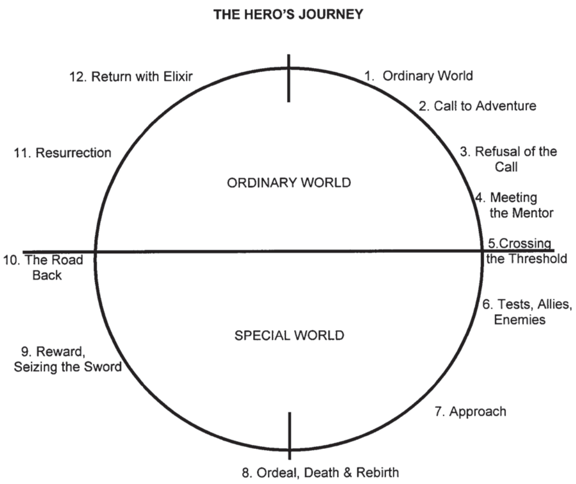

Figure 1. The Hero's Journey.

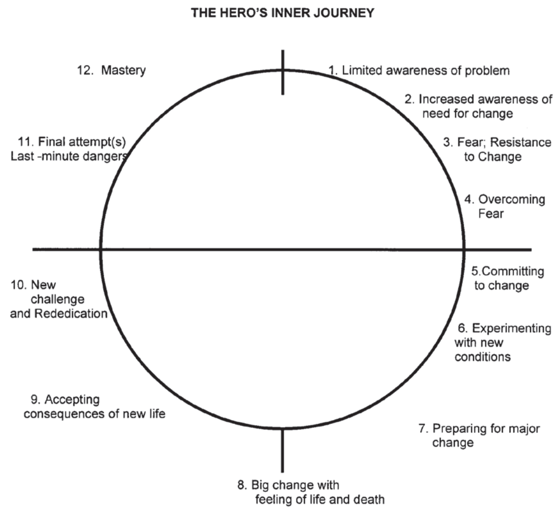

Figure 2. The Hero's Inner Journey.

UK government has developed a hero story to guide its future by proclaiming that all new homes in the country *will* be zero carbon by 2016. This hero story, where we are saved by clever technologies, is inspiring, positive, and familiar. In this story, we don't need to do anything because the technology will do it for us.

Oddly, however, the central characters in the energy version of the hero story are missing. The "hero" in an energy hero story is actually a technology or a set of technologies rather than the person or group providing them. These technologies must triumph over … what exactly? As mentioned earlier in the paper, energy hero stories are missing an important element in their narrative arc: a proper foe. Apparently, we are battling ourselves.

Although the energy hero story deviates from the traditional hero story in some important ways, this storyline's emphasis on universal patterns intersects with another characteristic of energy research. Schweber and Leiringer (2012) recently explored the intellectual contours of the energy and buildings research literature. They found that almost 80 % of the literature takes what they call a "positivist" approach to the material. This approach uses a natural scientific method and focuses on identifying patterns between variables. Campbell's work on the hero story suggests that there is a template that unifies heroic activity across time, space, and cultures. The positivist research approach also seeks generalizable theories that transcend their immediate context, therefore they share an alignment with hero stories.

In contrast to the universality of the hero story, a learning story focuses on the search for meaning in specific times and places.

LEARNING STORIES

The best known type of learning story is the fable. Fables are short stories designed to teach specific life lessons. They occur in overly fictitious settings with stylized characters that are not meant to be realistic (Teachfind). For example, central characters are often animals that speak like humans.

For this paper, we focus on a later form of learning story that is set in the real world and used for both research and teaching, usually of children. Learning stories are used to document educational development (Carr 2001; Carr & Lee 2012). They have a theoretical base in sociocultural theory (Hill). In this tradition, learning occurs in authentic cultural locations rather than in fictionalized or "special" spaces. The learning story anticipates that the specific context, location and people involved will all play a part in the learning process. They provide us with a picture of real people in real situations, struggling with real problems.[7] No one in a learning story is seeking a magic elixir unless that means acquiring the ability to read and write.

From a energy research perspective this narrative form dovetails with what Schweber and Leiringer (2012) call an "interpretivist" approach. Interpretivist research accounts for only about 20 % of the energy and building literature. In contrast with the hero story, which takes place largely in an imaginary world, learning stories in both their original form and their energy counterparts occur in all the living colour and idiosyncratic elements of the real world. Learning stories don't form universal patterns that can be mapped. There are no heroes, and no villains. In a learning story, protagonists are normal people who need to rise to a challenge. They are not saved by Superman or a deus ex machina dropping from the ceiling: they have to save themselves. The learning story in energy policy lies in between the technical potential and what is achieved in practice. The learning story is what commissioning tells us, and what post occupancy evaluation reveals. The learning story can be difficult and contentious. It is less soothing than the hero story, as it asks for participation, reflection, and does not provide a single truth.

HORROR STORIES

If the other story types exist to be inspiring or educational, horror stories are scary. Much of the discussion about horror stories has to do with the construction of evil and its relationship to the real world. One website that gives advice on how to write a horror story suggests:

> The center of any horror novel is the fear, rational or not, within the main character. The main character […] should

7. http://www.authenticearlyyearslearning.com/learning-stories.html.

> begin as a hapless victim of the overpowering evil, and should be a good person. Though the fear can be of a psychological nature, […] there should be some supernatural or unexplained entity or mystery whose solution is outside the realm of typical understanding.
>
> The evil should begin as an invisible force. In fact, it will often appear at the beginning that the main character has created the evil in his own mind. The evil […] should be sinister, and should only reveal its true self slowly as the story progresses. Regardless of what shape it finally takes when its presence is known (demon, vampire, person, etc.), its power and intent should be obviously evil and supernatural.(Brown 2001)

Other elements include disbelief of people close to the main character about the evil threat surrounding them all. Stewart (1982, p. 33) also suggests that horror stories excel at working through the "possibilities offered by information unfolding in time." The tension and excitement created by suspending information rather than delivering it quickly is an important element in the horror story.

Given the above, it isn't surprising that climate change has been used as the "horror" in films like *The Day After Tomorrow*. It is invisible to the naked eye, and it is supra-natural if not supernatural. There are many disbelievers, and time is certainly an important element in the story. But what is the energy equivalent of a horror story? The authors submit that it the tale no one wants to tell. It is a story of failure, of technologies that did not perform as promised. The fear is not in the central character, the fear is in the teller. There are fears of a fallen hero, fears of project requirements unsatisfied. Abraham Maslow's law of the hammer (1966) suggests "if all you have is a hammer, everything looks like a nail." We suggest that the overemphasis on the hero story in energy research is like Maslow's hammer. In moving from the imaginary world to the real world, the hammer bangs into something that is not a nail. And the hammer, or the energy efficiency advocate, feels fear. By adding more learning stories to the energy toolkit, we submit it is possible to move beyond binary hero/horror or success/failure frames.

Stories in Practice: Three Cases

In this section, we use three case studies to examine how energy hero stories "fail" in practice. The cases are: a "green" academic building in the US; a European renewable and rational use of energy project in the UK, Corsica, the Netherlands, and Spain; and a UK deep retrofit programme involving 119 housing units. In each case, researchers were asked to evaluate the projects. In each case, there was pressure of various kinds for the research to prove the hero story rather than challenging or changing it. We argue that by adding a learning story to the hero story, the "failure" turns into an educational opportunity.

TALES OF ENERGY EXPECTATION IN A GREEN ACADEMIC BUILDING[8]

This story is about a building of modest size, constructed with great expectations. The Adam Joseph Lewis Center (AJLC) for Environmental Studies at Oberlin College (Oberlin, Ohio, USA) has enjoyed considerable critical acclaim. It has received architectural awards from the American Institute of Architects, construction awards from national and state contractors organizations, an Ohio governor's award for energy efficiency, and been named one of the thirty "Milestone Buildings for the Twentieth Century" by the US Department of Energy. An early model of the building is included in an architectural textbook on the interactive effects of buildings and the environment (Fitch & Bobenhausen 1999: 336), a diagram appears in a popular environmental science textbook (Miller 2001: 537), and it has been the subject of numerous articles in the press. Part of its notoriety has to do with its star architectural team, William McDonough + Partners, which is famous for several sustainable buildings as well as a book on the topic of sustainability (McDonough & Braungart 2002). Part also has to do with the dedication and eloquence of its on-campus champion, David Orr, who is a prolific writer, a dynamic speaker, and has published several articles about the AJLC's design process (Orr 2002, 2003b, 2003a). It is a two storey 13,600 square foot building with three classrooms, a library, an auditorium, six offices, a conference room, and a kitchen. It also houses a "Living Machine" that treats and internally recycles wastewater from within the building.

The AJLC Hero Story

The AJLC was designed to be a building that teaches. In the words of David Orr, the chair of Oberlin's Environmental Studies Program, the project team wanted a building that would "help redefine the relationship between humankind and the environment – one that would expand our sense of ecological possibilities" (Reis 2000). An early design intent associated the AJLC was that the 60 kW photovoltaic array on the roof would produce more energy than the building consumes.

There are several different ways in which this intent has been interpreted. The strongest version of this claim is that the AJLC would be a "net energy exporter" on an annual basis (Gabrielli 1995). A second version reports that the building will be a net energy exporter "at times." (Fitch & Bobenhausen 1999: 336) A third interpretation is that the building will "evolve into" a net energy exporter (McDonough + Partners 2004) Audiences expecting the strong version of the design intent to manifest in practice have been disappointed to learn that the AJLC is not currently a net annual energy exporter. However, the second version of the claim is true. On sunny summer days when the air conditioning is not running, the building does produce more energy than it consumes. Whether or not the AJLC will *eventually* become a net annual energy exporter, as the third interpretation suggests, remains to be seen. This version of success depends partly upon further reductions in annual energy use and partly upon replacing the existing 60 kW rooftop photovoltaic array with more efficient solar cells which will (theoretically) be available in the future.

The AJLC Learning Story

To monitor and assess precisely these kinds of issues, the AJLC is overflowing with monitored data. Funded in part by a grant from the Andrew W. Mellon Foundation and installed in collaboration with the National Renewable Energy Laboratory, there are 148 data points that collect data on the flow of energy and matter through the building and its landscape (Petersen

8. Text for this section taken largely from Janda and von Meier (2004).

2002). These sensors collect data on a minute-to-minute basis, and their real-time reflection of the relationship between the building and the environment is posted on the web and displayed in the atrium lobby (see http://www.oberlin.edu/ajlc). These data and the graphs they create provide a quantitative frame through which to view the AJLC's contribution to environmental problem-solving.

What is interesting about these data is that they seem to create more controversy than they resolve. In addition to the data points monitored by the Environmental Studies Program faculty, there are additional data available through a separate energy monitoring system and tabulated by a faculty member in physics. The raw data collected by the sensors are not disputed. However, there has been some disagreement regarding the interpretation. Depending on the time period chosen to analyze and the context selected for analysis, the AJLC uses either more or less energy than its peers.

In terms of its site energy, Petersen (2002) shows that the AJLC's gross energy consumption between April 2001 and April 2002 was 30,000 Btu per square foot. Compared to a national average reported for educational buildings, this is roughly 62 per cent better than normal. Compared to nine other buildings on Oberlin's campus, the AJLC's energy performance is 64 per cent better. When the production of energy produced by the AJLC's extensive PV array is included, its net energy consumption is just 14,000 Btus per square foot. This figure suggests that the AJLC imports only 17 per cent of the average energy consumed by Oberlin's other buildings.

While these numbers seem definitive, Scofield (2002a, 2002b, 2002c) uses the same data sources to paint a different picture. Instead of focusing on the amount of power generated by the PV array, for instance, it is possible to look at the differences between actual generation and projected energy output. From this perspective, Scofield shows that total energy production from the AJLC's PV array for 2001 was 15 % below projections. This kind of deficit is typical for PV arrays, yet it affects the AJLC's ability to meet its annual load without assistance from the grid. In terms of energy consumption, Scofield uses data from January 2000 to December 2001 to show that the building used 48,000 Btu per square foot. Using this number as a basis of comparison, the AJLC's gross energy use is only about 37 % better than the average educational building in Ohio's climate. Moreover, Scofield argues that a better basis for comparison should be source energy consumption, not site energy consumption. Because the AJLC is all-electric, any electricity not produced with its own PV array is most likely generated by burning coal in a local power plant. This process is only about 33 % efficient, which means that the source energy requirements of the AJLC are 144,000 Btu per square foot – 11 % to 17 % greater than comparable buildings. Because the AJLC does not meet its entire annual energy budget with its own PV array, Scofield suggests that the as-built AJLC may have been "greener" if it was not all-electric.

If the AJLC "succeeds" according to one quantitative analysis and "fails" according to another, what are readers of either or both analyses to make of these interpretations? To some degree, the difference between these assessments stems from koan-like questions about whether it is better to see the glass as half-full or half-empty.[9] Both Petersen and Scofield assess the AJLC's performance over time, but their analyses use different time periods. Scofield uses data from the building's initial operation; Petersen uses data from a later period. If buildings have a learning curve, the part of the curve selected for analysis inevitably influences the results of the assessment, as does the basis for comparison. Unable to reconcile differences between these viewpoints, what many people on the Oberlin College campus take away from this debate is that the AJLC just plain "doesn't work." Or worse, that either its advocates or its attackers are lying. Faculty within environmental studies (e.g., Petersen) were expected to uphold the hero story against the "attack" by the faculty member in physics (Scofield). The newest faculty member (Janda) tried to stay in the middle by showing that neither story was more true than the other. In 2012, more than a decade after the AJLC opened its doors, its performance is still a subject of controversy and scholarly interest.

RETROFIT FOR THE FUTURE: RIGHT HERE, RIGHT NOW

The Retrofit for the Future (RfF) is a demonstration programme organised and funded by the UK's Technology Strategy Board. Launched in 2009, the programme intended to demonstrate that the ambitious target of 80 % carbon emission reductions could be met by 2050 by installing low-carbon interventions and innovative technologies in the existing housing stock (TSB 2009). The programme involved deep refurbishment of 119 low-rise social housing units in total, through 86 projects across the UK. £17 million was budgeted for RfF to enable the building sector to drive refurbishment in social housing. Through a competitive process, grants of up to £150 k per project were awarded to successful project teams (architects, building companies and organisations as well as housing associations and social landlords).

The overall aim of the design teams was to use innovative solutions and multiple systems integrated into a 'whole house' approach to achieve the best possible standards of energy efficiency and make deep cuts in carbon emissions. Low-carbon retrofit interventions were determined by technical specifications, performance baselines, CO_2 and primary energy targets provided by the TSB. The targets set out for assessment were based on a reduction of 80 % from the 1990 figure and calculated with the Standard Assessment Procedure (SAP) 2005 and the Passive House Planning Package (PHPP) using the average baseline figures for an 80 m^2 semi-detached house (Ruyssevelt 2011; EST 2009). In their proposals, a number of design teams set the bar even higher using the Association of Energy Conscious Builders (AECB) passive house technical standards (AECB 2007). Some of the RfF projects and design teams have achieved architectural awards and received media attention. For example, the RfF retrofit solutions undertaken in a 1990s mid terrace house won a 'Best small housing project' awards from the Architects' Journal (AJ) (Oxford Brookes University 2013b). Another RfF project, a Victorian end terrace in Oxford, was written up in the Oxford Mail and BBC News. These stories highlighted the deep reductions achieved in the project (Bardsley 2011, August 27; BBCNews 2011).

9. A "koan" is an unanswerable question used in Zen teaching. An example of a koan is "what is the sound of one hand clapping?"

The RfF Hero Story

The RfF hero story has two different versions, depending on the tellers. The RfF hero story was not only about 80 % carbon emission reductions through innovative technologies and whole house approaches. It was also about bringing substantial savings to social tenants' bills. For project teams, the main "hero story" is the extent to which their design refurbishment solutions met the competition's emissions reduction targets. However, for the occupants living in the RfF properties, the "hero story" revolves around overall improvement of indoor comfort levels and reductions in their energy costs. Although many different stories can be told about RfF (see Topouzi's independent 2013 eceee paper), we focus on only one example here due to space constraints: the Oxford Victorian terrace house.

From the media's perspective, the 'Victorian terrace big eco makeover' in Oxford is a successful example of an RfF project:

> The idea is to cut the amount of carbon emissions from the property by 80 per cent – and less than six months in, it is already showing a reduction of 85 per cent. (Bardsley 2011, August 27)

At the same time, the project's leader clarifies:

> … the house uses 85 % less gas and electricity when compared to conventional homes … and produces 80 % less CO_2 emissions than conventional homes. (Oxford Brookes University 2013a)

Although it is not clear in the article whether the carbon emission and energy bills reduction is compared to post-refurbishment levels, modelled targets or a typical 80 m^2 semi-detached house, the hero story is successful as the project achieved its goal numerically.

For the occupants—a couple who had lived in the Victorian terrace house for 21 years—the success of the low-carbon refurbishment was evident both in the reduction of energy bills and overall indoor comfort in the house. The couple's lived experience in the pre-refurbished building was a very cold, damp and draughty environment with poor light levels and extreme temperature differences between rooms and floors. It was difficult to heat due to poor building fabric and the rising fuel costs. Their past experience with the property provides a baseline that allows them to compare and understand the change between the past and post-refurbishment environments. This baseline also sets the level of success for their hero story. As the occupants explain, there was a significant reduction in their utility bills:

> … [male] we had a big-big drop … it was around £600 per period [quarterly payment] and now it is £150 … [female] the electricity was £80 so we've reduced the standing order down to £29 on the electricity a month and I think is about £28 on the gas and they were £44–45 … (occupant interview 07/09/2011)

The comfort levels in the house have also changed. Significantly, the levels of light, temperature and indoor air; have made the occupants feel warmer, better, and overall very satisfied with the low-carbon improvements.

In both of the above versions there is no question about the project's success. Some ambiguity, however, derives from a closer inspection of the different baselines (actual vs. modelled/ estimated/ average) that were used to define the hero story.

The RfF Learning Story

There is still very little evidence in the UK regarding deep refurbishments that implement low-carbon 'whole house' approaches. The RfF programme plans to contribute to this field by providing insights into the designed, 'as built' and actual performance of such interventions. These insights will also feed into the overall evaluation of retrofit processes, helping to shape the efficient delivery of future similar schemes. Hence, all demonstration projects are participating in an extensive two year quantitative and qualitative monitoring process. These data are to be publically available, allowing future researchers to match quantitative and qualitative data for each project.

Not surprisingly, the evaluation of post-refurbishment monitored data highlights issues related to the energy performance gap between 'as designed' and 'in use.' It also shows the hero stories are not quite as numerically successful as the newspaper stories suggest.

There are two different pairs of numbers that are used to define performance for both gas and electricity in the RfF projects (see Figure 3). The first pair of numbers is based on SAP models. The pre-refurbishment SAP model sets a baseline for "average use" against which different refurbishment packages can be tested in the design phase. The selected set of measures then provides the post-refurbishment forecast. The SAP model allows a level playing field for technologies to be compared, but it is set in an imaginary world where occupants have assumed "typical" behaviours. In contrast, the second pair of numbers are the actual yearly consumption of the house as a system, both before and after the refurbishment. This is performance of the house and its occupants, as measured by meters and monitors, rather than assumed by software.

Findings from the Oxford house indicate a failure of the SAP modelling tool to accurately estimate the performance of the building in the pre-refurbishment stage. Comparing the SAP pre-refurbishment prediction to the actual pre-refurbishment use reveals that SAP overpredicts gas consumption (60 % higher than actual consumption) and underpredicts electricity consumption (33 % lower than actual consumption). Oddly, comparing the SAP pre- and post- models does not yield a set of figures that exactly satisfy the RfF hero story. For gas, SAP predicts the design will result in an 86 % reduction; for electricity, SAP predicts a 59 % *increase* in use. Presumably, then, the "85 % reduction" figure quoted in the newspaper is the SAP design prediction for gas use only. Adding gas and electricity figures together, the SAP pre- and post-estimates result in a combined energy reduction of 81 % in the imaginary world of SAP. Although these numbers do not quite match the newspaper story, they technically satisfy the RfF requirements.

But what if we forget about SAP and evaluate just pre- and post-actual consumption? The actual in-use consumption between the pre and post-refurbishment dropped by 42 % in gas and 28 % in electricity, with an overall measured energy reduction of 39 %. Although this reduction is only half of what RfF promised to achieve, the interesting result here is that the occupants were satisfied anyway. Given that the occupants did not have to pay for the £90,000 cost of the refurbishment, any

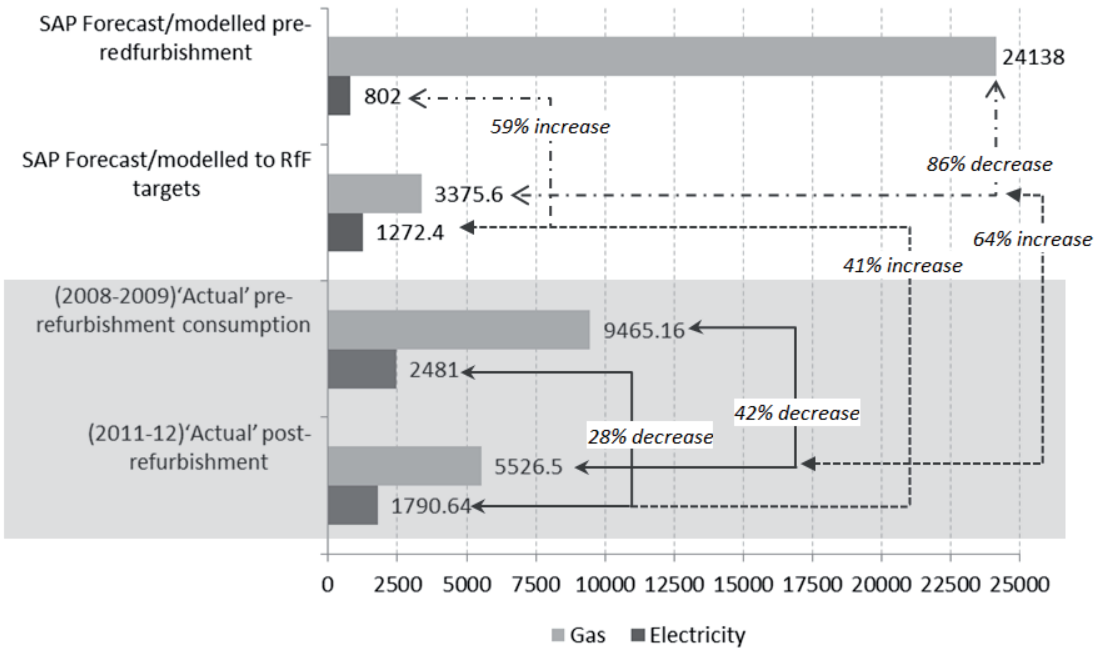

Figure 3. Gas and electricity consumption (pre and post-refurbishment) actual and estimated (in kWh).

discernable reduction in energy costs (even half of what was promised) were no doubt welcome.

The figures above highlight that the hero story can tell a part of the building's story but certainly not full real extent of it. Despite the different numbers between estimated and actual savings, the occupants '…are generally very delighted' with post-refurbished property. What the hero stories do not also include is occupants' 'forgiveness' and 'forget' factors. That is, if occupants like a building, they will overlook some elements that don't work in favour of those that do (Leaman & Bordass 2007). The Oxford occupants like their refurbishment, so even though not everything worked as intended, they were still happy. Even delighted.

CONCERTO => CRRESCENDO => CONFUSION[10]

Since 2005, the European Union has fostered the development of renewable energy and energy efficiency at the city and community level through a series of programs called first "CONCERTO", then "CONCERTO Plus" and now "CONCERTO Premium." Within CONCERTO, European Commission co-funded 22 projects comprising 58 communities and sites that are located in 23 countries in Europe. Each project covers up to four communities and sites in different EU countries. Each site implements different approaches to reach a reduction of CO_2 emissions that are intended to be appropriate for specific local conditions (CONCERTO 2012b).

The CONCERTO initiatives are framed as a research and demonstration program, where innovative energy technologies would be applied in cities and their results be monitored, reported, and disseminated. They aim to explore a broad range of technical and socio-economic issues related to sustainable energy, including:

- innovative technologies ready to be applied
- use of renewable energies sources for cities
- energy efficiency measures
- sustainable building and district development
- economic assessments
- affordable energy
- energy transparency for citizens (CONCERTO 2012a)

cRRescendo was one of the projects funded by CONCERTO. cRRescendo stands for "Combined Rational and Renewable Energy Strategies in Cities, for Existing and New Dwellings to ensure Optimal quality of life." With the assistance of CONCERTO co-funding, the cRRescendo project aimed to integrate a major share of sustainability into thousands of homes in the metropolitan areas of its partner cities: Almere (Netherlands), Milton Keynes (UK), Viladecans (Spain) and Ajaccio, capital of the isle of Corsica. The cRRescendo project started in 2005 and was due to finish in 2010; however, because of complications and delays, the project has received two year-long extensions from the European Commission and finished in 2012.

The CONCERTO/cRRescendo Hero Story

One underlying assumption in CONCERTO is that technological change (in this case, renewable energy and energy-efficient technologies) leads to economic and social benefits. To obtain co-funding from the EC, projects need to prove both technical and social benefits as a result of the co-funded measures. The second underlying assumption in CONCERTO is that change at the city scale will have more impact than change at the building level. The CONCERTO website asserts:

10. Text for this section taken largely from Janda (2012).

> What all sites have in common is the aim to demonstrate that the optimisation of the building sector of whole communities is more efficient and cheaper than optimisation of each building individually. (CONCERTO 2012b).

To provide quantitative data to back up this assertion, a set of socio-economic indicators were developed at the CONCERTO level to help evaluators gather and compare results between and across the 22 projects. There are 30 indicators divided between eight issue areas covering different aspects of social, environmental, and economic benefits.

The orientation of the CONCERTO indicators illustrates the expectation that the CONCERTO projects would have a significant enough impact on a local area that the project could be seen to influence not just the project participants but also the wider community. "Stimulation of the Local Economy" was a socioeconomic issue area containing seven indicators to evaluate the economic relationship of the CONCERTO project to the larger community. In addition, two other issue areas asked for the contribution of the project reducing to overall emissions reductions and affecting the energy generation mix in the area.

The CONCERTO/cRRescendo Learning Story

From a cRRescendo perspective, the CONCERTO indicators had a poor fit with most of the local projects, both before and after the project began. A major complication for cRRescendo was the global financial downturn that began to manifest during the latter half of 2007. As banks and financial institutions struggled, new construction projects were either put on hold, changed, or cancelled. As wider expectations of growth were downsized, CONCERTO plans in all the cRRescendo cities were also delayed and/or downsized. For most cRRescendo cities, plans shrank in scope from large scale community projects to smaller scale projects including just a few buildings rather than whole neighborhoods.

Initial participant population estimates for the cRRescendo projects ranged from 3 % to 10 % of the total population. Even at these numbers, it is a stretch to assume that any of the cRRescendo plans would satisfy the CONCERTO goals of stimulating the local economy, creating new businesses, changing community demographics, or reducing local emissions. However, after the reduction in technical scope that occurred during the course of the project, it is even harder to imagine that projects in Ajaccio, Viladecans, or Milton Keynes would have any observable, let alone measureable effect on these areas. Final percentages of the city residents who participated in these projects were less than 1.5 %, and the highest participant percentage in Almere was just 3 %. So why were at least a third of the EU evaluation indicators asking for quantitative data to "prove" impacts that were vanishingly small and highly confounded with other variables?

Although "stretch" goals can be used with good effect in voluntary environmental projects (e.g., the "platinum" level in the US Green Building Council's LEED program), they did not serve this purpose within cRRescendo. Far from stimulating the project partners to do more or think creatively to reach toward the larger CONCERTO goals, the poor fit between the CONCERTO indicators and the project achievements resulted in a feeling of defeat for project partners. Accordingly, the partner cities in cRRescendo provided very little data to CONCERTO evaluators on the environmental, social, and economic indicators.

Discussion

The case studies above should come as no surprise to anyone who has studied research and demonstration projects of any kind. We know that the thing we promise will not be all that we have suggested. The weavers who sold the Emperor his new clothes in Hans Christian Andersen's famous fairy tale *knew* he would be naked. But only a little child had the social freedom to point out that the Emperor was wearing nothing at all.

What social freedom do we have as researchers to tell things as we see them? Why does it feel like a betrayal and a professional faux pas to mention that the supposedly perfect and highly ornamental gown of social, economic, and environmental benefits is … a bit patchy in places?

Part of the problem, of course, is that people of all kinds love hero stories. Hero stories create drama and excitement. Who doesn't love a little drama and excitement? We also want to be policy relevant. And policy makers love hero stories. We also want to get funded. Funders are drawn to the kind of certainty that the hero story provides.

What this means is that the hero story is not going to go away and be replaced by the learning story. However, the hero storyline doesn't need to be replaced. It needs to be augmented. Every hero story has at least one learning story within it, as Joseph Campbell's depictions of the hero's outer journey and hero's inner journey suggest (Figures 1 and 2). Our cases studies support this interpretation. In our experience, if you scratch the surface of a hero story, you will uncover a learning story. Hero stories play a different role than learning stories do, and this role is important. What we argue below is for greater recognition of the importance of the learning story, as well as the inevitable linkages between the two story types as time unfolds in the real world. Moreover, there are far more opportunities for learning stories to be explored than are currently recognized. For the field of building performance, there are almost endless opportunities to engage people of many different kinds in developing learning stories that have direct relevance *to them*. Building performance is a situated learning opportunity, waiting to be unwrapped. But to unwrap these opportunities, we have to be willing to let the hero stories change, develop, and alter into a myriad of learning stories.

Table 1 shows the relationship between world types, building lifecycles, story types, research & evaluation methods, and policies over time. The concept of building lifecycles will be familiar to most readers, as is the implicit relationship between the types of research, evaluation, and policies that can be applied at different stages of the building and/or rebuilding process. For instance, it is not possible to do a post-occupancy evaluation on a building strategy that is in its design phase (either as a new build or retrofit). To this more familiar sequence, we add the elements discussed in this paper and call attention to the shifts that occur between stages over time.

THE IMAGINARY WORLD

The energy hero story is strongest and most prevalent in the imaginary world of ideas. This is when the program for the (re)building is formulated and design concepts are developed.

In the case studies above, the strongest version of the AJLC hero story – where the building produced more energy than it consumed – was the earliest one. Researchers and other stakeholders can opine about the great deeds they will do with project X, Y, or Z. Models and forecasting methods spin webs of possibility, based on assumptions about how the world works. Policy makers and funders give incentives to those who spin the "best" web. Codes and regulations are applied to keep worse webs from being respun. They also serve to signify levels of achievement that the projects must meet or surpass.

THE REAL WORLD

When it gets to the real world, things get a bit more complicated for the hero story. Translating ideas into reality is an imperfect business. Between construction and initial occupancy, the real world starts to challenge the imaginary world. As Janda and von Meier (2005) note, there are simply "more ways for things to go accidentally wrong than accidentally right." Commissioning processes may be used to try to resolve differences between design ideas and as-built reality. Certificates may provide information on how the building should perform, and how it does perform. Some accidental discrepancies that can be corrected will be fixed. Other discrepancies, for better or worse, will be left as they are to become part of the lived reality of the building. As time moves on, this lived reality will then eclipse the earlier design intents, whatever they were. Various combinations of the building and its occupants will either learn to live together in harmony or evolve in pursuit of a more perfect union (Brand 1994). Building/owner/occupant combinations that work or achieve some kind of social significance will become success stories, in the sense that they will be maintained and avoid a state of disrepair. This success may not be universal, but people who love something about a building will fight to preserve it.

On the other hand, combinations of buildings/owners/and occupants that do not work, either socially or physically, will fail. The buildings will be vacated and eventually demolished.

ENGAGING IN AND REPORTING ON REALITY

Hero stories have little place in much of a building's actual lifespan. If a building lasts for 30 years (the typical length used for amortization in the US), the hero story is unlikely to be remembered beyond the first few years. The remaining time in the building lifecycle could be spent engaging in learning stories. Yet we spend so much of our time and effort on the hero story that little attention seems to remain for other types of tales to be told. And as the case studies indicated, the prevalence of the hero story serves to frame what researchers and implementers need to deliver to satisfy funding requirements. Absent conclusive data that supports the hero story, researchers and implementers may be concerned about reporting sub-optimal results. Not wanting to risk perceived failure, their choice may be to deliver an overly optimistic interpretation of the data. We hope that introducing the concepts behind these story types

Table 1. Stages, Stories, Evaluations, and Policies.

World Type	Building Lifecycle Stage	Story Type	Research &Evaluation Options	Policy Type
Imaginary	Program	Hero	Modelling, forecasting	Incentives
	Design	Hero	Modelling, forecasting	Building codes and regulations, information
Real	Construction	Transition from hero to learning	Expectation vs. physical reality (e.g., designed vs. as built)	Health & safety, building codes and regulations, information (e.g., Energy Performance Certificate)
	Initial Occupancy (~1-3 years)	Transition from hero to learning	Tuned models; empirical data analysis (e.g., physical and social context; post-occupancy evaluation; variation over time)	Recommended procedures; commissioning requirements; warranties, information (e.g., Display Energy Certificate)
	Later occupancy	Learning / Success => love (?)	Empirical performance; possible new models for renovation; social/cultural impact analysis	Voluntary guidelines (e.g., facility management practices, green leases);
Alternate Endings	Vacancy	Failure / Horror	Economic valuation; possible physical defects	Health & safety; bankruptcy laws; squatters rights
	Demolition	Failure / Horror	Economic valuation	Health and safety; reclamation & reuse

might create some flexibility for researchers and implementers to be able to turn a hero story into a learning story, rather than a failure or horror story.

Conclusions and food for further thought

This paper introduced concepts used in story writing to examine the relationship between promised and delivered results in energy efficiency projects. The authors have argued that "hero stories" abound, and that "learning stories" are less often told. We used real world examples from new build and retrofit projects of different scales and in different countries to show how learning stories are contained within, linked to, and maybe even produced by hero stories. Our case studies call attention to these implicit narratives, which can create conflict when the tellers (e.g., researchers) have to tell one kind of story but have data for the other. By recognizing that both kinds of stories are important, the paper provides recommendations for policymakers, researchers, implementers, and users to resolve conflicts and tensions between different kinds of tales. It also argues for the continued importance of the learning story in energy policy.

In this paper, we have focused on learning stories as a necessary complement to hero stories. We would, however, like to leave the reader with a provocative idea. Perhaps for a sequel to this paper, we could examine the role of love stories. If the goal of environmentalism in the built environment is to get people to care about and for their property, a love story might be an even better metaphor than a learning story. It is something to think about.

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