Energy and Sustainability Performance

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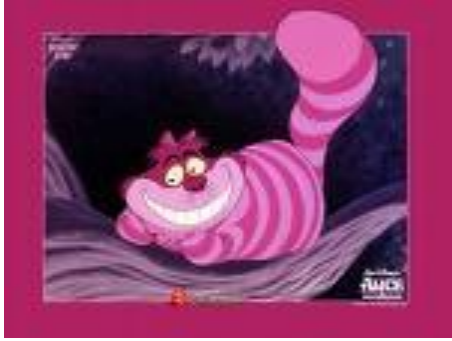
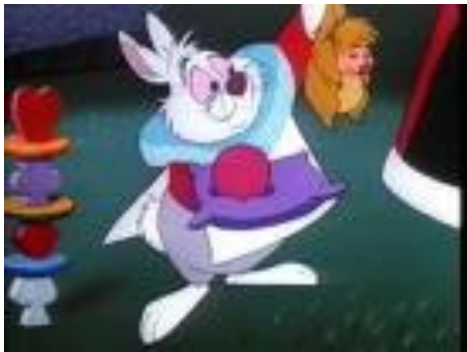
How Do We Make Better Energy Decisions in our "Wonderland" world?



- Where things are not as they seem!
- Where driving may be better than walking
- Where refrigerating (or not) ketchup determines much of its life-cycle impacts
- Barack Obama 2009: "At a time of such great challenge for America, no single issue is as fundamental to our future as energy."
- Energy impacts are likely 70%+ of all goods/services or "lifestyle" sustainability impacts

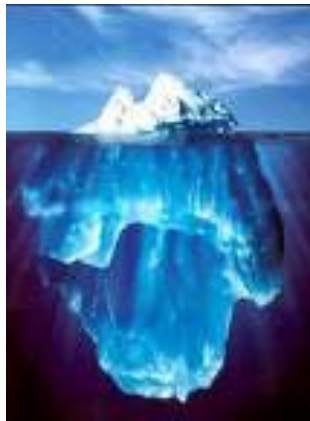


Deep Appreciation to Robert Ayres for lifetime of pioneering work

The Externalities Problem (1969): ”…a market must be allowed to operate **or some other form of decision rule** introduced to permit a rational choice to be made.”

Tough global price competition amidst “free markets” has meant companies must become “externalizing machines” to be cost competitive (Bakan, *The Corporation*, 2004)

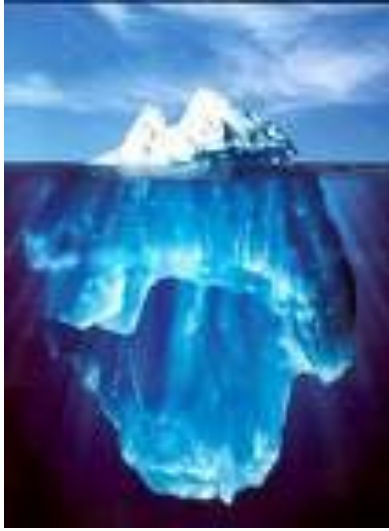
Will prices ever really tell the truth? Seems unlikely….



Can energy externalities be accurately-enough guesstimated? Monetized? Taxed?

- 2002: Sundqvist study of coal electricity externality estimates average 16 cents/kWh
- 2003 Canadian study: coal lifecycle costs = ~2X market price
- 2008 Harvard Med School: coal electricity external costs = 9-27 cents/kWh
- 2011 Harvard: “public health” effects of coal = 4.36 cents/KWh
- SCC estimates….???
- Amory Lovins – internalizing externalities:
  - ”We need to allow all ways to save or supply energy to compete fairly, at honest prices”
  - “Approximately right is better than precisely wrong.”

A whole system for seeing the iceberg: Sustainability Performance Lifecycle Management System (SPLMS)



- Invented 2003 since LCAs frustrating / not cost-effective or timely for orgs. / results determined by local sources of energy beyond LCA reach
- Inspired by ISO14001 “points” systems for determining what’s “significant”
- Focused on the knowledge and decisions that business decision-makers need to make: Supply chain partners and values/risks of the firm and its stakeholders
- Starts with LCA info available; adds social/economy

Sustainability

- At its heart: life-cycle intergenerational responsibility
  - "Protecting the next generation from this one."
  - A "Sustainable Technology" is one where all negative externalities can be cost-effectively mitigated before next generation inherits them
- SPLMS uses whatever definition desired
- Ft. Carson Energy project: Ten categories within Alan AtKisson's Four Sustainability Components: Nature, Economy, Well-being, Society

USAG Ft. Carson's Leading Edge Sustainability Program

- In 2002 invited community stakeholder teams to create 25-year goals to actually become "sustainable" for energy, transportation, purchasing, land management, air/water use/emissions, solid waste, buildings, etc.
  - Garrison Commander signed commitment / ISO14001 management process
  - Regional partners engaged by largest area employer

- Energy goal: 100% renewable energy use by 2027, maximizing efficiency in buildings/transportation
- Transportation goal: 40% reduction in vehicle traffic
- See National Academies: "Achieving High Performance Federal Facilities" (2011)

SPLMS Journey

- 2003: Concept development – examined bicycles.
- 2006: Clif Bar & Co. complete sustainability performance assessment of company value chain
  - Examined 20 inputs and processes of the 70+ possibilities selecting 12 HotSpots to manage
  - ~100 page lifecycle info backgrounds developed for key product inputs including best global industry practices
  - LCA Conference presentation, Zurich, 2007
- 2008-2012: USAG Ft. Carson Studies: Energy and Mattresses
  - Energy study informed key stakeholders of Pikes Peak Area Council of Governments' Sustainability Plan
- Conceptual "open-source" tool – adaptable by each user and continually updated with new info/priorities

Ft. Carson PRISTINE study using SPLMS: 10 Categories

- Nature
  - Climate
  - Water
  - Ecology
- Economy
  - Lifecycle energy efficiency
  - Employment
  - Economy
- Well-being
  - Lifecycle Human Health
  - Regional Human Health
- Society
  - National Security
  - Sustainability Justice

Ft. Carson SPLMS study results: 100 points possible

Sustainable Biodiesel: 88

Wind: 86

Photovoltaic solar: 65

Hydrogen electricity: 49-56

Biodiesel: 37

Biomass Electricity: 33

Nuclear electricity: 31

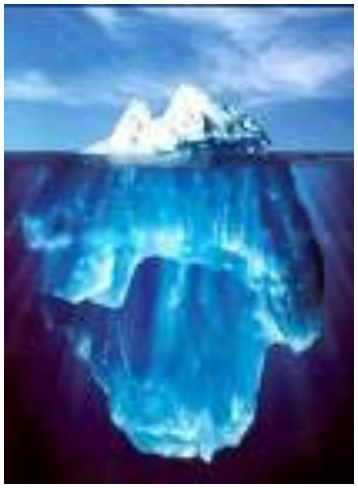
Diesel: 30

Natural gas: 27-29

Coal electricity: 21

Gasoline: 21

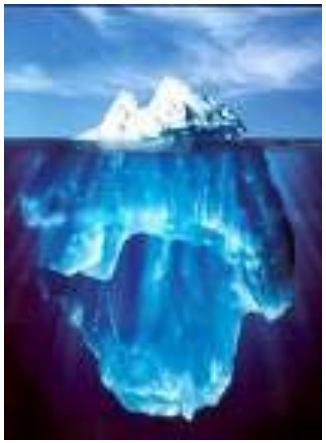
SPLMS Findings (1)



Lithium-ion batteries might be national security risk – validated 2019-21:

- Making LI-ion batteries from recycled batteries may require 38-45% more energy and 16-20% higher GHGs (2019 life-cycle model)
- China now possesses about 90% of global capacity to process raw lithium, 70% of cobalt and 40% of nickel; accounts for 75% of global LiB mfg capacity
- A “US reliable Li-ion value chain”: a decade away
- Chinese mining companies face less ESG scrutiny than Western competitors

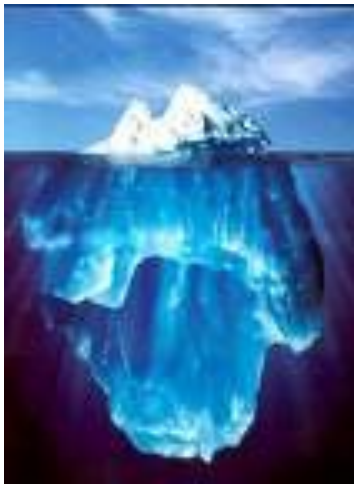
SPLMS Findings (2)



”Zero-emission vehicles….are not”

- 2012 EU Study (assuming vehicle lifetimes of 150k km.):
  - “EV’s powered by the present EU electricity mix offer a 10-14% decrease in Global Warming Potential relative to conventional diesel vehicles and 20-24% reduction relative to gasoline vehicles”…
  - “However, EV’s exhibit the potential for significant increases in human toxicity, freshwater eco-toxicity, freshwater eutrophication, and metal depletion impacts – largely emanating from the vehicle supply chain.”

SPLMS Findings (3)



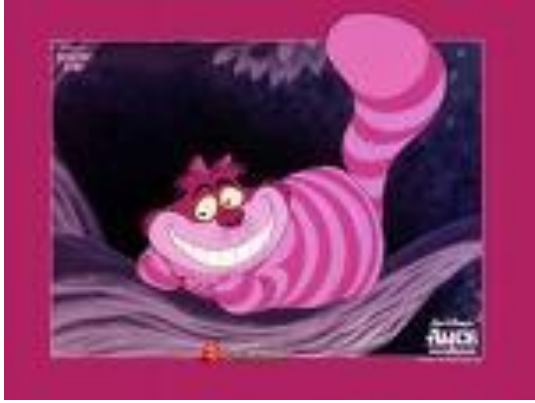
Electricity lifecycles have widely varying supply-chain death rates (per gigawatt/yr delivered)

- Nuclear: 0 – 0.1
- Hydro: 0 – 0.9
- Natural gas: 0.1 – 0.4
- Wind: 0.2
- Coal: 0.4 – 2.8
- Biomass/Peat: 1.4
- Lignite: 2.2
- Oil: 4.2

LifeCycle Challenges: Data and Speed Standardization/Consistency

- 2019 study of 179 energy-related impacts on the environment concluded:
  - "Multi-criteria analyses of energy systems often use a suite of indicators…
  - "Indicators must be applied using a standard set of effects, definitions and measurements…"

How Do We Make Better Energy Decisions?



Understand the waste and its potential: exergy/anergy; ensure the most sustainable choices are most “economic”

Understand the full lifecycles, today and likely future – empower qualitative wisdom

Educate/engage/empower stakeholders including Youth Stakeholder Groups