Communicating Risk

Developing a Framework for Promoting Ammonia Fuel:
How a Dangerous Chemical could lead to a Safer Society

Trevor Brown

Tenth Annual NH3 Fuel Conference, Sacramento, CA

September 24, 2013

Contemporary Marketing Wisdom to Promote Sustainable Behavior:

- **Tell stories, not facts**
  - "Stories are more powerful than data … because they allow individuals to identify emotionally with ideas" (NYT review of Timothy Wilson's "Redirect")
- **Create a positive vision of the future**
  - Not scare tactics: peak oil / climate apocalypse
- **Give people incentives to change behavior**
  - Take into account: we aren't always rational

See Daniel Kahneman's video from National Academy of Science conference "The Science of Science Communication" http://dotearth.blogs.nytimes.com/2012/05/25/daniel-kahneman-on-the-trap-of-thinking-that-we-know/?_r=0
Timothy D. Wilson (University of Virginia, http://people.virginia.edu/~tdw/): "Redirect – The Surprising New Science of Psychological Change," Sept 2011 http://www.hachettebookgroup.com/titles/timothy-d-wilson/redirect/9780316051880/

Marketing Problem:

- Create a positive vision ...

  of a deadly chemical.

  – Ethical questions
  – Political questions
  – Ammunition for opposition interests:
    Safety is NH3's "Achilles Heel"

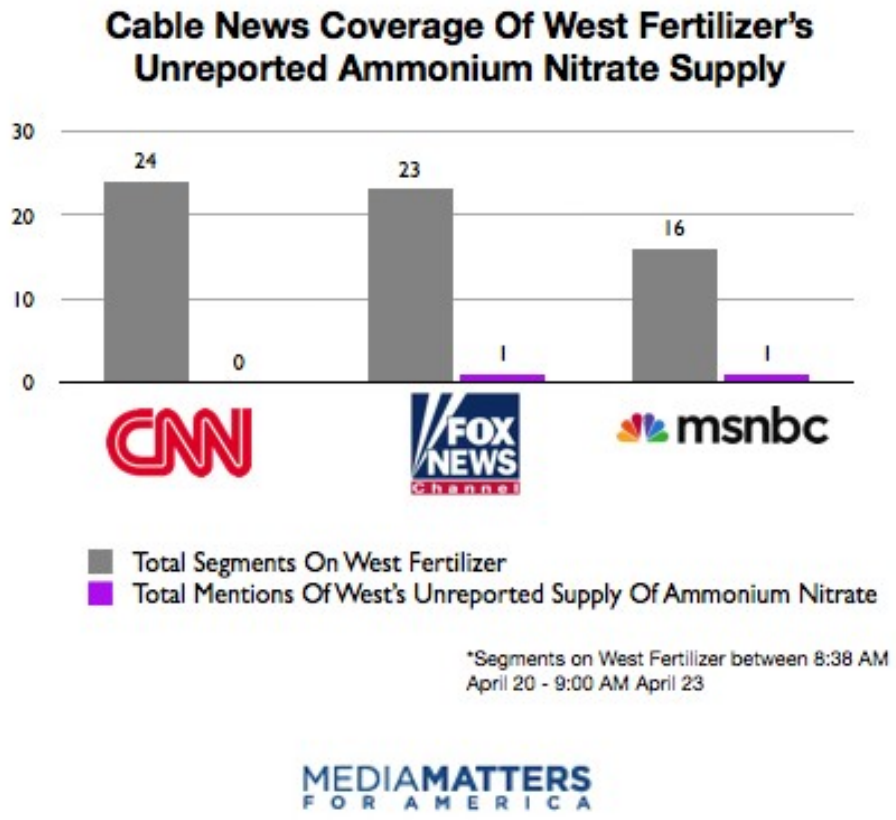
Stories v. Facts: "Is Ammonia Explosive?"

- Technically Correct: "**Yes**"
  Not very helpful. Definition: "Explosive" = "Able to explode"
- Technically Correct: "**No**"
  Not very helpful. Definition: "Explosive" = "Likely to explode"
- Practical Answer: "**Only in very unusual circumstances**"

- Factual Answer: "**Ammonia can only explode in a deflagration if it reaches its lower flammability limit of 16% to 25% with a source of ignition of 1204°F. Or you could get a pressure explosion called a BLEVE – a Boiling Liquid Expanding Vapor Explosion – that may or may not involve an ignition, which occurs when a tank ruptures with pressurized liquid above its boiling point, but they're rare now that our standard safety technology is better**."

- Most Useful Answer: "**You're thinking of Ammonium Nitrate – the fertilizer that exploded at West, Texas. It's what was used in the Oklahoma City bombing. Ammonia is a different chemical. It's in your pee, or your household cleaner. Yes, it can be dangerous – you certainly don't want to breathe it in – but it stinks, so you'll smell it before you're in any danger**."
  Relies upon Factual Answer being available

“You mean Ammonium Nitrate?”



http://mediamatters.org/research/2013/04/23/report-cable-news-ignores-tx-fertilizer-plants/193735

Engineering Solutions

- Experts tell us:
  "**Ammonia is as safe as you want it to be**."
  - True, and we have a 100 year safety record
  - But: fails to engage on an emotional level
  - And: fails to address human nature
- "Guns don't kill people. People kill people."
  The same is often true for ammonia.
  - Why? Because we're irrational, ignorant, afraid, incompetent, greedy, hostile, insane (ie, human)

Clean, safe technology: Engineering Solutions

Natural Gas bus in the US

Natural Gas bus in Pakistan

http://www.buswest.com/
http://www.aljazeera.com/news/asia/2013/05/201352544547450994.html

Classifying the Causes of Industrial Ammonia Accidents

Borrowed from Andy Pearson (Star Refrigeration, Glasgow, UK):

- Operator not trained for job
- System design / Equipment selection flawed

Increased regulation has no effect if safety code is not followed by designers, installers, operators

- System design / Equipment selection compliant but flawed

Complexity of safety code: shortcuts and ambiguity

- Mechanical failure

Even under best practices, accidents will happen: provide worst case scenario protections

See: Andy Pearson's "Making Ammonia Systems Safer," 5th IIR Conference: Ammonia Refrigeration Technology, Ohrid, 2013
http://www.mf.ukim.edu.mk/web_ohrid2013/abstracts.html or video interview: http://www.youtube.com/watch?v=c-yvhZocIVk
http://www.star-ref.co.uk/star/contact-us/andy-pearson.html

Making Ammonia Systems Safer
Andy Pearson:

- "Safety standards have been developed over a period of nearly 90 years … incremental approach … makes it difficult to achieve significant improvement in the light of new information … change is extremely slow … encourages the standard writers to focus on small details which may cause them to miss the big picture."

- "Designers, installers, users of systems and the general public would be far better served if the safety standards were "risk based." This means that the standard would be based on what could actually happen in any specific scenario, with the methods of reducing the hazard based on specific measures to address the particular risks."

See: Andy Pearson's "Making Ammonia Systems Safer," 5th IIR Conference: Ammonia Refrigeration Technology, Ohrid, 2013
http://www.mf.ukim.edu.mk/web_ohrid2013/abstracts.html or video interview: http://www.youtube.com/watch?v=c-yvhZocIVk
http://www.star-ref.co.uk/star/contact-us/andy-pearson.html

Risk Homeostasis Theory

- We have a target level of risk
- We do not minimize the risk …

we optimize the risk

  - Example 1: Advanced Drivers have more car accidents

    "**The effect of a course in driving on slippery roads for drivers of heavy vehicles was studied …**

    A significant increase in accident risk was found for drivers that had gone through the course."

Christensen P, Glad A. "Mandatory course of driving on slippery roads does not reduce the accident risk," Nordic Road and Transport Research 1996; 8:22–3.
https://www.toi.no/publications/mandatory-course-in-driving-on-slippery-roads-for-drivers-of-heavy-vehicles-effect-on-the-accident-risk-article17991-29.html
Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Risk Homeostasis Theory

- We have a target level of risk
- We do not minimize the risk …

we optimize the risk

  - Example 2: BP Risk Management and the Deepwater Horizon

    February 2010:
    "We continue to show our ability to take on and manage risk, doing the difficult things that others either can't do or choose not to do."
    Tony Hayward (BP CEO), BP Annual Report

    April 2010:
    Deepwater Horizon

    January 2011:
    "I do not believe that BP is an unsafe company ... because if you learn to manage risk, a company can actually take on more risk."
    Bob Dudley (BP CEO), Fortune Magazine

http://features.blogs.fortune.cnn.com/2011/01/24/bp-an-accident-waiting-to-happen/

Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Risk Homeostasis Theory

- We have a target level of risk
- We do not minimize the risk …

  we optimize the risk
- **Feedback loops are essential**
  - Example 1: Changing lanes in Sweden, drivers adapt to the perceived risk of their environment

    "**In 1967, Sweden changed from left hand to right hand traffic. This was followed by a marked reduction in the traffic fatality rate. About a year and a half later, the accident rate returned to the trend before the changeover**.

    "**Perceived risk was suddenly significantly higher** … Road users adjusted their behaviour by choosing much **more prudent behaviour** … As a result, **the fatal injury rate dropped**. After some time, however, people discovered—through the mass media as well as their own experiences—that the roads were not as dangerous as they had thought. **The level of perceived risk dropped** … Consequently, road users opted for **less cautious behaviour** and **the fatal injury rate rose again**."

Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Risk Homeostasis Theory

- We have a target level of risk
- We do not minimize the risk …

  we optimize the risk
- **Feedback loops are essential**
  - Example 2: What would it be like with an Ammonia Fuel tank?
    - Do you smell ammonia? (5ppm)
    - If yes, do you still think your Ammonia Engine is still safe?
- So we have a new Communication imperative:
  (credit again to Andy Pearson)
  Communicate the Near Misses
  - Stories of danger averted through engineering solutions: Positive, but maintaining the feedback loop.

Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Risk Homeostasis Theory

- We have a target level of risk
- We do not minimize the risk …

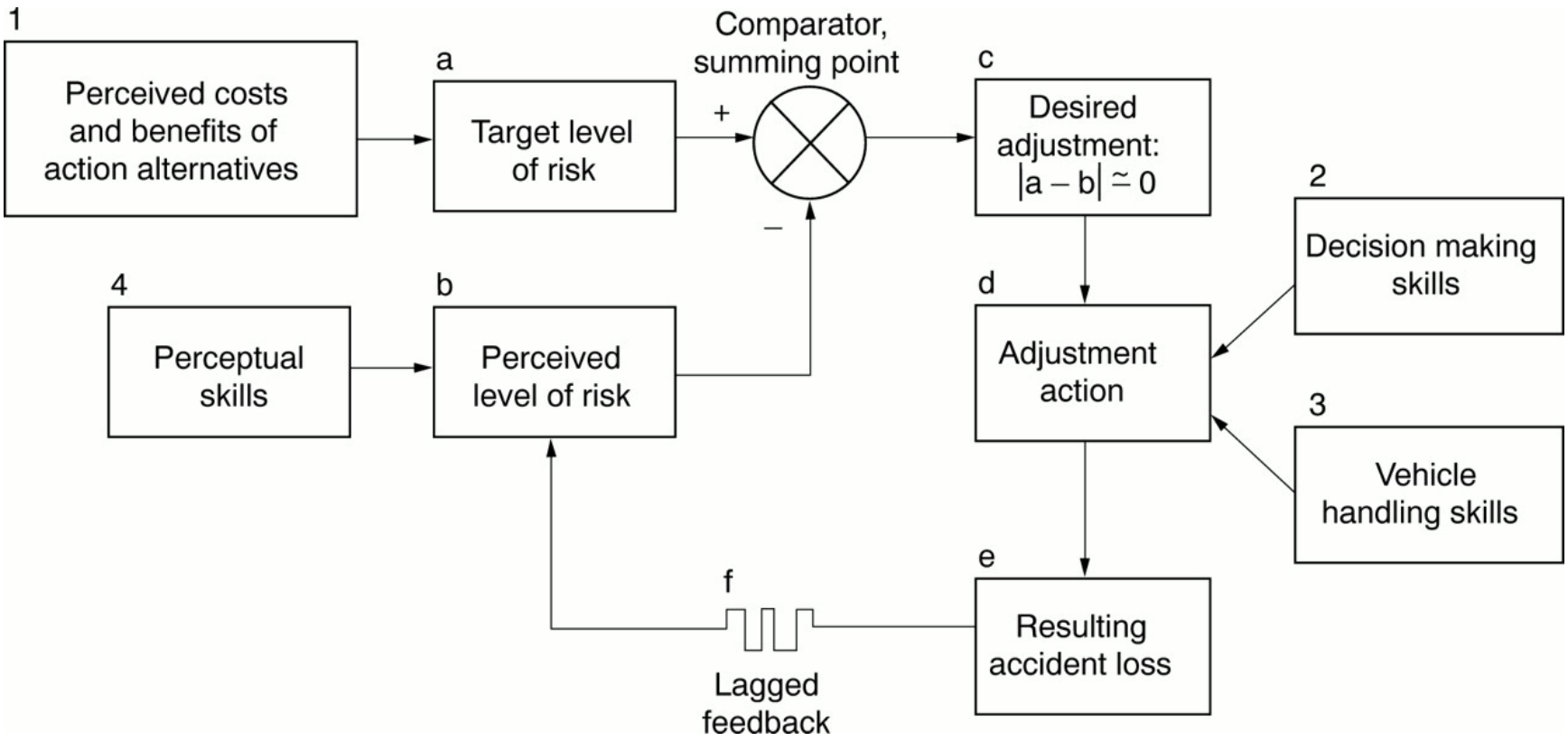
  we optimize the risk
- Feedback loops are essential
- **MOST EFFECTIVE aim of safety planning is**

  not to mitigate dangerous behavior
  not to punish dangerous behavior

  but **to reduce our level of risk tolerance.**

Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Risk Homeostasis Theory



Gerald J S Wilde (Department of Psychology, Queen's University, Ontario) "Risk Homeostasis Theory," British Medical Journal, Injury Prevention 1998;4:89-91. http://injuryprevention.bmj.com/content/4/2/89.full

Why is this interesting?

- The Ammonia Economy could be inherently safer than the Fossil Economy
- "**Fear factor**" and **direct hazards** could very likely **reduce levels of risk tolerance** on an individual and social scale.
- In other words:

Ammonia Fuel Internalizes the Externalities

- A trade off from incumbent fuel hazards
  - Deferred
  - Transferred
- To ammonia fuel hazards
  - Immediate
  - Direct
- Meaningful comparisons await demonstrable NH3 Fuel products and application

Thank you

Trevor Brown
tb@trevorbrown.us
www.trevorbrown.us