THE EARTH INSTITUTE
COLUMBIA UNIVERSITY

RESEARCH PROGRAM ON
Sustainability Policy and Management

Panel Presentation on

Measuring Progress towards Sustainability: The State of the Science on Indicators and Metrics of Sustainability: Climate Change and Infrastructure Vulnerability

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Panel Questions

I. Provide an overview of the evolution of efforts to develop sustainability indicators/metrics, including cross-sectoral initiatives, since 2000.

II. What indicators and metrics have been found to be the most useful for promoting sustainability?

III. What knowledge gaps exist related to the development of effective and innovative sustainability indicators?

The Earth Institute at Columbia University

- **The Earth Institute** is a new form of academic institution designed to institutionalize interaction among many academic fields and professional disciplines to address the problems of **global sustainability**.
  - We bring together the **people and tools** needed across ecology, engineering, environmental science, physics, law, public health, economics, political science, public policy, ethics and management to help address the problems of climate change, renewable energy, ecosystem maintenance, water quality, food production, air quality, waste management and the manufacture of goods and services with the least possible environmental impact.
- The Earth Institute is the **largest research institute** at **Columbia University,** comprised of nearly 800 full-time employees with an annual budget of roughly US$139 million.
- It includes over **two dozen research centers** and programs examining every aspect of sustainability. Our activities are deeply embedded within Columbia University, spanning three campuses and over 16 departments/schools.
- Our mission is to develop programs of **research, education, outreach and practical application** of knowledge to address the critical issues of sustainability.

Research Program on Sustainability Policy & Management

Launched in July 2013 to provide a rigorous analytic base to help inform sustainability decisions faced by investors, companies, organizations, and governments, and to help address implementation challenges.

- **Objectives:**
  - To hasten the integration of sustainability principles in the management of private, non-profit, and governmental organizations by providing the data necessary for decision-making.
  - To develop models to overcome barriers to institutionalizing sustainability in organizational operations.
- **How:**
  - Research the mechanisms behind sustainability management to develop and promote more effective policies and organizational practices.
  - We analyze sustainability strategies and initiatives, examine methods of measuring and valuing sustainability practices, and study the impact of policies that stimulate sustainability innovations and trends.

Potential Range of Indicators

- Many indicators of apparent unsustainability:
  - Poor air quality, contaminated water sources
  - Diminished soil health
  - Over- consumption and waste
  - Climate change impacts
  - Infrastructure vulnerability
  - Large imbalances in trade and investment flows
  - Unsustainable debt/anemic growth
  - Rising social inequality

- BUT also:
  - Higher incomes
  - Significant technological capacity
  - Scientific knowledge
  - Unprecedented access to energy

Metrics Database

- **Sustainability Metrics:** A study which we hope will ultimately serve as a foundation towards developing a set of **generally accepted sustainability metrics**.
  - We created a database of nearly 600 environmental, social and governance metrics, conducted a review of frameworks and indices to measure performance, and examined financial benefits of sustainability.
  - Results of this initial study is described in two white papers; two more papers will be completed this summer.
  - The next stage of our study involves analyzing the frameworks and indices that aggregate these indicators, and paring down indicators to begin a process of settling on a common core that replicates the applicability and universality of financial indicators and generally accepted accounting principles.

Utility is in the Eye of the User

The variety of metrics users:

- **Corporate Management:**
- **Employees:**
- **Consumers:**
- **Investors:**
- **Regulators:**
- **Local Governments:**
- **National Governments:**
- **Ratepayers and Taxpayers:**

The dynamics between these stakeholders vary widely across industries and regions.

Role of the Investor in Sustainability

Functions of Financial Markets:

1. Facilitate resource allocation of **financial, physical**, **natural** and **human** capital, spatially and across time, in an uncertain environment.
2. Risk-pooling and risk-sharing for households, firms, government.
3. Provide signals for decentralized decision-making.

Growth of the Investor in Sustainability

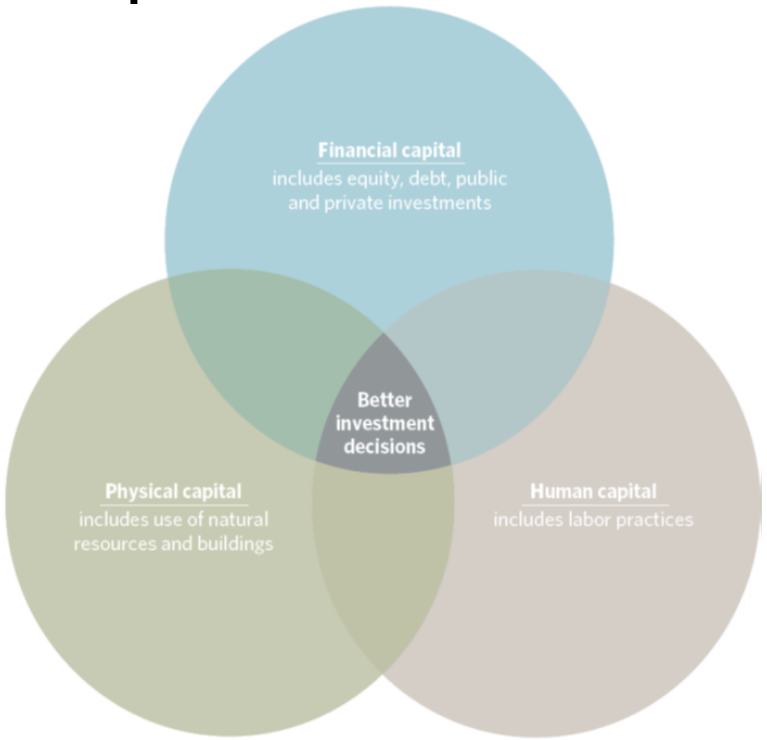
- Global sustainable investing assets under management rose from $13.3 trillion in 2012 to $21.4 trillion in 2014 (21% to 30% of professionally managed assets)
- Growth primarily in US, Canada & Europe
- Integrates environmental, social and governance factors into stock due diligence, portfolio selection and risk management.

Long Term Investors

Large institutional investors (e.g. CalPERS) accept that better investment decisions require assessment of natural capital and human capital.

Three forms of capital:

Sustainable investment in its simplest form is the ability to continue, and for a long-term investor like CalPERS with long-term liabilities, it is critically important. Long-term value creation requires the effective management of three forms of capital: financial, human and physical — this is why we are concerned with environmental, social, and governance issues.



Green Accounting

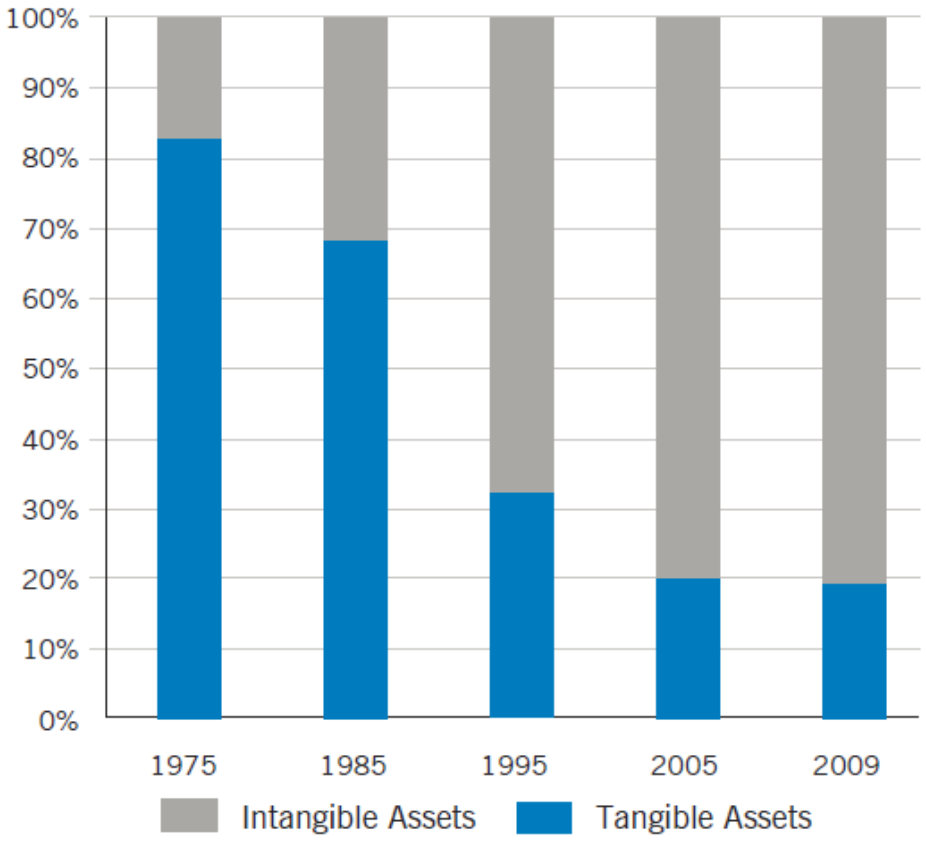
- A prerequisite to reducing or eliminating environmental damage costs is to precisely measure those costs in monetary terms
  - Identify and allocate shared costs correctly to ‘clean’ and ‘dirty’ products
  - Identify new revenue sources created by eco-efficient products and processes
  - Evaluate the benefits of environmental action and the potential risks of inaction
  - Design transverse payments for ecosystem services across jurisdictions

Green Accounting

- Without accounting for prices, centralized decision-making will lead to misallocation of resources:
  - Water-consuming factories in watersheds vulnerable to climate change
  - Insufficient diversification of fuel or energy sources
  - Behaviorally induced risks (such as coastal property, induced earthquakes)

Eccles, Serafeim & Krzus (2011)

Table 1 **Components of S&P 500 Market Value**



Sustainability Metrics for Investors

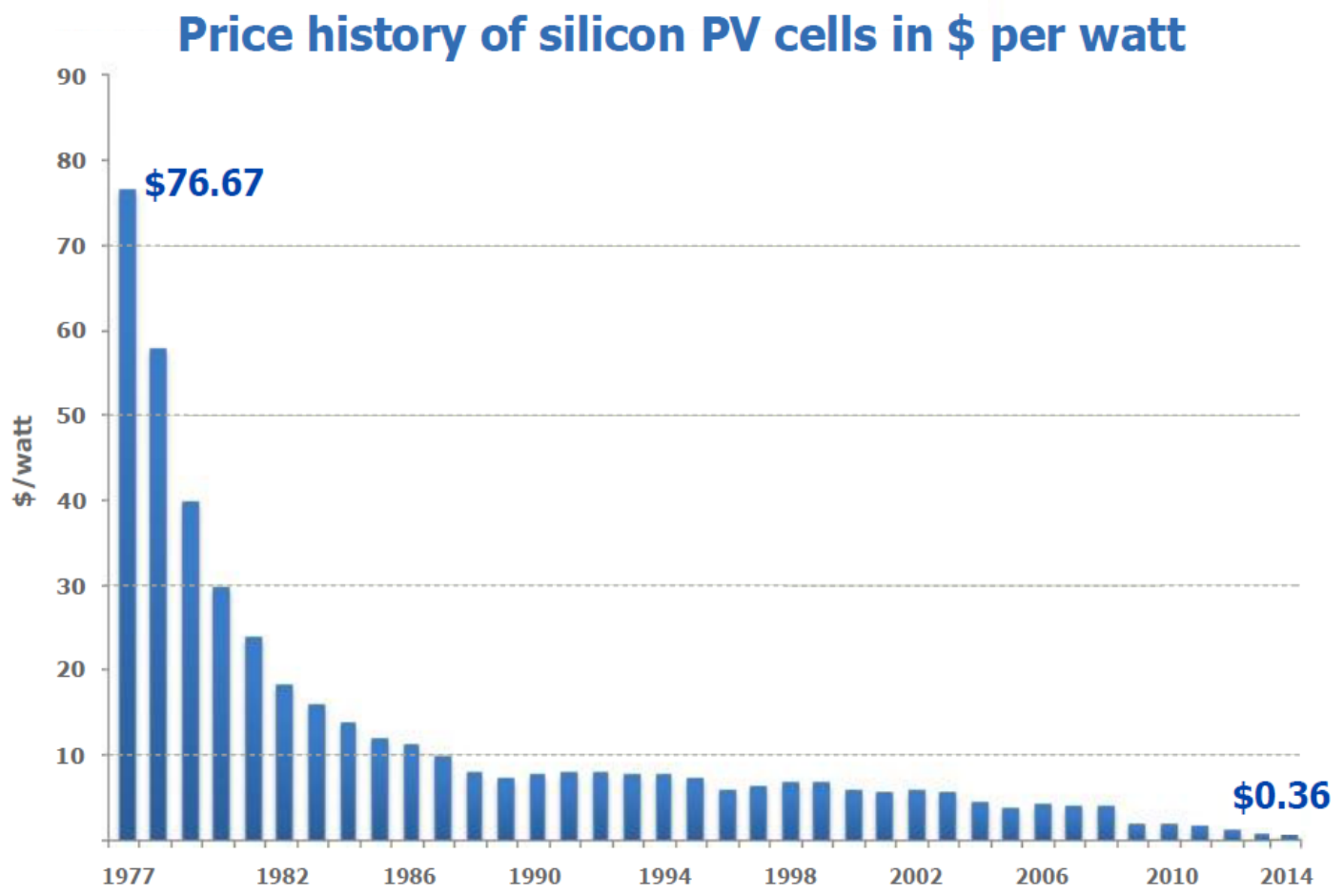
Perception and data that ESG excellence signals competitive advantage:

- Signal of management quality
- Greater institutional ownership
- Lower cost of capital
- Leverage capacity
- High customer loyalty
- Efficient operations and supply chain

Wide Embrace of Sustainability Metrics

- GRI guideline sustainability reports rose from 50 in 2000 to 1,860 in 2010.
- CorporateRegister has 5,400 reports with sustainability information out of 8,220 reporting companies in 2010.

Value of Natural Capital is inversely related to extraction cost



Source: Bloomberg, New Energy Finance & pv.energytrend.com

Investor Due Diligence Process

1. Revenue Impact
   - Input efficiency and reliability (energy, water)
   - Product differentiation
   - Customer loyalty
2. Cost Impact
   - Employee attraction, retention, productivity
   - Low maintenance
   - Ongoing fines
   - Disaster likelihood: regulatory, litigation, reputation
3. Valuation Impact
   - Multiple expansion

Sustainability Metrics for Investors

- Standard ESG Metrics
  - Multiple standards
  - 20+ frameworks
  - Hundreds of Key Performance Indicators (KPIs)
  - Inconsistency in computation
  - Composite Index Shortcomings:
    - Arbitrary Weights
    - Varying Weights
    - Reward for Transparency rather than Performance

Eccles, Serafeim & Krzus (2011)

Table 3 **Global Market Interest**

Variable	Category	Hits
ESG Disclosure Score	DISCLOSURE	2,395,230
GHG Scope 1	ENVIRONMENTAL	1,520,488
Governance Disclosure Score	DISCLOSURE	1,337,078
Environmental Disclosure Score	DISCLOSURE	1,238,417
GHG Scope 2	ENVIRONMENTAL	1,067,085
Social Disclosure Score	DISCLOSURE	978,541
Total GHG Emissions	ENVIRONMENTAL	920,170
% Independent Directors	GOVERNANCE	899,148
GHG Scope 3	ENVIRONMENTAL	890,932
Direct CO_2 Emissions	ENVIRONMENTAL	781,569
Size of the Board	GOVERNANCE	735,853
Carbon Disclosure Leadership Index Score	CDP	732,102
Scope 1 Activity Emissions Globally	CDP	729,630
Number of Independent Directors	GOVERNANCE	651,913
Verification Type	ENVIRONMENTAL	645,330
UN Global Compact Signatory	ENVIRONMENTAL	606,998
Total CO_2 Emissions	ENVIRONMENTAL	583,403
Board Meeting Attendance %	GOVERNANCE	540,427
Number of Board Meetings for the Year	GOVERNANCE	519,099
CEO Duality	GOVERNANCE	508,482

Eccles, Serafeim & Krzus (2011)

1. Increasing interest in Bloomberg ESG screen
2. Carbon data most requested
3. Disclosure viewed as proxy for mgmt quality
4. “E” and “G” more requested than “S”
5. Equity investors: broad interest in “ESG”
6. Fixed income investors: primarily interested in “G”
7. Sell-side: interest in carbon data
8. Buy-side: interest in “ESG”

Investor Metrics Ecosystem

- **Frameworks:** GRI, IIRC, CDP, UNPRI Stock Exchange Initiative
- **Analysts:** GMI Ratings, KLD/MSCI (bought GMI), Sustainalytics, ESG Analytics
- **Raters:** OEKOM, EIRIS, Inrate, Ethifinance, Vigeo
- **Index Providers:** FTSE4Good, DJSI, Corporate Knights

Evolving Sources of Data

1. Open Data Initiatives (e.g. TRI, WRI Aqueduct, IPE, CIESIN, Hotspot database)
2. NGO reports (e.g. Oxfam, Greenpeace)
3. Subscription-based aggregators (e.g. LaborVoices, LaborLink)

Sample: Bloomberg ESG Screen

GRAB

Click numbers for transparency

BP US Equity | 96) Settings | 97) Actions | 98) Output | 99) Feedback | Financial Analysis

BP PLC — Periods 10 Annuals — Currency USD

1) Key Stats | 2) I/S | 3) B/S | 4) C/F | 5) Ratios | 6) Segments | 7) Addl | 8) ESG | 9) Custom

11) Overview | 12) Environmental | 13) Social | 14) Governance | 15) Exec & Dir Comp | 16) ESG Ratios | 17) Carbon Discl Proj

In Millions (except Per Share)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
12 Months Ending	2006-12-31	2007-12-31	2008-12-31	2009-12-31	2010-12-31	2011-12-31
CDP Disclosure Score	n/a	64	66	67	80	75
CDP Reporting Boundaries	n/a	n/a	n/a	EQU	OTH	OTH
Carbon Emissions Disclosure Indicat	Public	Public	Public	Public	Public	Public
Reporting Period						
Start Date of CDP Reporting Year	n/a	2007-01-01	2008-01-01	2009-01-01	2010-01-01	2011-01-01
End Date of CDP Reporting Year	2006-12-31	2007-12-31	2008-12-31	2009-12-31	2010-12-31	2011-12-31
CDP Survey Year	2007	2008	2009	2010	2011	2012
CDP Reported Fiscal Year	2006	2007	2008	2009	2010	2011
Risks and Opportunities						
Regulatory Risk Exposure	n/a	n/a	Yes	Yes	Yes	Yes
Physical Risk Exposure	n/a	n/a	Yes	No	No	No
Other Risk Exposure	n/a	n/a	Yes	Yes	Yes	Yes
Regulatory Opport Present	n/a	n/a	Yes	Yes	Yes	Yes
Physical Opport Present	n/a	n/a	No	No	No	No
Other Opportunities Present	n/a	n/a	No	No	Yes	Yes
GHG Emissions						
Scope 1 Emissions	59.30	63.46	61.40	65.03	64.92	61.82

Zoom 100%

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2013 Bloomberg Finance L.P.
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Sample: GMI ESG Ratings

GMIRATINGS

ESG Fact Sheet

March 2013

Overview

GMI Ratings publishes Environmental, Social and Governance (ESG) ratings on approximately 6,000 companies worldwide. These ratings provide an independent assessment of the sustainable investment value of public companies. Unlike traditional ESG risk models, our rating methodology is designed to identify risks most likely to affect equity valuations. Specifically, our ratings reflect actual corporate behaviors rather than policies or affirmations of intent to adhere to best ESG practices. Further, we assign context-sensitive relative weightings to our key metrics, based on market, regional, ownership or sector differences. This sensitivity to regional and sector-dependent variations sharply differentiates GMI Ratings from exclusionary screening methodologies associated with more traditional Socially Responsible Investing (SRI) research.

Breadth and Depth of ESG Coverage

Approximately 6,000 companies

- North America
- Western Europe
- Asia Pacific
- Japan
- Emerging Markets

150 ESG KeyMetrics®

- Corporate events
- Governance/BOD
- Governance/Pay
- Governance/Ownership & Control
- Environmental performance
- Social Impact

Simple Quantification

ESG Rating	Percentile Ranks
A (Superior)	96-100
B (Above Average)	76-95
C (Average)	26-75
D (Below Average)	6-25
F (Failing)	1-5

Sample: Sony ESG Report

oekom research

oekom Corporate Rating

Sony Corp

Corporate Responsibility Prime rated by oekom research

Industry:	Consumer Electronics & Household Appliances
GICS Industry:	Household Durables
Country:	Japan
ISIN:	JP3435000009
Bloomberg Ticker:	6758 JP Equity

Status **Prime**

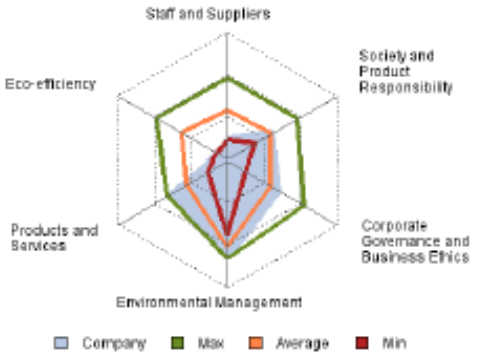
Rating **C+**

D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
poor				medium			good			excellent	

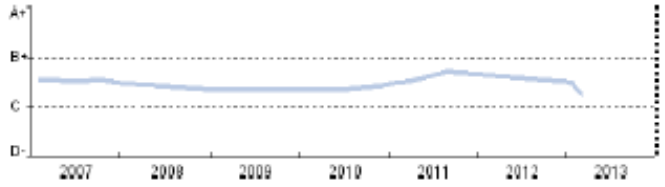
Strengths and Weaknesses

+ comprehensive measures to check compliance of key suppliers with the company's labour / health and safety standards
+ group-wide strategy to reduce the energy consumption of products
+ group-wide implementation of a strategy for addressing climate change and related sector-specific risks
+ development of take-back material recovered for reuse/recycling shows an upward trend

- no information available on measures to set up voluntary recycling systems for e-waste in developing countries
- lack of transparency regarding measures taken to reduce emissions of products



Rating History



Sample: Puma EP&L

Valuation results

The table below shows the weighted average values (per tonne) for each pollutant according to the locations of PUMA's operations and that of its global supply chain. The table also shows the range of values across the locations (values vary according to location and sector as described above).

Air Pollutant	Weighted Average Value per tonne (EUR)	Range (EUR)
Particulates	14,983	1,285 – 191,743
Ammonia	1,673	1,133 – 5,670
Sulphur dioxide	2,077	783 – 6,422
Nitrogen oxides	1,186	664 – 3,179
Volatile Organic Compounds	836	425 – 1,998

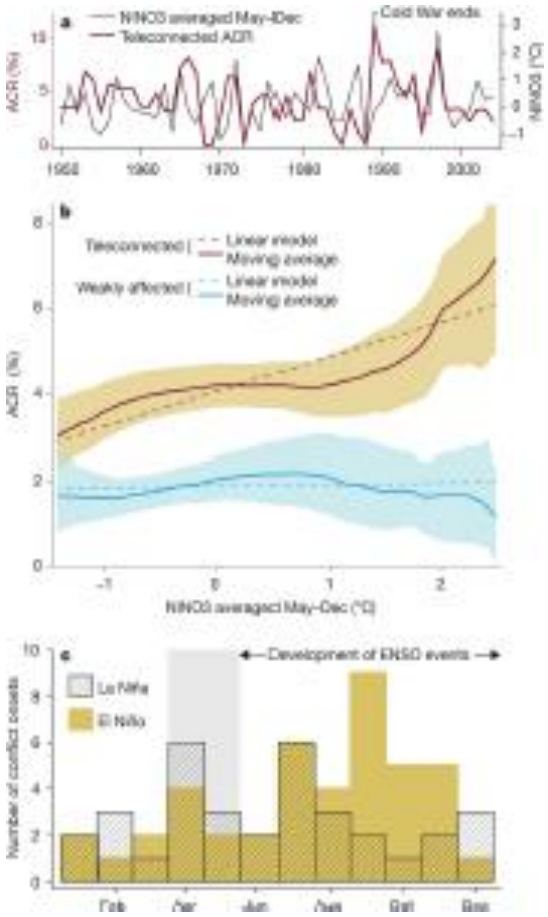
Water	Weighted Avg Value per m3 (EUR)	Range (EUR)
Water usage	0.81	0.03 – 1,845

Sample: Geospecific Hazard Assessment

Knowledge Gaps / Challenges

1. Consensus
2. Regulation
3. Linking of Metrics to Value

Annual conflict risk and ENSO



SM Hsiang et al. Nature 476, 438-441 (2011) doi:10.1038/nature10311

Natural Capital Affects Market Value

- Konar & Cohen (2001):
  - (Legal) toxic releases and environmental lawsuits are negatively correlated with the market value of firm intangibles (after controlling for key financial variables)

Human Capital Affects Long Term Returns

- Undervalued Human Capital (Edmans, 2011):
  - Contributes to persistent profits
  - Not directly incorporated in stock prices
  - Value-weighted portfolio of the “100 Best Companies to Work For in America” earned an annual four-factor alpha of 3.5% from 1984-2009, 2.1% above industry.

Stakeholder Relations increases Intangible Value

- Stakeholder relations are an investment in intangible value for providers of financial capital (Jiao, 2011):
  - Ratio of market value of assets to replacement value increases with increases in stakeholder relations score
  - Economically significant determinants of Firm Value (in order): Return on Assets, R&D/Sales, Sales Growth, Stakeholder Value

Panel Questions

I. Provide an overview of the evolution of efforts to develop sustainability indicators/metrics, including cross-sectoral initiatives, since 2000.

II. What indicators and metrics have been found to be the most useful for promoting sustainability?

III. What knowledge gaps exist related to the development of effective and innovative sustainability indicators?