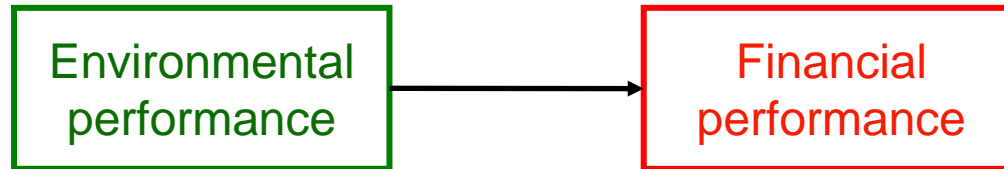


# Technology and Environmental Sustainability: Improving Performance

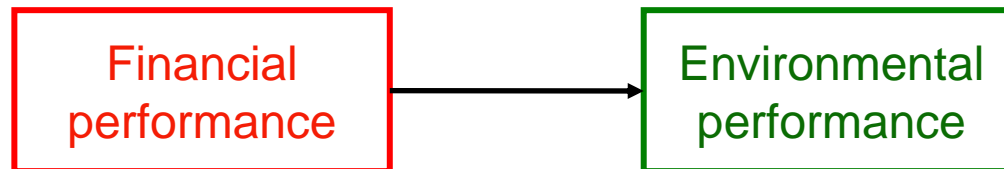
Robert D. Klassen

January 25, 2008

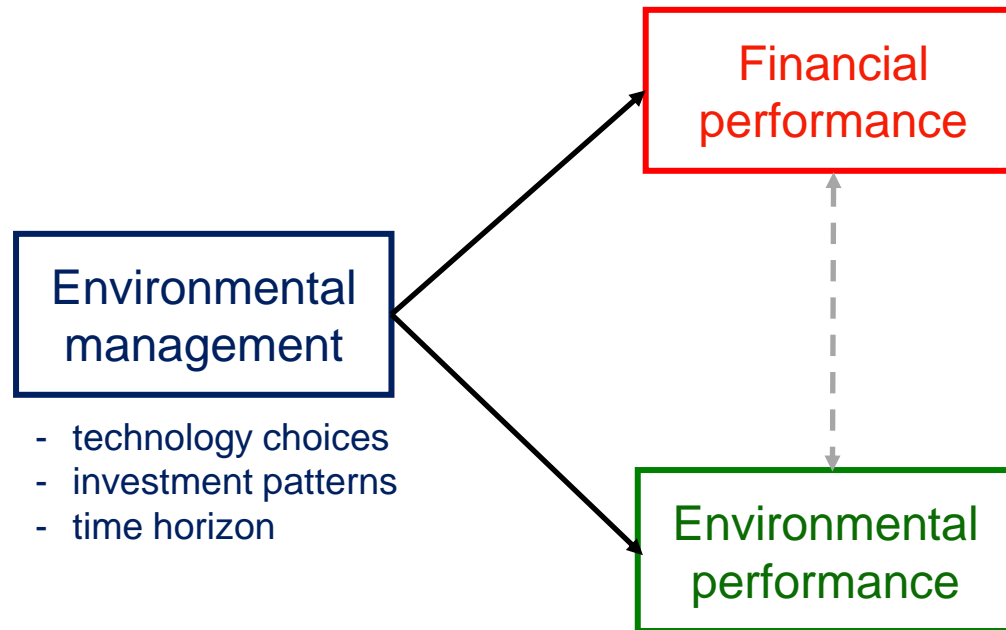
# Linkages between performance



**OR**



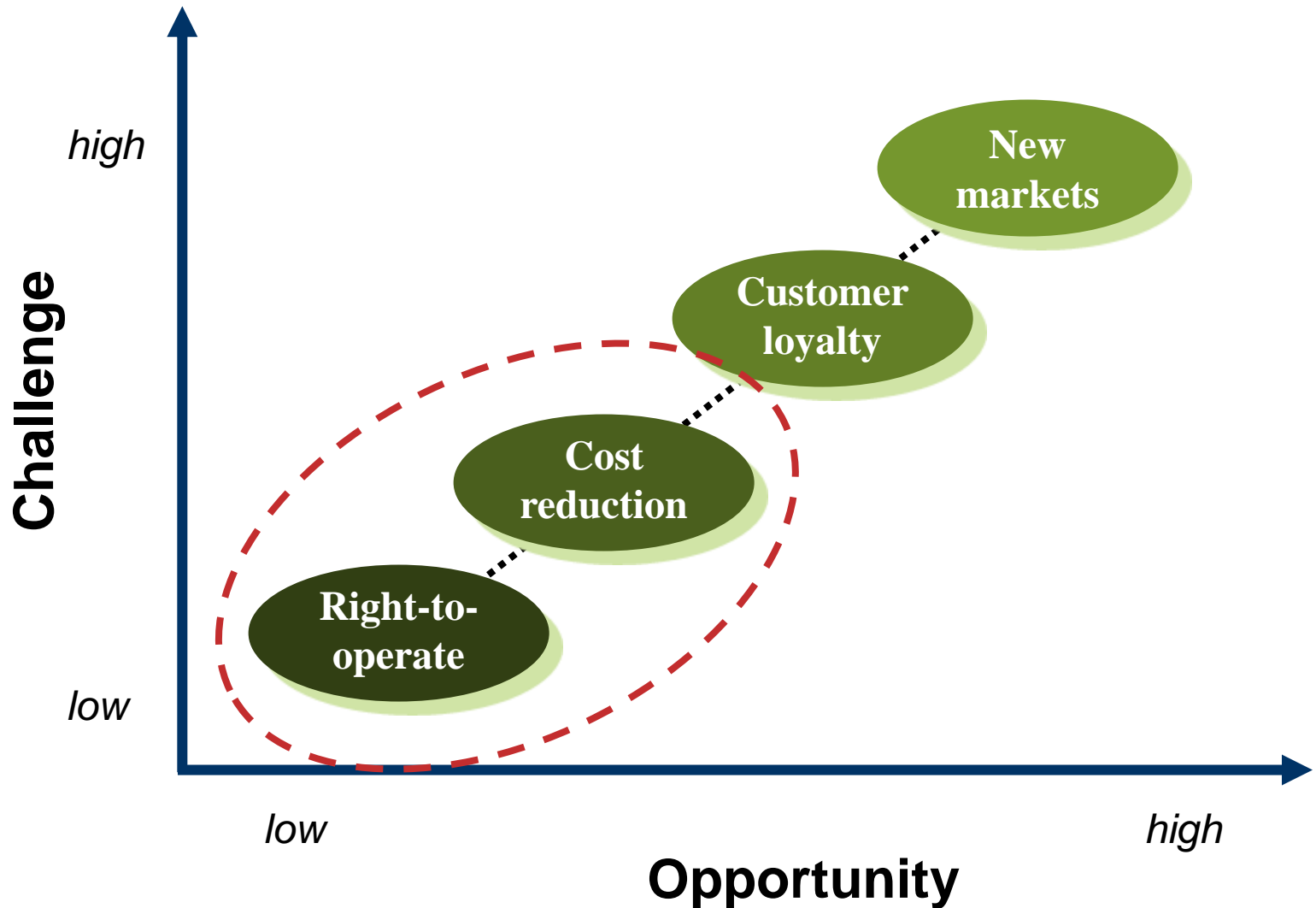
# Different question...



# Foundational research

- Environmental management → event (signal)
  - environmental awards
  - crises (e.g., spills, etc.)
  - 162 events over a decade
  - controlled for general market changes and firm history
- Significant changes in equity values
  - awards: increased market valuation by 0.82% (\$81M)
    - systematic risk ( $\beta$ ) decreased too: 1.06 → 0.95
  - crises: decreased valuation by 1.50% (\$390M)
- Other factors
  - 1<sup>st</sup> time awards: bigger increase = new information
  - *but* for industries with higher pollution expenditures: smaller increase for 1<sup>st</sup> time awards = market skepticism

# Environmental management



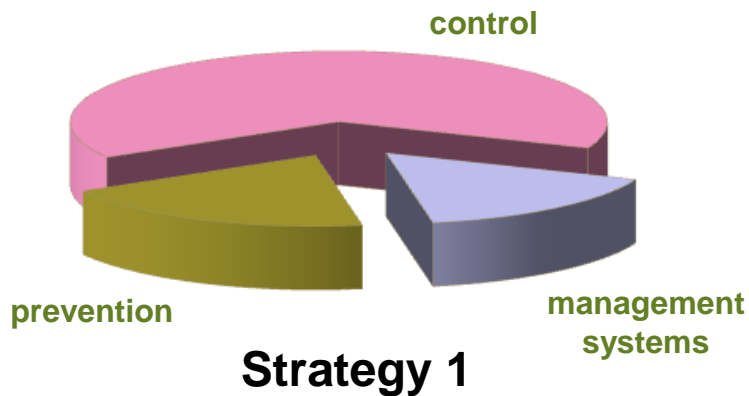
# Right-to-operate

- Pollution control
  - end-of-pipe technologies
  - depresses productivity
- Remediation
  - fixing historical problems
  - potentially huge costs

# Cost reduction

- **Pollution prevention**
  - product and process technology (e.g., 3M)
  - improved product quality (Pil and Rothenberg, 2003)
  - waste reduction leads to improved firm-level financial (King and Lenox, 2002)
- **Management systems**
  - linked to improved operations performance (Melnyk et al. 2003)
  - International diffusion of ISO 14001 driven by geography and culture (Albuquerque et al., 2007)

# Strategic choice: Environmental technology portfolio



For pollution prevention:

- large level
- modest allocation

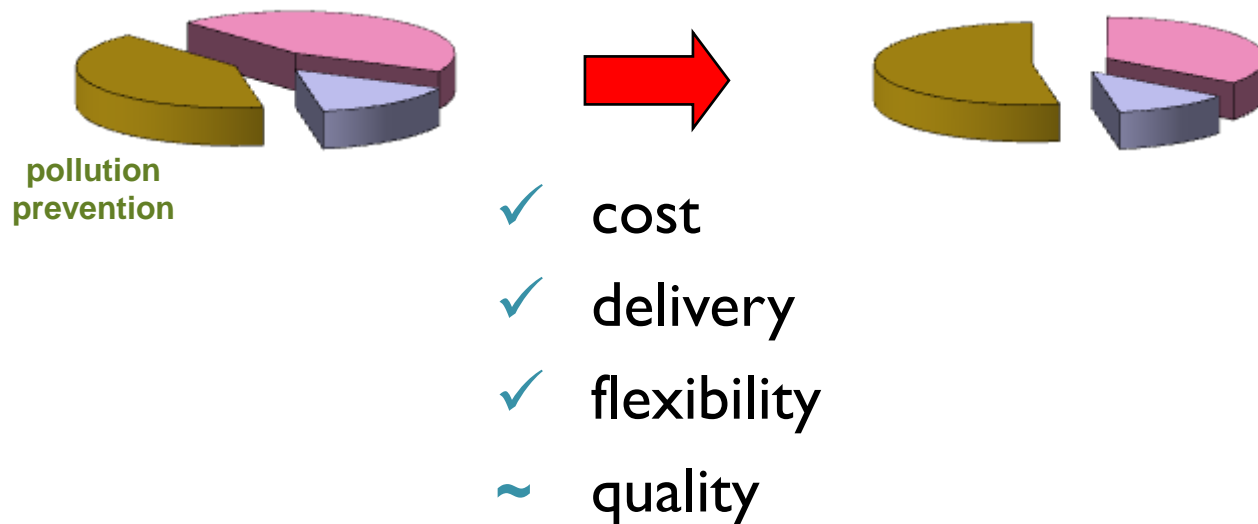


For pollution prevention:

- small level
- large allocation

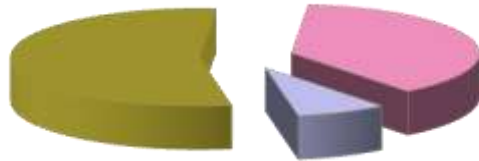
# Shifting your environmental technology strategy

- Single industry in U.S.
  - furniture manufacturing, 83 plants
  - allocation of technological investment

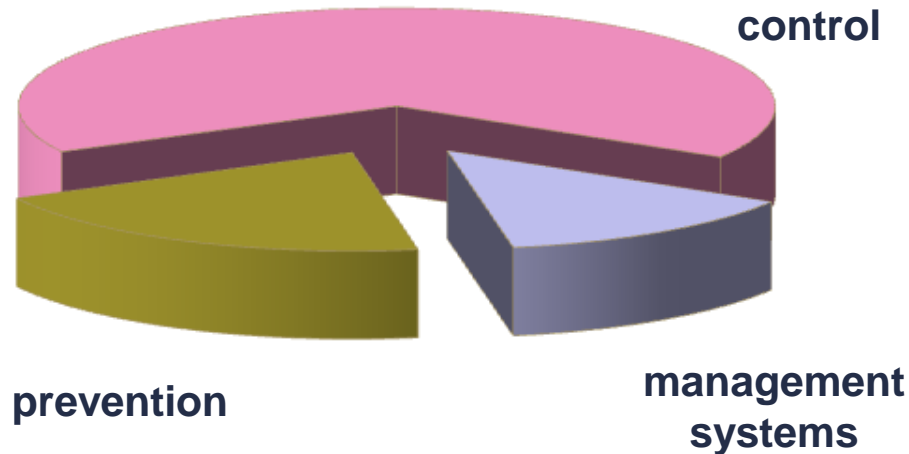
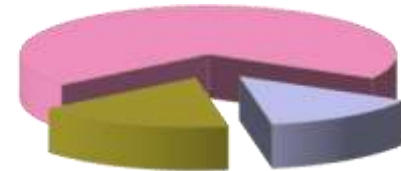


# Canadian business...

Capital investment

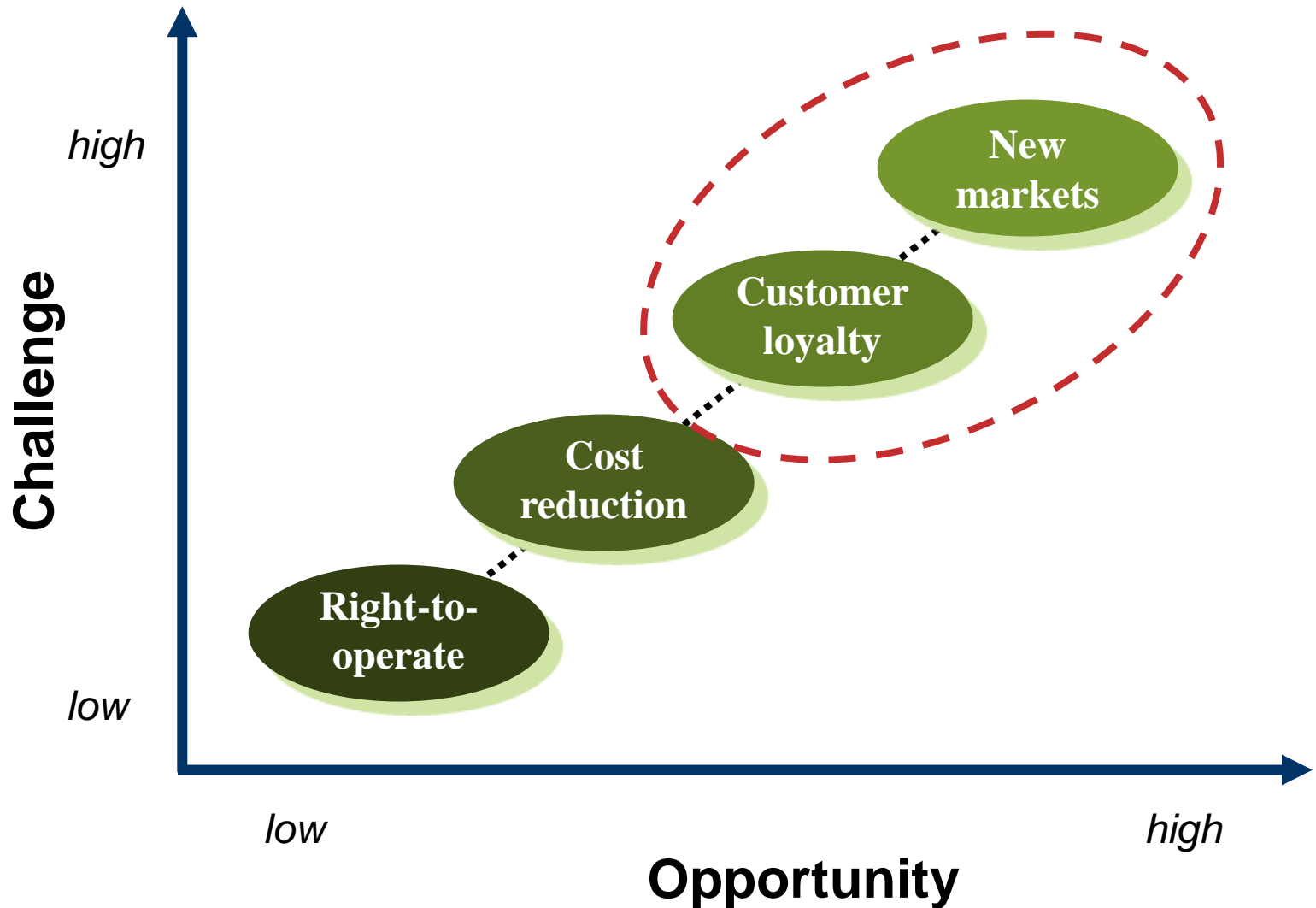


Operating expenses



Overall strategic emphasis

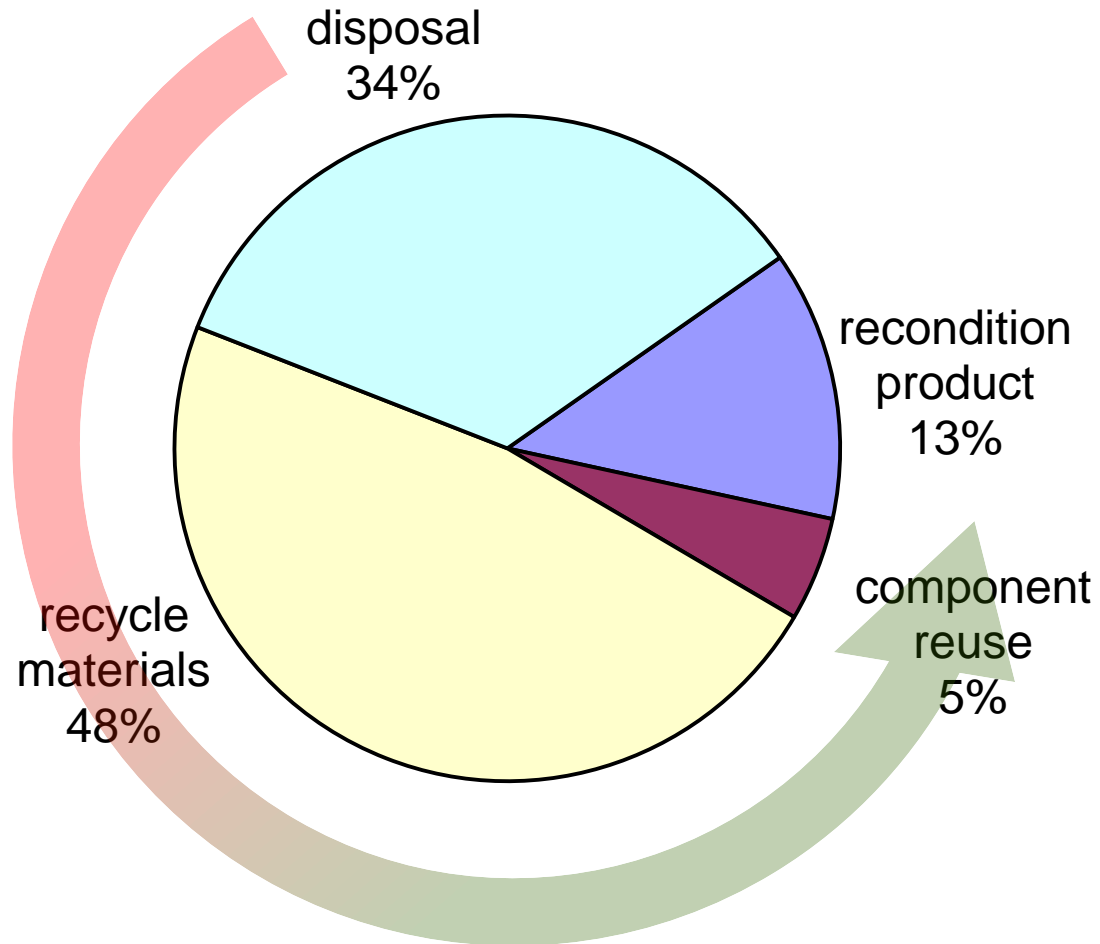
# Environmental management



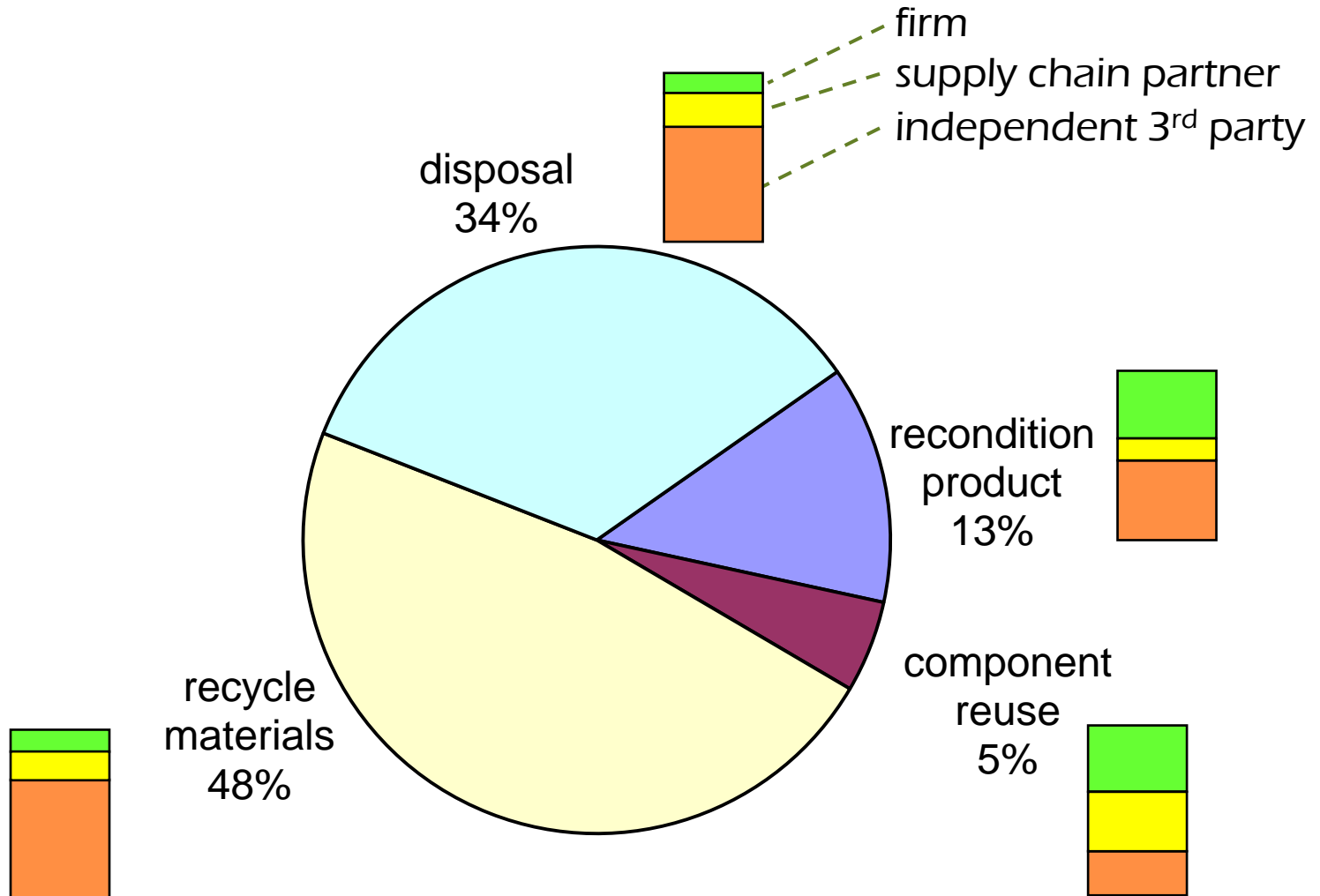
# Customer loyalty

- Service industries
  - customer satisfaction: bridge between systems and performance (Kassinis and Soteriou, 2003)
- ISO 14001
  - enhances customer loyalty and trust (Sambasivan and Yun Fei, 2007)
- Closed loop supply chains
  - leased or end-of-life returned products
  - potentially fosters longer term customer relationship
  - Canadian firms are only beginning to develop
    - fabricated metal, machinery, electrical, and transportation equipment

# End-of-life fate for products



# Who's responsible?



# New markets

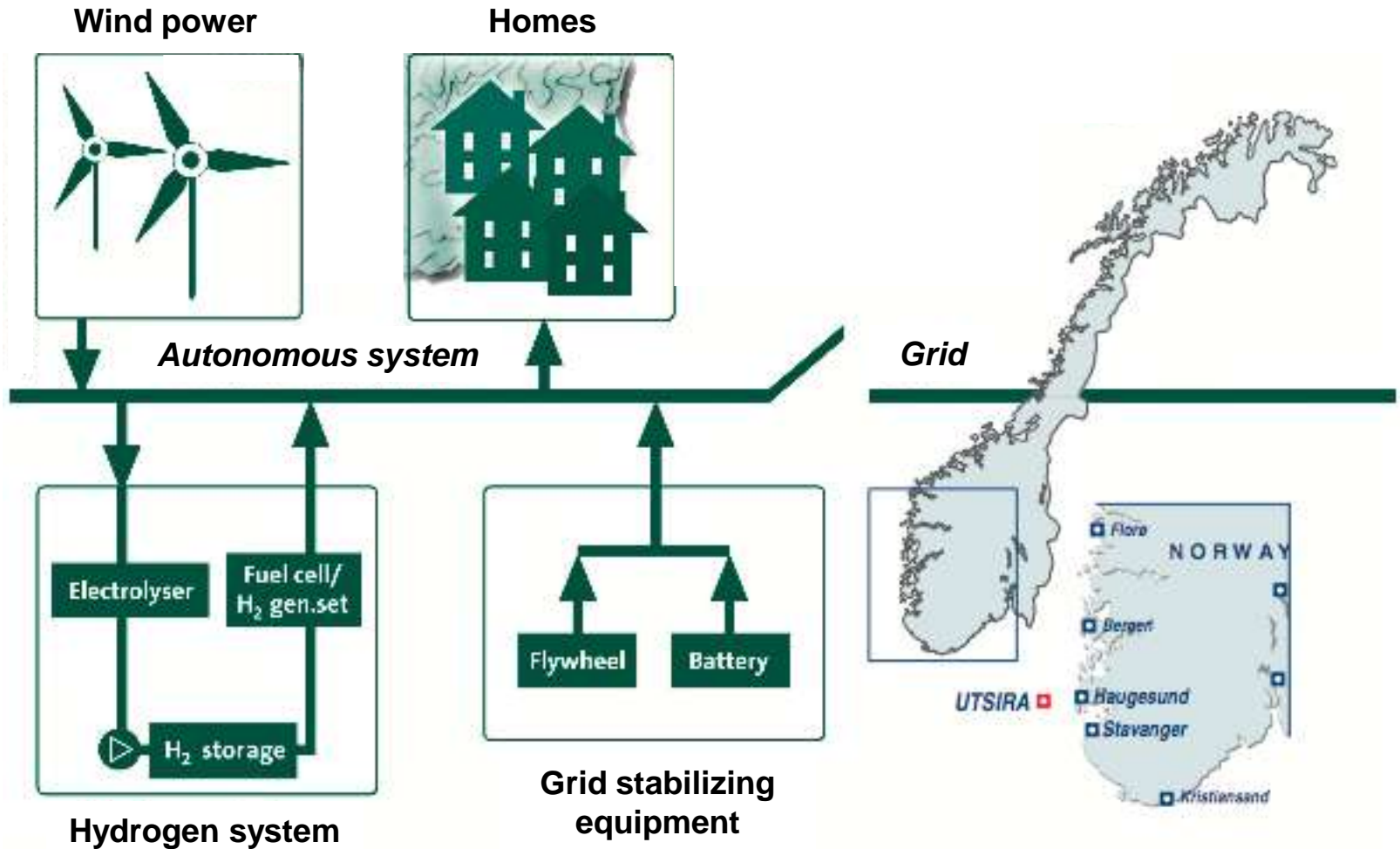
- Eco-labelling or certification
  - e.g., organic foods
  - significant change in product or process
- Premium pricing
  - Danish consumers paid a premium of 13-18% for products that were environmentally certified by a 3rd party (Bjorner et al. 2004)
- New technologies
  - e.g., hybrid vehicles
  - green power

# Hydro – R&D in environmental technologies

- Utsira: island community near coast of Norway
  - demonstration project
    - power for 10 homes
  - integrated wind-hydrogen system
    - combine 600 kW wind towers; electrolyzer; hydrogen engine; and fuel cell



# Technology integration





# Utsira equipment

# Future development

- Award-winning design
- Remote communities
  - thousands of islands in Europe relying on diesel power
- Grid balancing for larger utilities
  - most appropriate for utilities with high percentage of renewable sources



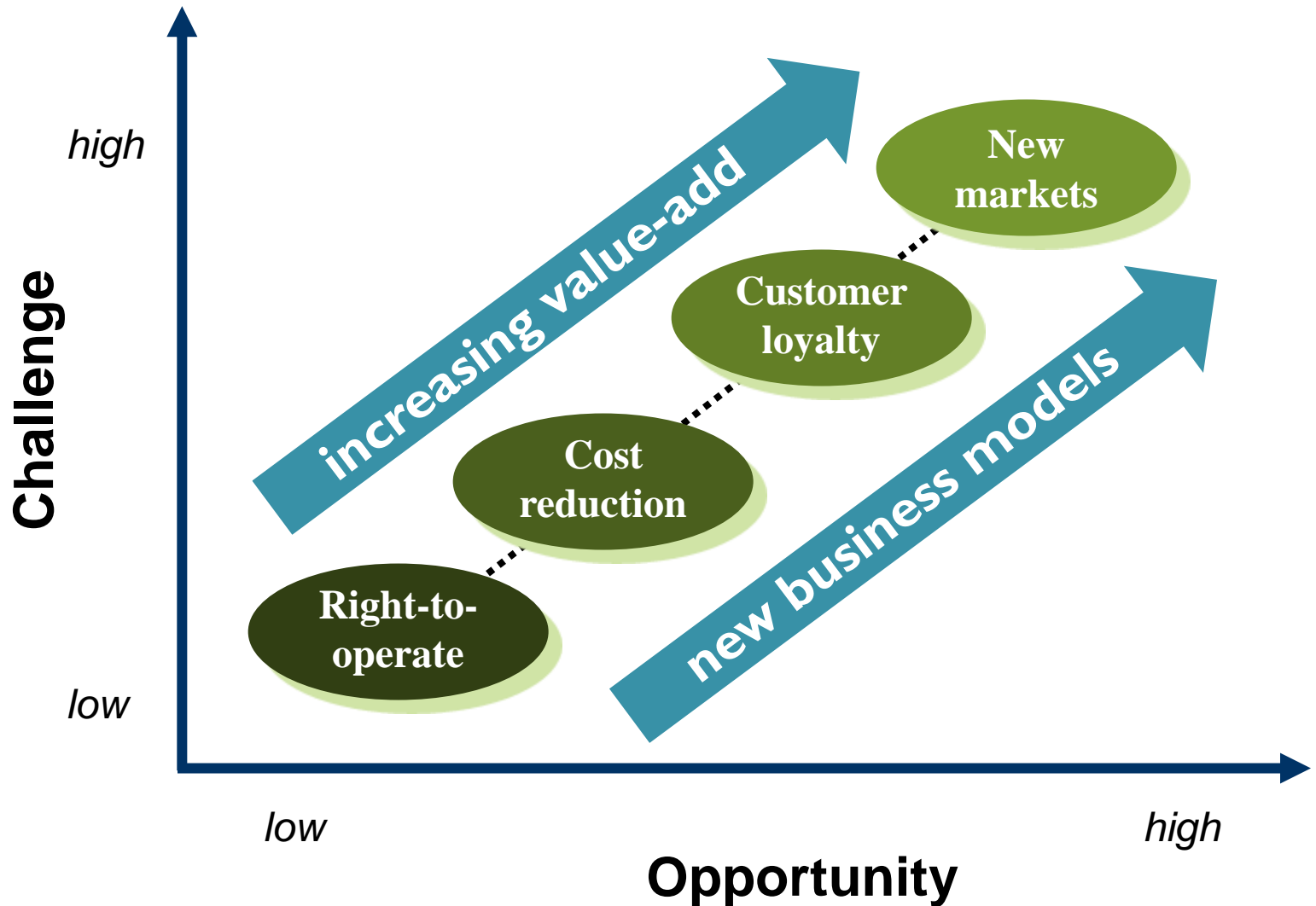
# Hydro's key learnings: A work in progress

- Early stage development
  - isolated testing is easier to justify
  - monitoring many (remote communities) vs. few (large utilities)
  - potential scalability
- Hydro's role?
  - equipment supplier
  - system integrator
  - operator
- Fit with overall corporate strategy

# Wind power moves to the deep sea

- Talisman and Scottish & Southern Energy
  - North Sea, in Moray Firth

# Future directions



# Conclusions

- Goods news
  - environmental (more sustainable) technologies provide important business opportunities
- Challenging news
  - how you do it matters – no “plain vanilla” approach
  - strategic allocation across technologies
    - form (e.g., pollution prevention) and objectives (e.g., new markets)
  - *Cost reduction* can be assessed using traditional financial means (e.g., pollution prevention in products)
  - *Customer loyalty* and *New market* requires more strategic integrative development (creating future “options”)