# The Future of Measuring Environmental Risk and Opportunity in Investment Portfolios
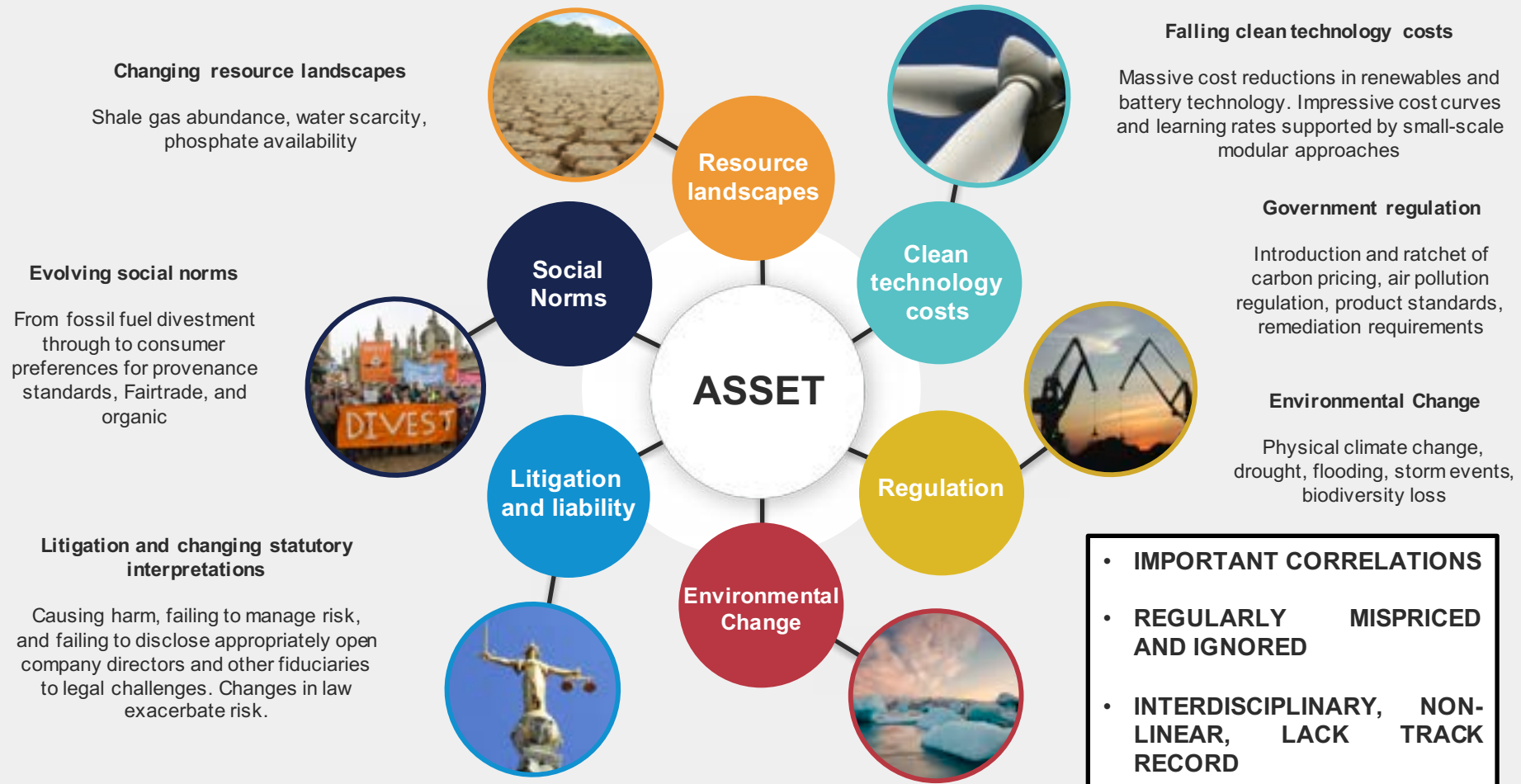
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# ENVIRONMENT-RELATED RISK AND OPPORTUNITY

**How do environmental factors affect asset values?**



**Changing resource landscapes**

Shale gas abundance, water scarcity, phosphate availability

**Falling clean technology costs**

Massive cost reductions in renewables and battery technology. Impressive cost curves and learning rates supported by small-scale modular approaches

**Evolving social norms**

From fossil fuel divestment through to consumer preferences for provenance standards, Fairtrade, and organic

**Government regulation**

Introduction and ratchet of carbon pricing, air pollution regulation, product standards, remediation requirements

**Litigation and changing statutory interpretations**

Causing harm, failing to manage risk, and failing to disclose appropriately open company directors and other fiduciaries to legal challenges. Changes in law exacerbate risk.

**Environmental Change**

Physical climate change, drought, flooding, storm events, biodiversity loss

Resource landscapes

Clean technology costs

Social Norms

ASSET

Regulation

Litigation and liability

Environmental Change

- **IMPORTANT CORRELATIONS**

- **REGULARLY MISPRICED AND IGNORED**

- **INTERDISCIPLINARY, NON-LINEAR, LACK TRACK RECORD**

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# EXPOSURE AND WHY IT MATTERS

How is environmental risk and opportunity embedded throughout the investment chain and what are the data requirements of different stakeholders?

**ASSETS**

EXPOSED TO DIFFERENT ENVIRONMENTAL RISKS AND OPPORTUNITIES

**COMPANIES**

OWN EXPOSED ASSETS

**ASSET MANAGERS**

OWN COMPANY DEBT AND EQUITY

**ASSET OWNERS**

ALLOCATE CAPITAL TO ASSET MANAGERS OR ACT AS ASSET MANAGERS THEMSELVES

**POLICYMAKERS AND REGULATORS**

MANAGE MICROPRUDENTIAL RISK, SYSTEMIC RISK, ECONOMIC GROWTH, AND WANT TO IMPLEMENT NDCs SUCCESSFULLY

# CURRENT EFFORTS TO MEASURE EXPOSURE ARE DEEPLY FLAWED

**Carbon foot printing is not a solution, but current efforts focus on incremental improvements to a questionable approach**

**PHYSICAL CLIMATE CHANGE IMPACTS**

**INCREASING STRINGENCY OF ENVIRONMENTAL REGULATION**

**COMPETITION FROM CLEAN TECH**

**INCREASED REPUTATIONAL RISK**

**COMPANY A**

**CARBON INTENSITY DATA USED AS A 'TOP DOWN' PROXY**

**UNREPORTED DATA CALCULATED BY THIRD PARTIES USING NON-TRANSPARENT BLACK BOXES**

**FAILS TO CONVINCE MAINSTREAM**

# HYPOTHESES NEED TO BE DEFINED AND THEN MEASURED 'BOTTOM UP'

How should exposure to environmental risk and opportunity be measured?

**PHYSICAL CLIMATE CHANGE IMPACTS**

**INCREASING STRINGENCY OF ENVIRONMENTAL REGULATION**

**COMPETITION FROM CLEAN TECH**

**INCREASED REPUTATIONAL RISK**

ASSET — ASSET — ASSET — ASSET

**COMPANY A**

**HEAT STRESS PROJECTIONS**

**FLOODING PROJECTIONS**

**PRECIPITATION PROJECTIONS**

**ASSETS PARTICULARLY EXPOSED**

**PRICING OF EXTERNALITIES**

**ASSETS IN JURISDICTIONS PARTICULALRY AT RISK**

**PACE OF DEPLOYMENT IN KEY MARKETS**

**UTILISATION RATES**

**POLICY SUPPORT**

**ASSETS IN PROXIMITY TO NATIONAL PARKS**

**SALIENCE OF AREAS AFFECTED**

**SOCIAL MEDIA**

# EXAMPLE PROJECT: THERMAL COAL VALUE CHAIN FOR NORGES BANK INVESTMENT MANAGEMENT

### Top 100 Coal-Fired Power Utilities

- By coal-fired power generation in GWh
- 42% of all world coal-fired power stations
- 73% of all coal-fired generating capacity

| | Coal-Fired Power Utilities | [GWh] |
|---|---|---|
| 1 | CHINA HUANENG GROUP CORP | 471,139 |
| 2 | CHINA GUODIAN CORP | 455,038 |
| 3 | CHINA DATANG CORP | 415,118 |
| 4 | CHINA HUADIAN GROUP CORP | 369,511 |
| 5 | CHINA POWER INVESTMENT CORP | 293,658 |
| 6 | SHENHUA GROUP CORP LTD | 292,107 |
| 7 | ESKOM HOLDINGS SOC LTD | 214,924 |
| 8 | NTPC LTD | 208,588 |
| 9 | CHINA RESOURCES POWER HOLDINGS | 171,178 |
| 10 | KOREA ELECTRIC POWER CORP | 128,189 |

### Top 20 Thermal Coal Miners

- By 2014 thermal coal revenue
- Revenue ≥30% from thermal coal
- 70% of world thermal coal revenue

| | Thermal Coal Miners | [US$mn] |
|---|---|---|
| 1 | CHINA SHENHUA ENERGY CO | 14,006 |
| 2 | SASOL | 11,050 |
| 3 | COAL INDIA LTD | 10,251 |
| 4 | CHINA COAL ENERGY COMPANY | 5,966 |
| 5 | ADANI ENTERPRISES LTD | 5,068 |
| 6 | PEABODY ENERGY CORPORATION | 4,890 |
| 7 | INNER MONGOLIA YITAI COAL CO., LTD | 3,397 |
| 8 | YANZHOU COAL MINING COMPANY LTD | 3,045 |
| 9 | PT ADARO ENERGY TBK | 2,909 |
| 10 | ALPHA NATURAL RESOURCES | 2,837 |

### Top 30 Coal-Processing Technology Companies

- By normalised syngas production per day in $Nm^3/d$
- 34% of all world CPT plants
- 63% of all world CPT products

| | Coal-Processing Technology Companies | [kNm³/d] |
|---|---|---|
| 1 | SASOL | 90,260 |
| 2 | DATANG | 48,550 |
| 3 | SHENHUA GROUP | 43,360 |
| 4 | YITAI COAL OIL MANUFACTURING CO (INNER MONGOLIA YITAI GROUP) | 33,700 |
| 5 | SINOPEC | 29,481 |
| 6 | CHINACOAL GROUP | 24,100 |
| 7 | DAKOTA GASIFICATION CO | 13,900 |
| 8 | QINGHUA GROUP | 13,860 |
| 9 | YANKUANG GROUP | 13,415 |
| 10 | GUANGHUI ENERGY CO | 12,600 |

# ASSET-LEVEL DATABASES

Data sources and completeness

| Data | Data Source (in order of seniority) | Completion [%] | Notes |
|---|---|---|---|
| **Number of Coal-Fired Generating Assets (N = 1,445 coal-fired power stations)** | | | |
| Location | CoalSwarm's Global Coal Plant Tracker (CoalSwarm, Q4 2015) Enipedia Carbon Monitoring for Action Database (CARMA, v3.0 released Jul 2012) Platts' World Electric Power Plant Database (WEPP, Q4 2015) | 100% | |
| Capacity [MW] | CoalSwarm, WEPP, Enipedia, CARMA | 100% | |
| Generation [MWh] | Enipedia, CARMA, Oxford Smith School | 100% | 26% estimated by regression |
| Plant Age | CoalSwarm, WEPP, Enipedia, CARMA, Oxford Smith School | 100% | 31% estimated by regression |
| $CO_2$ Intensity | CoalSwarm, WEPP, CARMA, Oxford Smith School | 100% | 22% estimated by regression |
| Cooling Technologies | WEPP, Oxford Smith School | 71% | 12pp added from GoogleEarth searching |
| Pollution Abatement Technologies | WEPP | 73% | |
| Coal Type | CoalSwarm, WEPP, Oxford Smith School | 71% | 29pp estimated based on proximity to reserves |
| **Number of Thermal Coal Mining Assets (N = 274 thermal coal mines)** | | | |
| 'Top 30' coal mining companies | MSCI | - | |
| % Rev by Activity | MSCI, Trucost | 97% | Data unavailable |
| Mine Production | Oxford Smith School | 69% | Data unavailable |
| Location | Oxford Smith School | 100% | |
| **Number of Coal Processing Technology Assets (N = 63 coal processing technology plants)** | | | |
| Location | World Gasification Database (Nov 2015) | 100% | |
| Capacity [Nm³/day] | World Gasification Database, Oxford Smith School | 100% | 14% estimated from product energy content |
| Plant Age | World Gasification Database | 100% | |

# RISK HYPOTHESES (LOCAL AND NATIONAL)

| # | NAME | SOURCE |
|---|------|--------|
| **Coal-Fired Power Utilities** | | |
| LRH-U1 | Carbon Intensity | CARMA/CoalSwarm/WEPP/Oxford Smith School |
| LRH-U2 | Plant Age | CARMA/CoalSwarm/WEPP |
| LRH-U3 | Local Air Pollution | Boys et al. (2015)/NASA's SEDAC |
| LRH-U4 | Water Stress | WRI's Aqueduct |
| LRH-U5 | Quality of Coal | CoalSwarm/WEPP |
| LRH-U6 | CCS Retrofitability | CARMA/CoalSwarm/WEPP/Geogreen |
| LRH-U7 | Future Heat Stress | IPCC AR5 |
| NRH-U1 | Electricity Demand Outlook | IEA |
| NRH-U2 | 'Utility Death Spiral' | Oxford Smith School |
| NRH-U3 | Renewables Resource | Lu et al. (2009)/ McKinsey & Co/ SolarGIS |
| NRH-U4 | Renewables Policy Support | EY's Renewables Attractiveness Index |
| NRH-U5 | Renewables Generation Outlook | BP/REN21 |
| NRH-U6 | Gas Resource | BP/IEA |
| NRH-U7 | Gas Generation Outlook | IEA |
| NRH-U8 | Falling Utilisation Rates | Oxford Smith School |
| NRH-U9 | Regulatory Water Stress | WRI's Aqueduct |
| NRH-U10 | CCS Legal Environment | Global CCS Institute |

| # | NAME | SOURCE |
|---|------|--------|
| **Thermal Coal Mining Companies** | | |
| LRH-M1 | Proximity to Populations and Protected Areas | NASA's SEDAC/UNEP-WCMC |
| LRH-M2 | Water Stress | WRI's Aqueduct |
| NRH-M1 | Remediation Liability Exposure | Oxford Smith School |
| NRH-M2 | Environmental Regulation | Oxford Smith School |
| NRH-M3 | New Mineral Taxes or Tariffs | Oxford Smith School |
| NRH-M4 | Type of Coal Produced | IEA |
| NRH-M5 | Domestic Demand Outlook | IEA |
| NRH-M6 | Export Sensitivity | IEA |
| NRH-M7 | Protests and Activism | CoalSwarm |
| NRH-M8 | Water Regulatory Stress | WRI's Aqueduct |
| **Coal Processing Technology Companies** | | |
| LRH-P1 | Plant Age | World Gasification Database |
| LRH-P2 | Water Stress | WRI's Aqueduct |
| LRH-P3 | CCS Retrofitability | World Gasification Database/GeoGreen |
| NRH-P1 | CPT Policy Support | Oxford Smith School |
| NRH-P2 | Oil and Gas Demand Outlook | IEA |
| NRH-P3 | Oil and Gas Indigenous Resources | BP |
| NRH-P4 | Other Local Environmental | Oxford Smith School |
| NRH-P5 | Regulatory Water Stress | WRI's Aqueduct |
| NRH-P6 | CCS Policy Outlook | Global CCS Institute |

# FINDINGS: UTILITIES

### LRH-U1: 'Carbon Intensity'

1. EUROSIBENERGO
2. GAZPROM
3. ELEKTROPRIVREDA SRBIJE (EPS)
4. CEZ AS
5. OOO SIBERIAN GENERATING CO
6. CHINA PETRO & CHEM (SINOPEC)
7. AGL ENERGY LTD
8. SHENZHEN ENERGY GROUP CO LTD
9. HARYANA POWER GEN CO (HPGC)
10. PUBLIC POWER CORP (DEI)

### LRH-U2: 'Plant Age'

1. ELEKTROPRIVREDA SRBIJE (EPS)
2. SCOTTISH AND SOUTHERN ENERGY
3. DTE ENERGY CO
4. AMEREN CORP
5. DYNEGY HOLDINGS INC
6. DOMINION
7. SALT RIVER PROJECT (AZ)
8. NRG ENERGY INC
9. TENNESSEE VALLEY AUTHORITY
10. ECU - ENERGY CO OF UKRAINE

### LRH-U3: 'Local Air Pollution'

1. WEST BENGAL POWER DEV CORP
1. SHENZHEN ENERGY GROUP CO LTD
1. MP POWER GENERATING CO LTD
1. SHENERGY COMPANY LTD
1. TAMIL NADU GEN & DIST CORP LTD
1. UTTAR PRADESH RAJYA VIDYUT
1. MAHARASHTRA STATE POWER GEN CO
1. TATA GROUP
1. MINISTRY OF ECONOMIC AFFAIRS

Top 9 Companies Tied

### LRH-U6: 'CCS Retrofitability'

Top 65 Companies Tied

### LRH-U4: 'Water Stress'

1. ELEKTROPRIVREDA SRBIJE (EPS)
2. SCOTTISH AND SOUTHERN ENERGY
3. DTE ENERGY CO
4. AMEREN CORP
5. DYNEGY HOLDINGS INC
6. DOMINION
7. SALT RIVER PROJECT (AZ)
8. NRG ENERGY INC
9. TENNESSEE VALLEY AUTHORITY
10. ECU - ENERGY CO OF UKRAINE

### LRH-U5: 'Quality of Coal'

1. ELEKTROPRIVREDA SRBIJE (EPS)
2. PUBLIC POWER CORP (DEI)
3. ENERGY FUTURE HOLDINGS CORP
4. NEYVELI LIGNITE CORP LTD
5. RWE AG
6. CEZ AS
7. PGE POLSKA GRUPA ENERGETYCZNA
8. GAZPROM
9. VATTENFALL GROUP
10. INTER RAO UES

### LRH-U7: 'Future Heat Stress'

1. GAZPROM
1. BASIN ELECTRIC POWER COOP
1. ECU - ENERGY CO OF UKRAINE
1. DATONG COAL MINE GROUP CO LTD
1. BERKSHIRE HATHAWAY ENERGY COMPANY
1. DTE ENERGY CO
1. AMEREN CORP
1. GREAT PLAINS ENERGY INC
1. ALLIANT ENERGY CORP
1. ENTERGY CORP

Top 10 Companies Tied

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# FINDINGS: MINERS

| | LRH-M1: 'Proximity to Protected Areas and Populations' |
|---|---|
| 1 | THE TATA POWER COMPANY |
| 2 | COAL INDIA LTD |
| 3 | SHANXI LU'AN ENVIRONMENTAL ENERGY DEVELOPMENT |
| 4 | INDO TAMBANGRAYA MEGAH TBK PT |
| 5 | YANG QUAN COAL INDUSTRY (GROUP) CO., LTD. |
| 6 | CHINA COAL ENERGY COMPANY |
| 7 | BANPU PUBLIC COMPANY LIMITED |
| 8 | YANZHOU COAL MINING COMPANY LIMITED |
| 9 | CHINA SHENHUA ENERGY CO |
| 10 | INNER MONGOLIA YITAI COAL CO., LTD. |

| | LRH-M2: 'Water Stress' |
|---|---|
| 1 | SHANXI LU'AN ENVIRONMENTAL ENERGY DEVELOPMENT |
| 1 | YANG QUAN COAL INDUSTRY (GROUP) CO., LTD. |
| 1 | CHINA COAL ENERGY COMPANY |
| 1 | DATONG COAL INDUSTRY |
| 5 | INNER MONGOLIA YITAI COAL CO., LTD. |
| 6 | CHINA SHENHUA ENERGY CO |
| 7 | YANZHOU COAL MINING COMPANY LIMITED |
| 8 | ARCH COAL |
| 9 | ALPHA NATURAL RESOURCES |
| 10 | BANPU PUBLIC COMPANY LIMITED |
| | Top 4 Companies Tied |

# FINDINGS: COAL-PROCESSING TECHNOLOGY COMPANIES

| LRH-P1: 'Plant Age' |
| --- |
| 1 SASOL |
| 2 DAKOTA GASIFICATION CO |
| 3 HARBIN YILAN COAL GASIFICATION |
| 4 YANKUANG GROUP |
| 5 TIANJIN BOHAI CHEMICAL GROUP |
| 6 SANWEI RESOURCE GROUP |
| 7 JIEHUA CHEMICAL |
| 8 HUALU HENGSHENG CHEMICALS |
| 9 SINOPEC |
| 10 DATANG |

| LRH-P2: 'Water Stress' |
| --- |
| 1 KOREA SOUTH EAST POWER CO (KOSEP) |
| 2 YANTAI WANHUA |
| 3 XINJIANG XINLIANXIN FERTILIZER CO. LTD. |
| 4 TIANJIN BOHAI CHEMICAL GROUP |
| 5 QINGHUA GROUP |
| 6 HUALU HENGSHENG CHEMICALS |
| 7 GUANGHUI ENERGY CO |
| 8 SHENHUA GROUP |
| 9 SANWEI RESOURCE GROUP |
| 10 YITAI COAL OIL MANUFACTURING CO (INNER MONGOLIA YITAI GROUP) |

| LRH-P3: 'CCS Retrofitability' |
| --- |
| Top 16 Companies Tied |

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# WHAT VOLUNTARY DISCLOSURE CAN AND CAN'T DO

We need to recognise voluntary disclosure's theory of change, its strengths, and its weaknesses

## CAN

### CHANGE BEHVAVIOUR OVER TIME

- Companies that disclose may do more to manage their environmental performance

- Voluntary disclosure frameworks take companies on this 'journey'

- Strategy entails asking more and more questions as part of each reporting cycle

### PROVIDE SOME USEFUL INFORMATION

- Information useful in providing insight into quality of reporting and therefore how seriously a company takes an issue

- Provides insight into how these issues might fit into corporate strategy

- Provides a way to hold companies to account if they mislead or misrepresent on a disclosure

## CAN'T

### PROVIDE VERY MUCH IN THE WAY OF DATA FOR FUNDAMENTAL INVESTMENT ANALYSIS

- Far from universal coverage

- Cumbersome annually reporting cycles

- Data already of out of date

- Asks questions disconnected from fundamentals

- Data quality is poor and significant investments attempt to assure it

- Slow moving

- Becomes a smoke screen for companies not doing very much at all

# NEW LIFE AND PURPOSE FOR VOLUNTARY DISCLOSURE

**Towards a Principle of Asset-level Disclosure**

## ASK FOR ASSET-LEVEL DATA

- Disclosure frameworks can ask for data that is actually useful!

- Asset-level data useful to all groups: a) asset managers evaluating the environmental performance of companies; b) asset owners evaluating the environmental performance of funds run by asset managers; c) regulators monitoring the stability of the financial system and build up of systemic risk; and d) policymakers concerned with ensuring that capital is flowing at sufficient scale and pace to deliver the transition to a more sustainable global economy.

- Better data on specific assets within company portfolios would allow for researchers and analysts to undertake their own research on the risks and opportunities facing company portfolios.

## WHAT ARE THE KEY ASSET-LEVEL DATA POINTS IN DIFFERENT SECTORS?

- The data points disclosed would depend on the sector in question and would need to take account of commercial confidentiality.

- Data fields would be decided sector by sector in consultation with companies. Should include:
    - Locational data to enable spatial analysis
    - Clarifying ownership
    - Technology employed
    - Production data

- Does not need to include breakeven points or equivalent

- Introducing a new 'Principle of Asset-level Disclosure' into reporting frameworks would can give new life and purpose to existing disclosure frameworks

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# WE LIVE IN A WORLD THAT WILL NEVER HAVE PERFECT DISCLOSURE

**'Company Data Intelligence Service' (CDIS) needed to bring together asset-specific information so advanced analysis can be undertaken**

## USE EXISTING ASSET-LEVEL DATA

- Existing datasets have much of the information required, but held in disparate locations
    - local or national registries and public records
    - existing proprietary and non-proprietary databases
    - company reporting to financial markets and to regulators
    - buried in universities and other research institutes

- Challenge is finding this data and then integrating it, matching, and assuring it

- Can get much more out of existing data
    - apply new analytical methods including machine learning and AI
    - quantitative analysis of qualitative reporting

- Massive benefits of having this basic asset-level data provided in consistent formats by trusted public goods initiative

- Costs of this much smaller than current voluntary disclosure frameworks

## AUGMENT WITH NEW DATA

- Remote sensing - satellites, drones, other sensors

- Big data and other novel data sets

- Where estimation needs to happen, should happen using transparent and robust methodologies

- 'Stick' to disclosure's 'carrot' – forcing companies to correct and disclose additional information

- Significant benefits of having one global initiative for coordinating the aggregation of basic asset-level data across sectors

- Enables consultants, data companies, and others to concentrate on more advanced analysis – not an arms race over the basics

- Prevents multiple proprietary datasets competing in different sectors slowing uptake

- Benefits of competition can be captured by public goods initiative

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# CONCLUSION

- **THERE ARE MULTIPLE ENVIRONMENTAL RISKS AND OPPORTUNITIES TRANSFORMING SECTORS AND INDUSTRIES GLOBALLY**

- **THESE CAN BE IDENTIFIED AND ASSETS MEASURED FOR EXPOSURE MUCH MORE EFFECTIVELY THAN EVER BEFORE. KEY FOR CAPITAL TO FLOW AWAY FROM 'BROWN' AND TOWARDS 'GREEN'**

- **WE NEED BASIC AND CONSISTENT ASSET-LEVEL INFORMATION ACROSS SECTORS TO DO THIS**

- **WE ALSO NEED TO DEVELOP ROBUST, FORWARD LOOKING MEASURES OF ENVIRONMENTAL RISK AND OPPORTUNITY**

- **VOLUNTARY DISCLOSURE HAS A ROLE, BUT WE MUST ACKNOWLEDGE ITS STRENGTHS AND WEAKNESSES**

- **WE LIVE IN A WORLD THAT WILL NEVER HAVE PERFECT DISCLOSURE**

- **THEREFORE TO GET ALL THE DATA WE NEED WILL REQUIRE US TO TRANSCEND REPORTING. TIME IS SHORT**

- **THE 'COMPANY DATA INTELLIGENCE SERVICE', RUN AS AN INTERNATIONAL COLLABORATION, COULD ACT AS THE FOCAL POINT OF THIS EFFORT AND BE GOVERNED AS A PUBLIC GOODS INITITAIVE**

- **THE UNIVERSITY OF OXFORD WANTS TO COLLABORATE WITH ORGANISATIONS TO MAKE THIS HAPPEN**

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