ACHIEVING CLIMATE ALIGNMENT IN FINANCE

(formerly ‘Objectively assessing the (in)compatibility of power assets with the Paris Agreement’)

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AGENDA

- **Time to focus on alignment**
- **Three pillars of alignment, including (in)compatibility**
- **Current approaches to measuring (in)compatibility**
- **A better ‘bottom-up’ approach for measuring (in)compatibility**
- **Towards Spatial Finance**

Time to focus on alignment

CLIMATE RISK MANAGEMENT ≠ ALIGNMENT WITH CLIMATE OUTCOMES

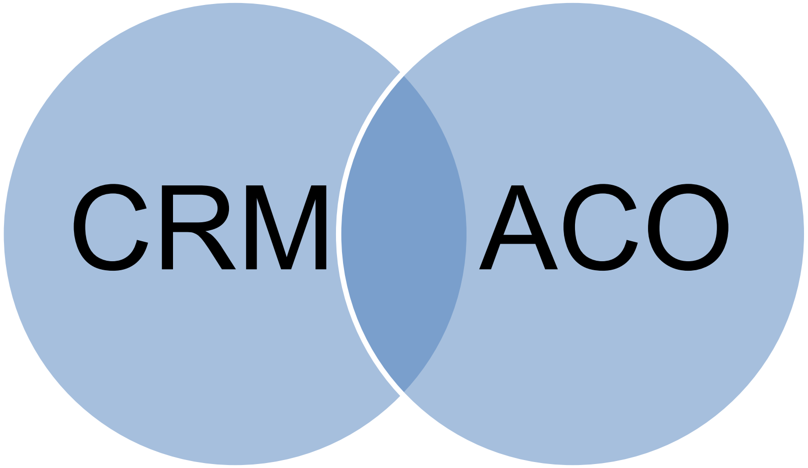
Climate-related risks stranding assets spurred work by supervisors and central banks

- New supervisory expectations and climate stress tests
- Task Force on Climate-related Financial Disclosures (TCFD)

But climate risk management (CRM) is often erroneously conflated with seeking or achieving alignment with climate outcomes (ACO).

- While there is overlap between CRM and ACO they are not the same.

CRM can make little or no contribution to ACO. E.g. reducing exposure to Country A carbon prices could entail moving production to Country B, potentially increasing net pollution overall ("Carbon Leakage"). Or a company could hedge exposure to projected increases in carbon prices and not alter underlying economic activities.



CRM can result in better climate outcomes, but not always. E.g. reducing Company A's exposure to increases in carbon prices could entail reducing the company's carbon emissions, helping ACO.

Synergies between ACO and CRM important and it makes sense to maximise them, but different from saying there is always a positive relationship between them both, or that CRM automatically and inevitably leads to ACO. It does not.

CRM VS ACO 2/2

- **Risk associated with the accidental (or sometimes intentional) conflation of CRM with ACO.**
  - Financial institutions signing up to the TCFD, for example, may think that by doing so they are making a difference to the climate, when this is not necessarily the case.

- **TCFD is an important development, but even if every economic and financial actor signed up to the TCFD and implemented it perfectly, we would still not have global ACO.**

- **Instead of incidentally contributing to ACO through CRM initiatives like the TCFD, we need specific ways of dealing with and contributing to the challenge of alignment.**

- **These need to be articulated, developed, and scaled across the financial system rapidly. We need to rebalance the distribution of effort and spend more time explicitly on ACO.**

- **Report one attempt to rebalance and clarify conversation**

ALIGNMENT WITH CLIMATE OUTCOMES: THREE PILLARS

1. **Properly measuring, tracking, and targeting (in)compatibility** - New family of forward-looking bottom-up asset-level approaches to measuring (in)compatibility. Carbon lock-in methods using asset-level data for measuring (in)compatibility together with confidence levels for given targets. These allows us to see which asset(s) and portfolio(s) are (in)compatible and how robustly they are (or are not).

2. **Making a real economy contribution** - Just because you hold a lot of Paris compatible assets (see above), doesn't necessarily mean you have made a contribution to ACO. Finance can contribute to the real economy transition in five main ways: A (cost of capital), B (liquidity), C (risk management), D (adoption of sustainable practices), and E (spill over effects). ACO must also mean demonstrating and measuring contributions. Financial institutions seeking ACO should proactively maximise the positive real economy impact for the instruments they have and potentially even seek to optimise their portfolio of instruments to maximise ACO.

3. **Perseverance and consistency** - the governance, behaviours, and principles we need to stick to over time in order to deliver ACO. In addition to robust target setting and tracking, and ensuring finance really does accelerate the real economy transition, financial institutions will have to systematically review how they can better support ACO and then develop plans to embed alignment in everything they do - an ongoing and resource intensive process.

Current approaches to measuring (in)compatibility

CURRENT EFFORTS TO MEASURE EXPOSURE ARE FLAWED

Carbon footprinting is not the solution and current efforts often focus on incremental improvements to a questionable approach

PHYSICAL CLIMATE CHANGE IMPACTS

INCREASING STRINGENCY OF ENVIRONMENTAL REGULATION

COMPETITION FROM CLEAN TECH

INCREASED REPUTATIONAL RISK

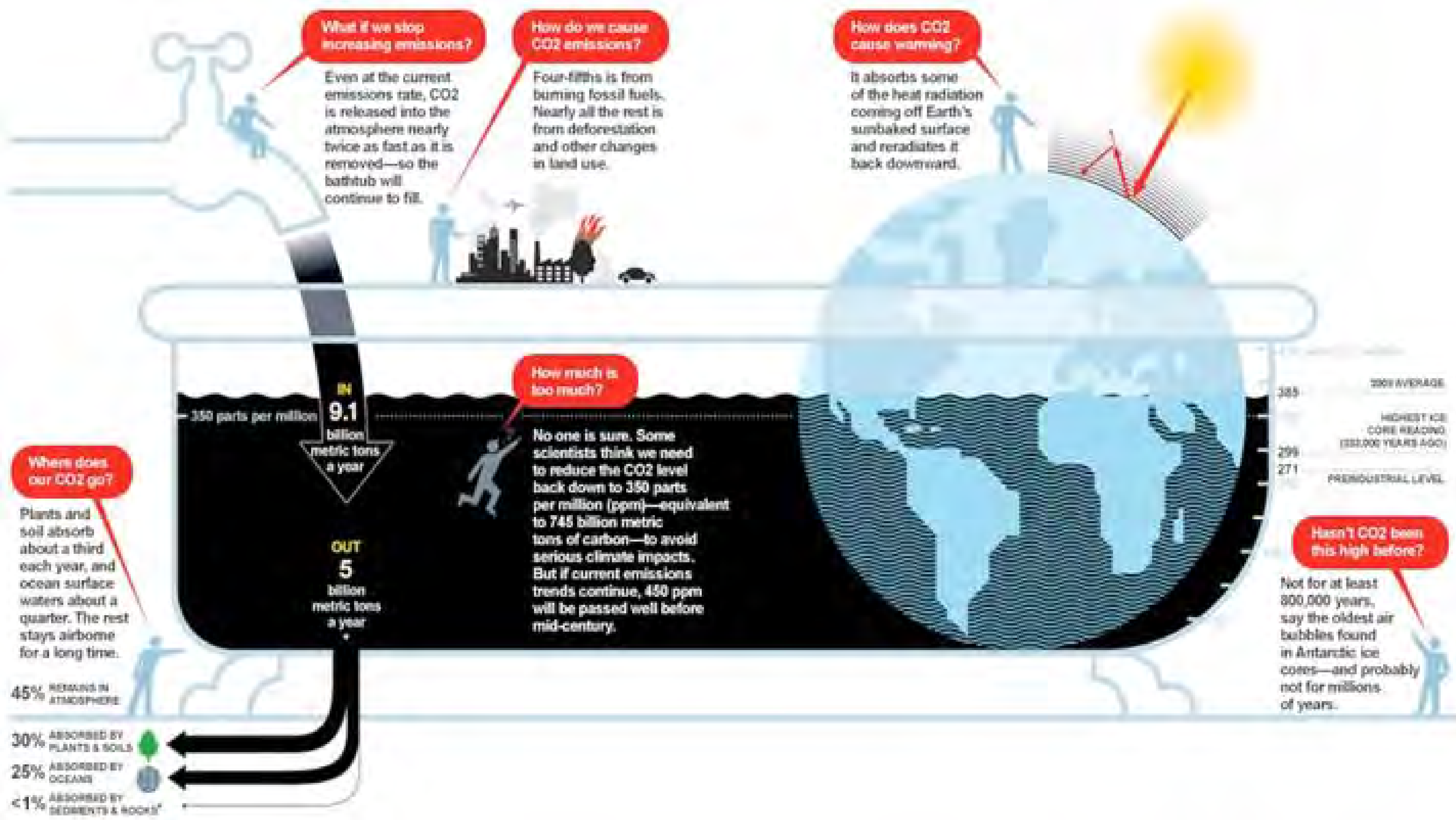
COMPANY A

CARBON INTENSITY DATA USED AS A 'TOP DOWN' PROXY

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

A better ‘bottom-up’ approach for measuring (in)compatibility (PILLAR 1)

TO STABILISE TEMPERATURES WE NEED TO ACHIEVE NET ZERO, I.E. PREVENT THE BATHTUB FROM OVERFLOWING



Source: National Geographic (2009)

PARIS AGREEMENT AIMS TO KEEP THE GLOBAL TEMPERATURE RISE THIS CENTURY TO "WELL BELOW 2°C ABOVE PRE-INDUSTRIAL LEVELS"

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- To stabilise climate at any given warming threshold, whether well-below 2°C (widely interpreted as 1.5°C), 2°C, 2.5°C, 3°C, or 4°C, we need to achieve net zero emissions in order to stabilise the stock of carbon in the atmosphere.

- This means reducing carbon emissions to zero in every sector we can, while also extracting and sequestering carbon from the atmosphere using biological, chemical, and industrial processes at incredibly large scales (McGlashan, Shah, Caldecott, & Workman, 2012).

- We need the capacity to capture and sequester carbon because some sectors, such as agriculture, have residual emissions that are nearly impossible to stop. There are sectors like aviation where we don't yet have zero carbon options.

STOCK VS FLOW AND THE IMPORTANCE OF CARBON LOCK-IN

ILLUSTRATIVE EXAMPLE

VS

Images: COG America

- Take an old coal plant and replace it with a new gas plant. New gas plant would emit 50-60% less carbon than the old coal plant.
- But the new gas plant will operate for at least 20 years (and as long as 40+ years depending on your assumptions), whereas the old coal plant might operate for only 5-7 years and which point it is replaced by renewables plus storage.
- Under this plausible scenario, while annual carbon emissions have improved, the new gas plant actually results in much more cumulative carbon emissions over its anticipated lifetime.

CASE STUDY
2ºC CAPITAL STOCK FOR ELECTRICITY GENERATION

- Carbon lock-in = Committed Cumulative Carbon Emissions (CCCE)
- CCCE are are the cumulative emissions that can be expected from the future operation of an asset over its expected economic lifetime under standard economic conditions.
- CCCE are a function of the lifetime of the asset, utilisation rates, and carbon intensity.
- CCCE can be reduced through early retirement, energy efficiency retrofit, switch to renewable fuels, or Carbon Capture & Storage.

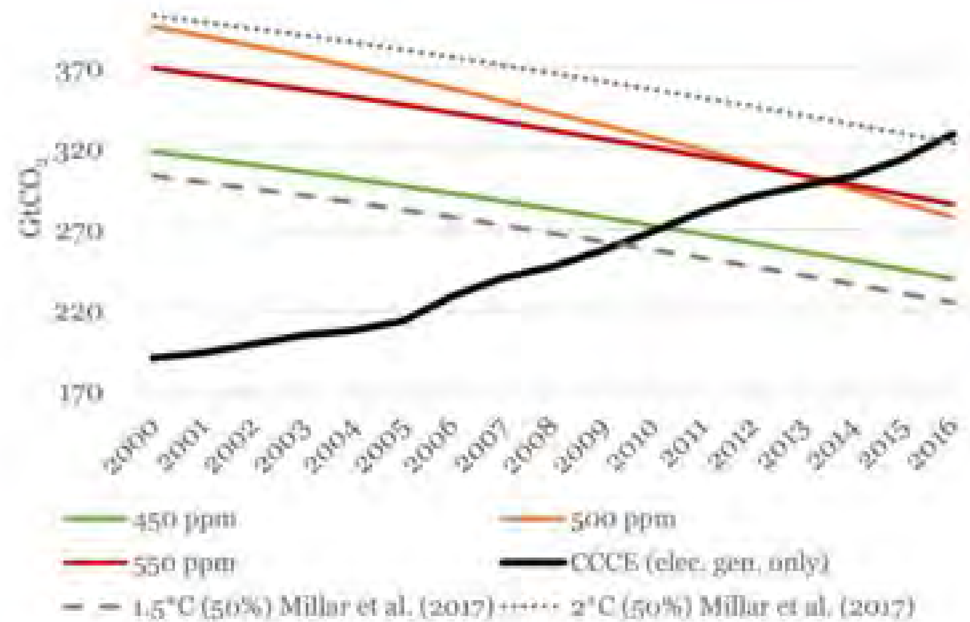


Figure 4. Development of remaining generation-only carbon budget in different climate scenarios (median) and committed emissions from generation capacity. In 2011, committed emissions from electricity generators reached the remaining total generation-only budget for the median 430–480 ppm scenario (good chance for only 1.5 °C–2 °C warming). In 2014, the remaining budget for the 480–530 and 530–580 ppm scenarios was reached. Following Millar *et al* (2017), the generation-only budget for a 50% chance for warming of less than 2 °C was reached in 2016.

Source: Pfeiffer, A., Hepburn, C., Vogt-Schilb, A. and Caldecott, B. (2018) Committed emissions from existing and planned power plants and asse stranding required to meet the Paris Agreement. Environmental Research Letters, 13(5).

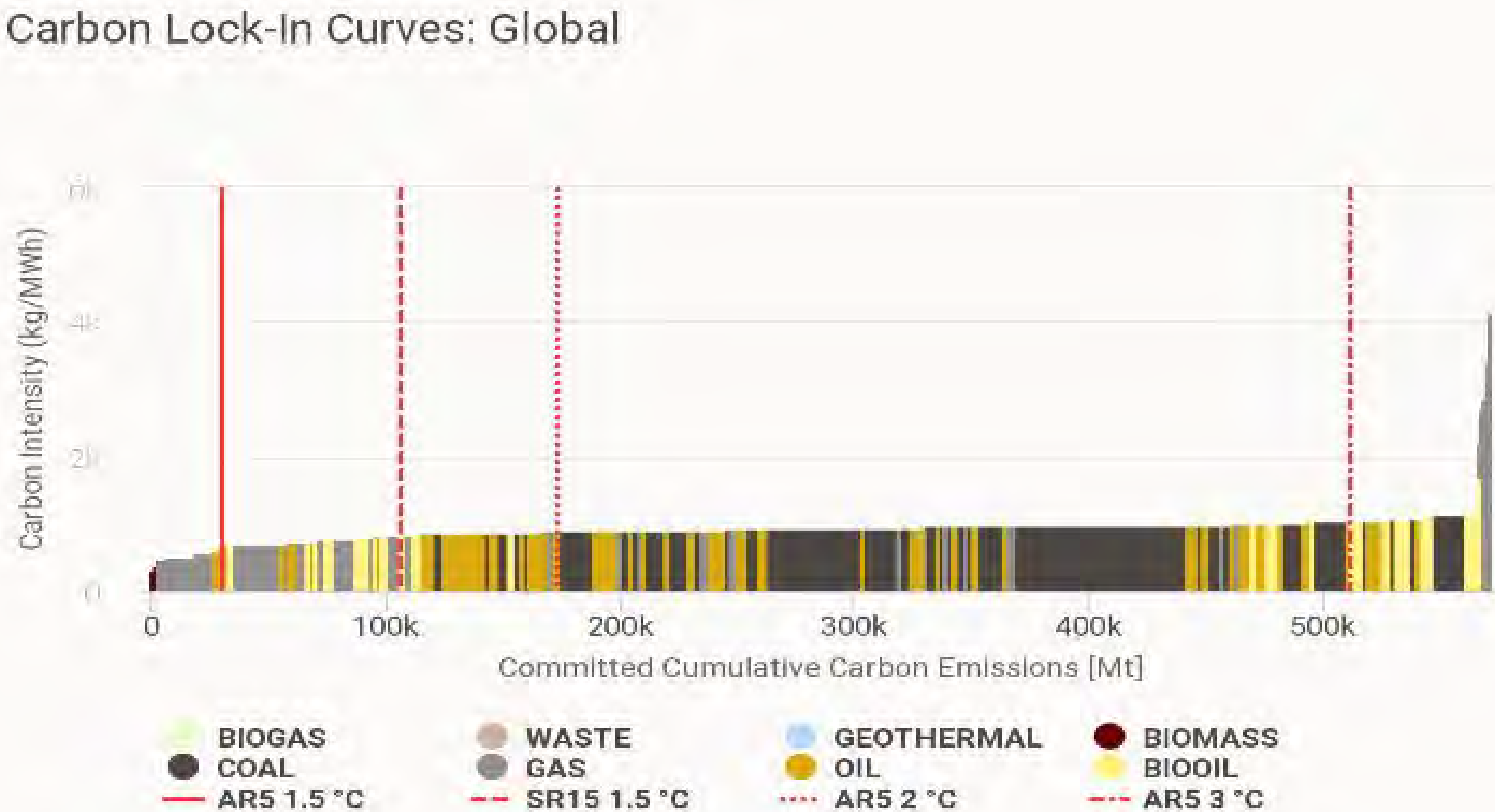
NEW FAMILY OF FORWARD-LOOKING BOTTOM-UP ASSET-LEVEL APPROACHES TO MEASURING (IN)COMPATIBILITY

Carbon lock-in methods using asset-level data for measuring (in)compatibility together with confidence levels for given targets. Requires:

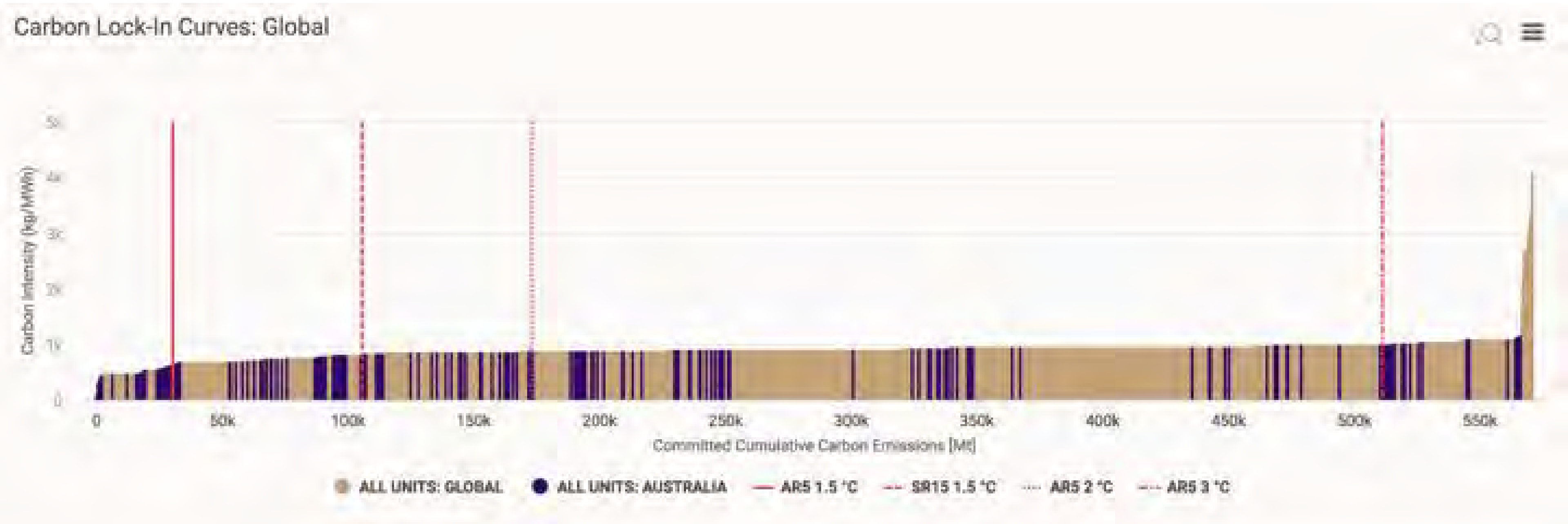
1. asset-level data tied to ownership by sector;
2. a global carbon budget for a Paris aligned warming threshold (i.e. a "well-below 2°C" carbon budget);
3. a proportion of this global carbon budget allocated to each sector;
4. assumptions of asset-level utilisation and efficiency to calculate asset-level carbon lock-in within each sector; and
5. an ordering method (e.g. by marginal cost, age, efficiency, or some combination) for assets to see which assets are at or below the carbon budget line for a given Paris aligned warming threshold.

Allows us to see which asset(s) and portfolio(s) are (in)compatible and how robustly they are (or are not).

COMMITTED EMISSIONS + BOTTOM-UP ASSET-LEVEL APPROACHES: CARBON LOCK-IN CURVES (CLICs)



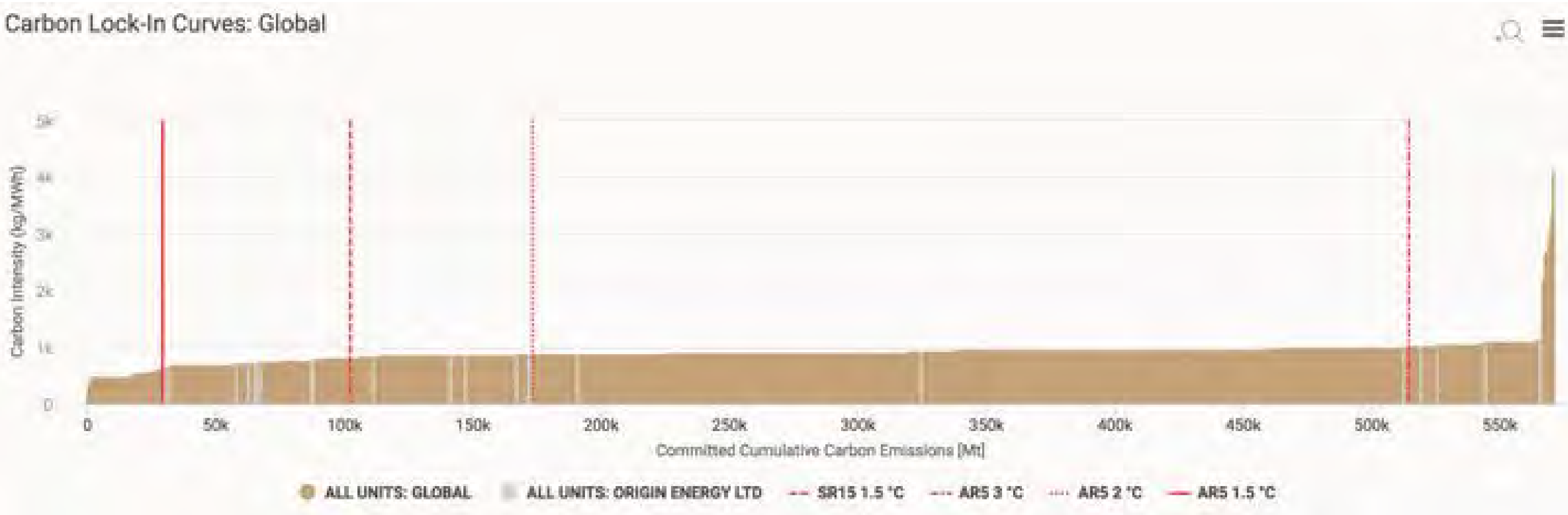
CLICs – AUSTRALIA, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
23.8%	75.3%	12.8%	3.2%

% of portfolio assets incompatible with each warming threshold

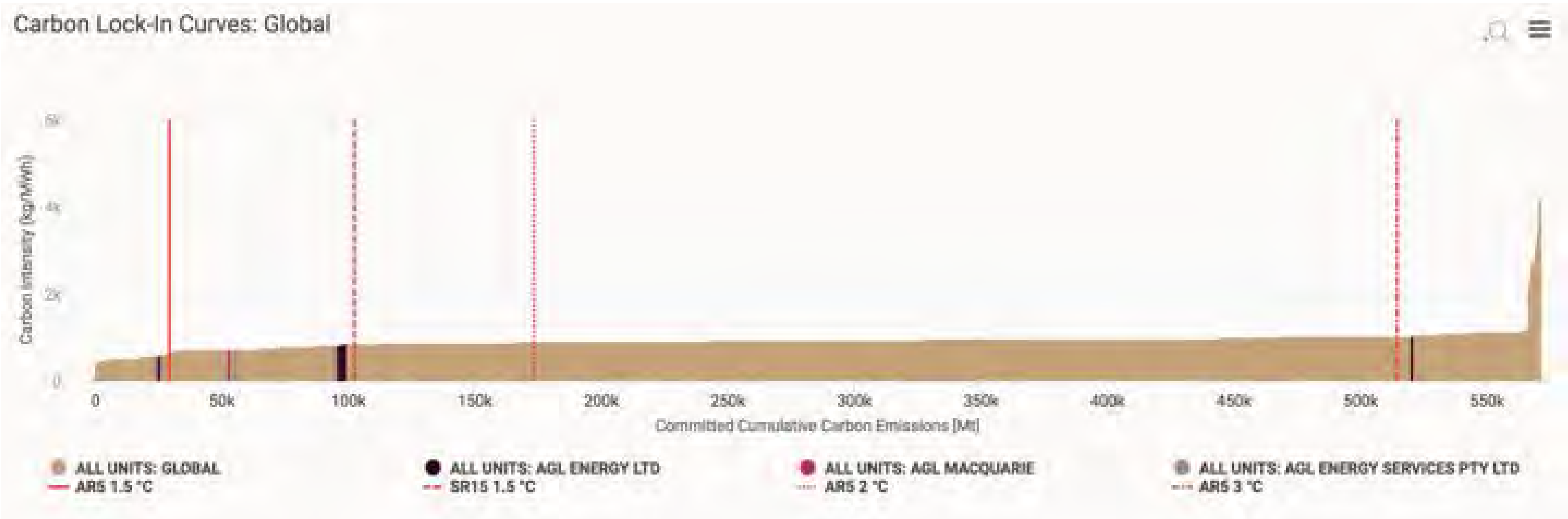
CLICs – ORIGIN, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
54.2%	100.0%	29.2%	16.7%

% of portfolio assets incompatible with each warming threshold

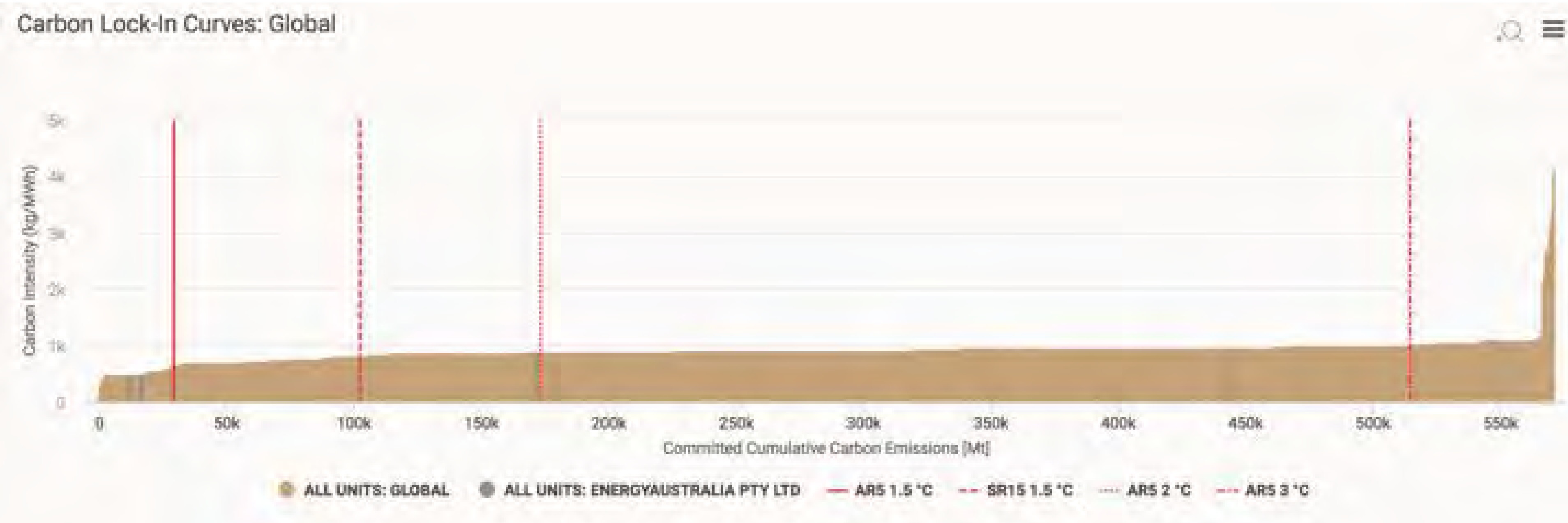
CLICs – AGL ENERGY, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
7.7%	76.9%	7.7%	7.7%

% of portfolio assets incompatible with each warming threshold

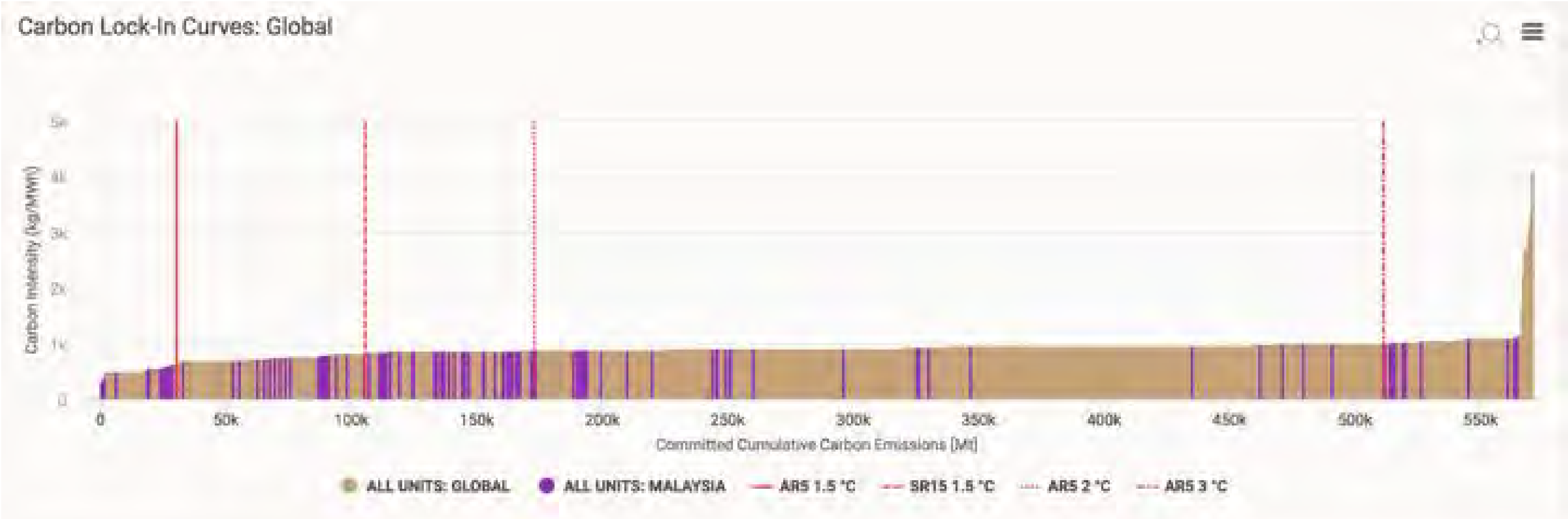
CLICs – ENERGYAUSTRALIA, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
40.0%	40.0%	20.0%	0%

% of portfolio assets incompatible with each warming threshold

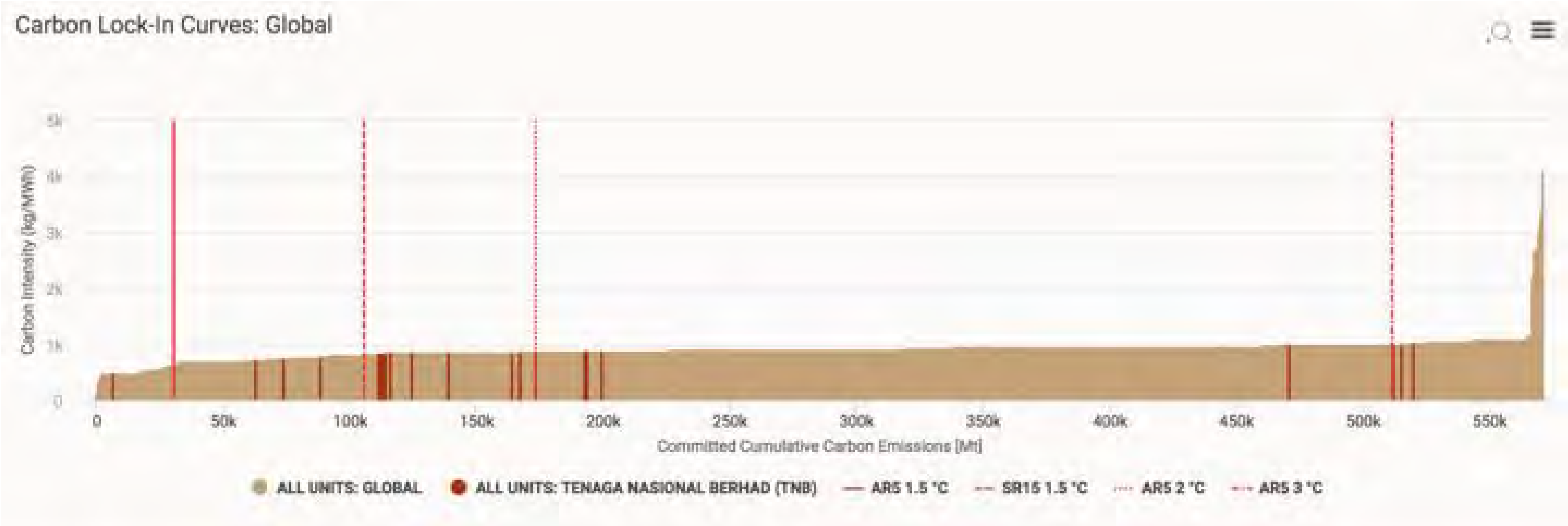
MALAYSIA



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
48.4%	91.3%	17.2%	4.0%

% of portfolio assets incompatible with each warming threshold

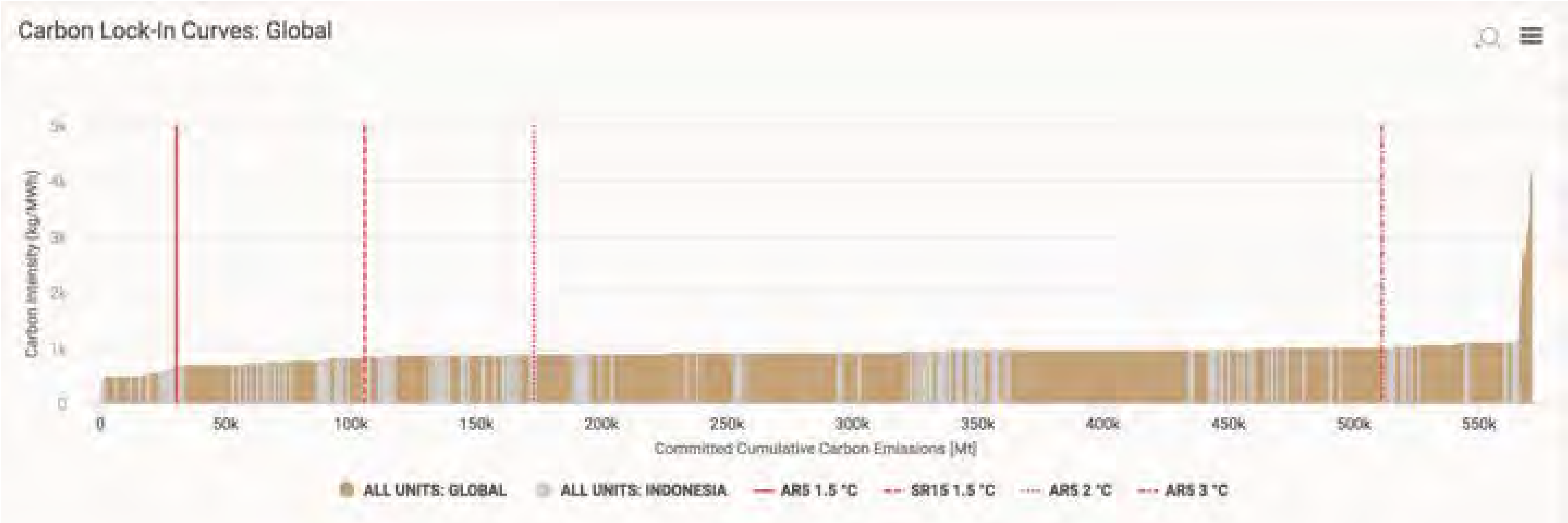
CLICs – TENAGA NASIONAL BERHAD, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
87.5%	96.9%	28.1%	9.4%

% of portfolio assets incompatible with each warming threshold

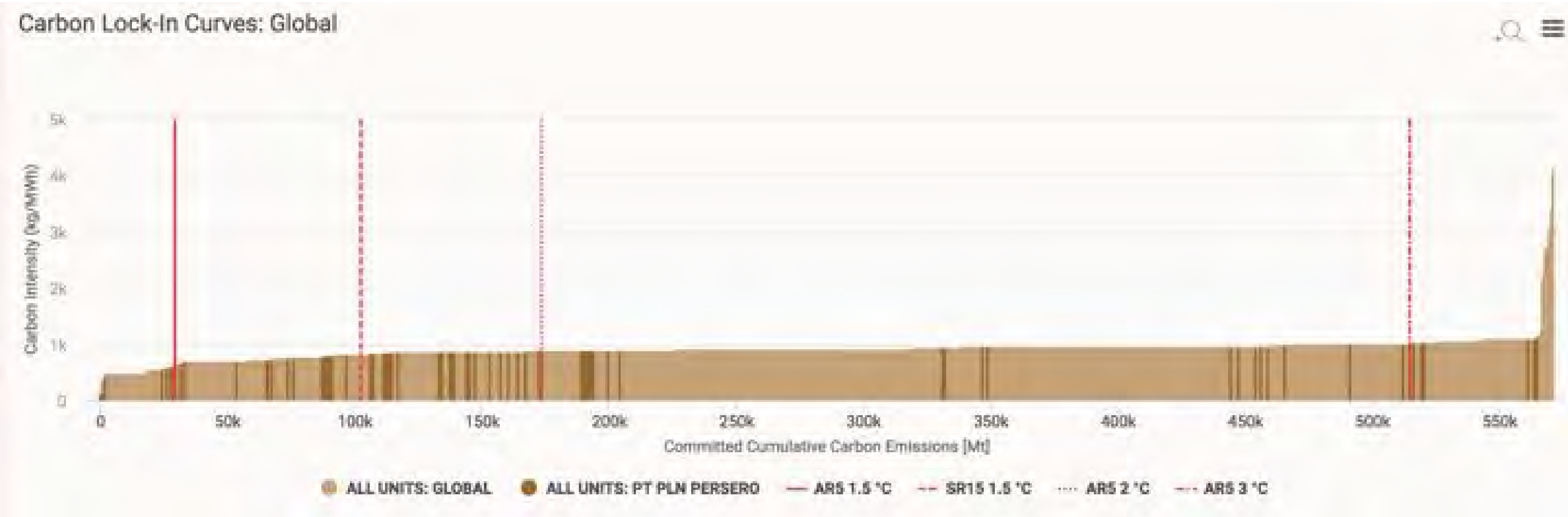
CLICs – INDONESIA, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
58.8%	90.4%	30.7%	4.8%

% of portfolio assets incompatible with each warming threshold

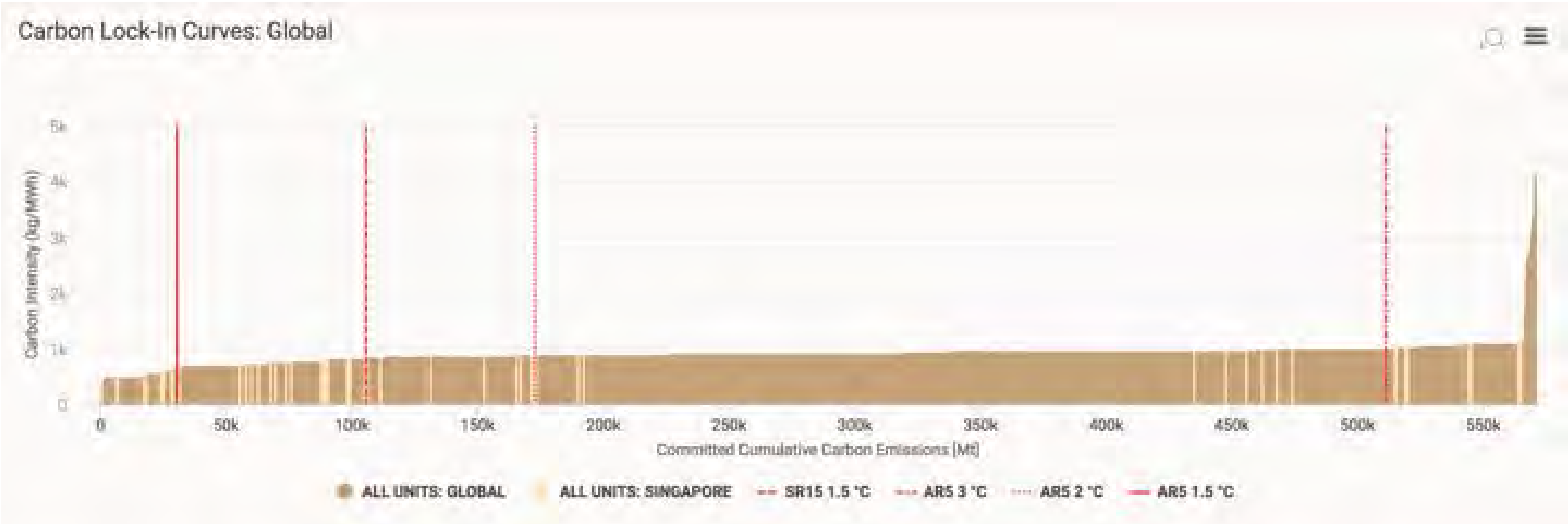
CLICs – PT PLN PERSERO, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
59.3%	90.7%	38.7%	8.0%

% of portfolio assets incompatible with each warming threshold

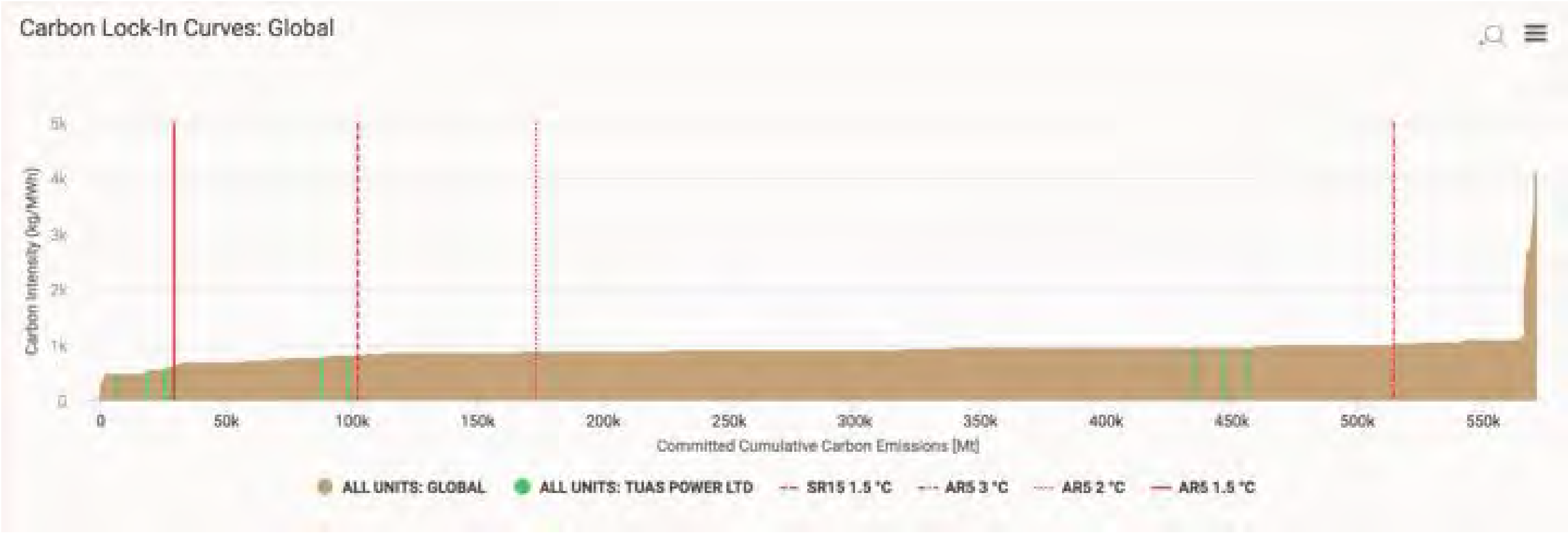
CLICs – SINGAPORE, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
59.1%	87.0%	39.0%	10.4%

% of portfolio assets incompatible with each warming threshold

CLICs – TUAS POWER, GLOBAL



SR15 1.5°C	AR5 1.5°C	AR5 2°C	AR5 3°C
25.0%	50.0%	25.0%	0.0%

% of portfolio assets incompatible with each warming threshold

COUNTRY RESULTS – GLOBAL CLIC

- **We assessed the compatibility with 1.5°C and 2°C carbon budgets for all power assets of AUSTRALIA, INDONESIA, MALAYSIA and SINGAPORE, as well as for the countries' largest utility companies AGL ENERGY, ENERGYAUSTRALIA, ORIGIN, PT PLN PERSERO, TENAGA NASIONAL BERHAD and TUAS POWER.**

Country	Carbon Budget (Global)	%age of current and planned assets incompatible
Australia	% Incompatible with AR5 1.5°C	75.3%
	% Incompatible with AR5 2°C	12.8%
Indonesia	% Incompatible with AR5 1.5°C	90.4%
	% Incompatible with AR5 2°C	30.7%
Malaysia	% Incompatible with AR5 1.5°C	91.3%
	% Incompatible with AR5 2°C	17.2%
Singapore	% Incompatible with AR5 1.5°C	87.0%
	% Incompatible with AR5 2°C	39.0%

UTILITY RESULTS – GLOBAL CLIC

Country	Utility	Carbon Budget (Global)	%age of current and planned assets incompatible
Australia	AGL Energy	% Incompatible with AR5 1.5^{o}C	76.9%
		% Incompatible with AR5 2^{o}C	7.7%
Australia	EnergyAustralia	% Incompatible with AR5 1.5^{o}C	40.0%
		% Incompatible with AR5 2^{o}C	20.0%
Australia	Origin	% Incompatible with AR5 1.5^{o}C	100.0%
		% Incompatible with AR5 2^{o}C	29.2%
Indonesia	PT PLN Presso	% Incompatible with AR5 1.5^{o}C	90.7%
		% Incompatible with AR5 2^{o}C	38.7%
Malaysia	Tenaga Nasional Berhad	% Incompatible with AR5 1.5^{o}C	96.9%
		% Incompatible with AR5 2^{o}C	28.1%
Singapore	Tuas Power	% Incompatible with AR5 1.5^{o}C	50.0%
		% Incompatible with AR5 2^{o}C	25.0%

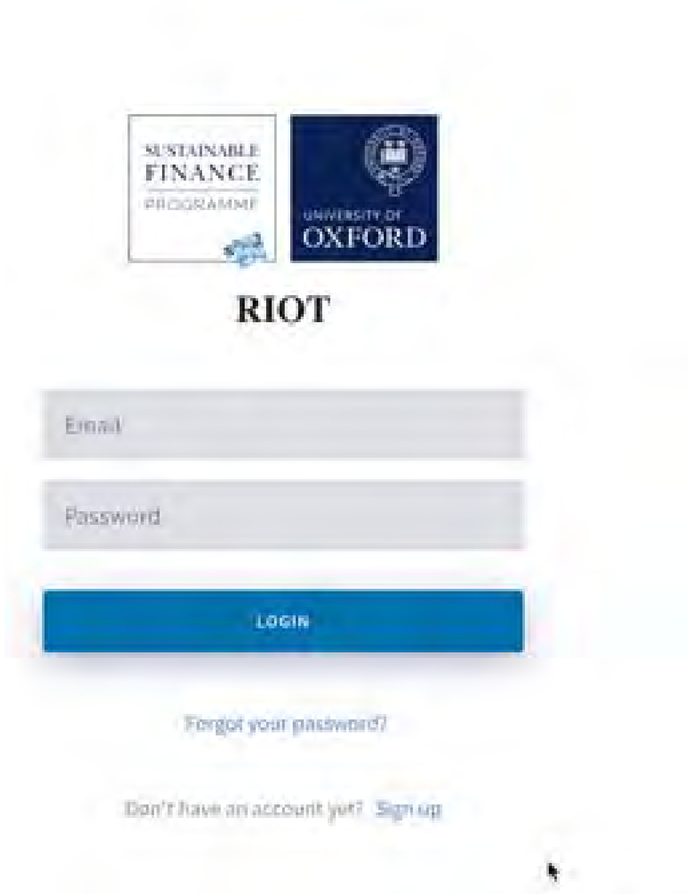
CONFIDENCE LEVELS CRITICAL AND CURRENTLY ABSENT
ASSET COMPATIBILITY WITH A GIVEN GLOBAL WARMING THRESHOLD IS NOT STATIC

The longer we delay net zero, the smaller the remaining carbon budget and the more likely we are to breach different warming thresholds.

The state of (in)compatibility could change under different circumstances. For example:
- size of carbon budgets change due to changes in science, IPCC AR5>SR15>AR6
- assets utilised less/more than previously thought
- polluting assets prematurely close, then the remaining assets will have more budget

Targets can explicitly acknowledges these uncertainties.
- In a given year X% of my firm’s assets will be compatible with Y carbon budget with Z confidence level. Z could represent +/- some range of carbon budget uncertainty or be some other measure of confidence.
- The key thing is that whatever the confidence level it would quantify simply how resilient your asset(s) or portfolio(s) level of Paris compatibility is/are to changes to your asset(s) usage and efficiency, the sector(s) carbon budget, and the global carbon budget.
- A portfolio that has X% of Paris compatibility, but a much lower confidence level would be less desirable than one with the same level of compatibility and a higher level of confidence.

VIDEO


RIOT
Email
Password
LOGIN
Forgot your password?
Don't have an account yet? Sign up

Data Sources

Data	Data Source (in order of seniority)	Completion %	Notes
Coal-Fired Generating Assets			
Location	CoalSwarm's Global Coal Plant Tracker (CoalSwarm, Q2 2018) Platts' World Electric Power Plant Database (WEPP*, Q4 2017, Q2 2018 in progress), WRI (Q2 2018 in progress) Enipedia (Q1 2017) Carbon Monitoring for Action Database (CARMA, v3.0 released Jul 2012)	100%	
Capacity [MW]	CoalSwarm, WEPP, Enipedia, CARMA, Greenpeace	100%	
Generation [MWh]	Enipedia, CARMA, Oxford Smith School	100%	
Plant Age	CoalSwarm, WEPP, Enipedia, CARMA, Greenepace, Oxford Smith School	100%	25% estimated
CO_2 Intensity	CoalSwarm, EIA, Sargent & Lundy (2009), Oxford Smith School	100%	8.4% estimated
Cooling Technologies	WEPP, Oxford Smith School	100%	60% estimated

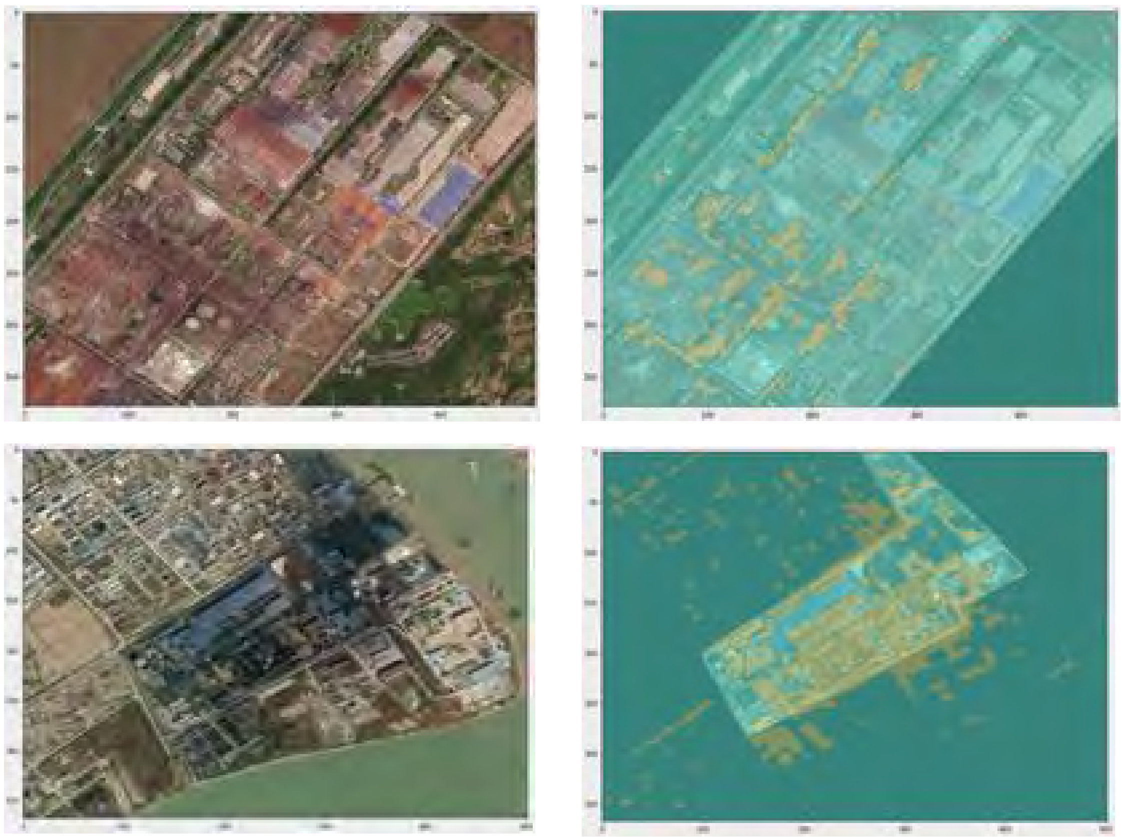
CEMENT AND IRON & STEEL

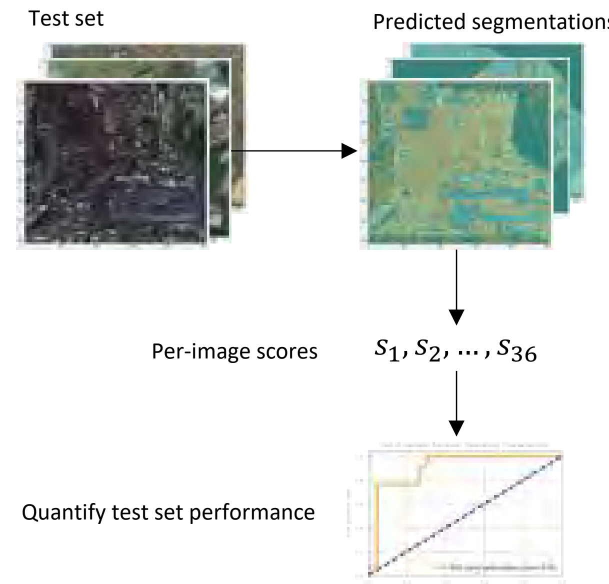
- Cement production and iron & steel production are two of the most emissions intensive industries, accounting for around 5.7% and 7.2% of global CO_2 emissions respectively
- Current asset-level datasets for iron & steel production and cement production are insufficient for undertaking full global sectoral risk and impact assessment
- These datasets often do not provide exact locations for assets, which is required for physical risk assessments and frequently do not include important data fields, such as capacity
- Current asset-level datasets are infrequently updated, typically only amended every 1 to 2 years

CEMENT AND IRON & STEEL

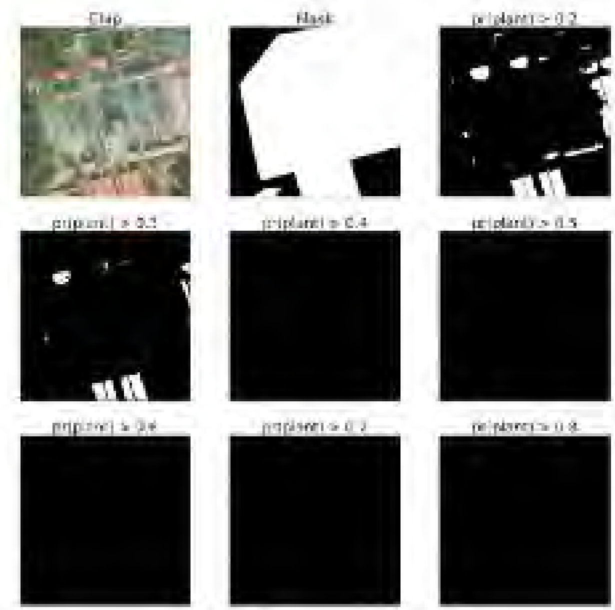
- Create an improved asset-level dataset that will be available open source
- Characteristics
  - Exact location (coordinates)
  - Ownership details (direct and ultimate owner – unique identifiers and links to ticker/exchange for publicly traded companies)
  - Production type
  - Capacity
  - Age (kiln/furnace)
  - Utilisation
- Method
  - Manual
  - Crowd sourcing
  - Web scraping
  - Machine learning (satellite imagery)

ASSET IDENTIFICATION



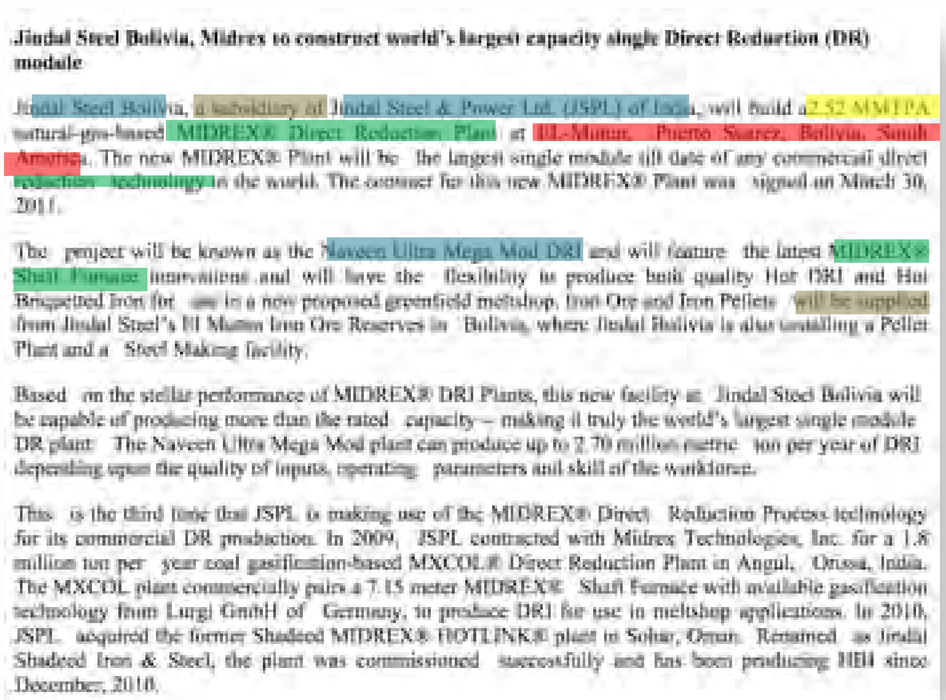


ASSET IDENTIFICATION



ASSET IDENTIFICATION

OWNERSHIP IDENTIFICATION



Jindal Steel Bolivia, Midrex to construct world's largest capacity single Direct Reduction (DR) module

Jindal Steel Bolivia, a subsidiary of Jindal Steel & Power Ltd. (JSPL) of India, will build a 2.52 MMTPA natural-gas-based MIDREX® Direct Reduction Plant at El-Mutun, Puerto Suarez, Bolivia, South America. The new MIDREX® Plant will be the largest single module till date of any commercial direct reduction technology in the world. The contract for this new MIDREX® Plant was signed on March 30, 2011.

The project will be known as the Naveen Ultra Mega Mod DRI and will feature the latest MIDREX® Shaft Furnace innovations and will have the flexibility to produce both quality Hot DRI and Hot Briquetted Iron for use in a new proposed greenfield meltshop. Iron Ore and Iron Pellets will be supplied from Jindal Steel's El Mutun Iron Ore Reserves in Bolivia, where Jindal Bolivia is also installing a Pellet Plant and a Steel Making facility.

Based on the stellar performance of MIDREX® DRI Plants, this new facility at Jindal Steel Bolivia will be capable of producing more than the rated capacity – making it truly the world's largest single module DR plant. The Naveen Ultra Mega Mod plant can produce up to 2.70 million metric ton per year of DRI depending upon the quality of inputs, operating parameters and skill of the workforce.

This is the third time that JSPL is making use of the MIDREX® Direct Reduction Process technology for its commercial DR production. In 2009, JSPL contracted with Midrex Technologies, Inc. for a 1.8 million ton per year coal gasification-based MXCOL® Direct Reduction Plant in Angul, Orissa, India. The MXCOL plant commercially pairs a 7.15 meter MIDREX® Shaft Furnace with available gasification technology from Lurgi GmbH of Germany, to produce DRI for use in meltshop applications. In 2010, JSPL acquired the former Shadeed MIDREX® HOTLINK® plant in Sohar, Oman. Renamed as Jindal Shadeed Iron & Steel, the plant was commissioned successfully and has been producing HBI since December, 2010.

Facility

Entity Relation

Production capacity

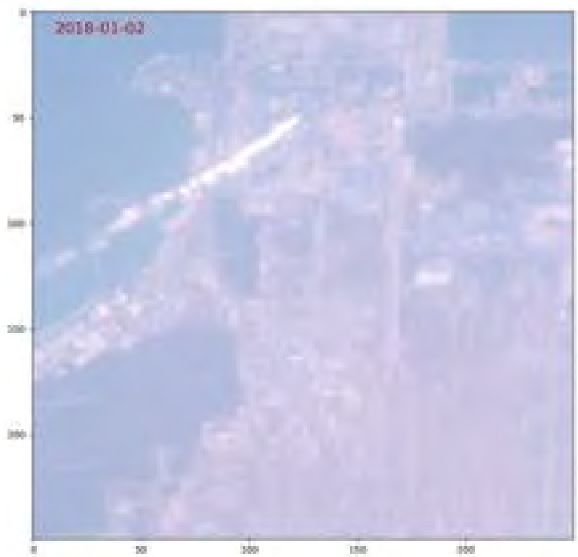
Innovation/Technology

Location

IDENTIFYING CHARACTERISTICS

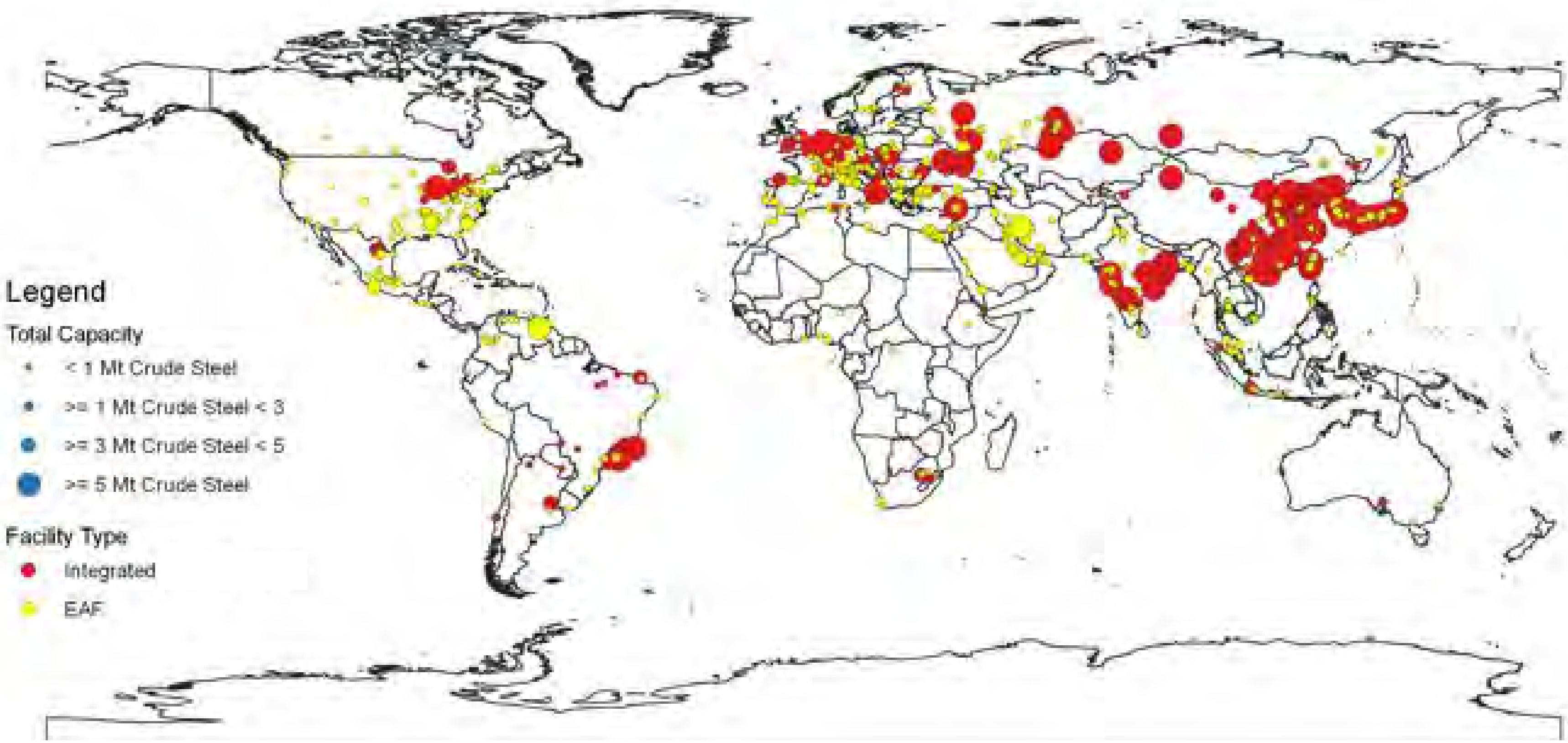
TEMPORAL CHANGES

EMISSIONS MEASUREMENT



Mission	Launch	Orbit	T. Cov.	Spatial Scale	PS Det.	GSD	Measure Technique	Fitting window [nm]	Data Products	DT	RP
GOSAT	2009	ss	3	regional/continental	no	10	passive SWIR	1650, 2060	XCO_2, XCH_4	7.1	1 - 2
GOSAT-2	2018	ss	6	regional/continental	no	10	passive SWIR	1650, 2060, 2300	XCO_2, XCH_4, XCO	4.0	0.4
TROPOMI	2017	ss	1	global	partly	7	passive SWIR	2300	XCH_4, XCO	4.2	< 1
Sentinel-5/UVNS	2021	ss	29	global	no	7.5	passive UV/VNIR/SWIR	290, 400, 1633, 2345	i. a. XO_3, XSO_2, XCO, XCH_4	n.o.	n.o.
OCO-2	2014	ss	16	global	partly	1.29 x 2.25	passive SWIR	1610, 2060	XCO_2	n.o.	< 0.3
TanSat	2016	ss	16	national/global	no	1 x 2	passive SWIR	1610, 2060	XCO_2	n.o.	< 1
GHGSat	2016	ss	14	local	yes	0.05	passive SWIR	1650	XCH_4, XCO	0.24	1
Bluefield	2019 - 21	ss	1	global	yes	0.02	passive SWIR	2300	XCH_4	0.015	0.8
CarbonSat	2020	ss	5 - 10	global	yes	2	passive SWIR	1650	XCH_4, XCO_2	0.8	0.4
MERLIN	2021/22	ss	28	global	yes	0.15	active Lidar	1650	XCH_4	n.o.	1 - 2
GEO-CAPE	2022	gs	< 1	continental	yes	0.375	passive UV/VNIR/SWIR	340, 1100, 1245, 1640, 2135	i.a. XSO_2, XHCHO, XCH_4, XNH_3	4.0	n.o.
GeoFTS	proposed	gs	< 1	continental	no	2.7	passive NIR/SWIR	760, 1600, 2300	XCO_2, XCH_4, XCO, XH_2O	0.61	0.2 - 2
geoCARB	2020 - 23	gs	< 1	continental	no	5 - 10	passive NIR/SWIR	763, 1611, 2065, 2323	XCO_2, XCH_4, XCO	4.0	0.7 - 10
G3E	proposed	gs	< 1	continental	yes	2 x 3	passive NIR/SWIR	760, 1600, 2300	XCO_2, XCH_4, XCO	1.3	0.5 - 10
Sentinel-4/UVN	2019	gs	< 1	national	no	8	passive UV/VNIR	305, 500, 760	XO_3, XNO_2, XSO_2 and XHCHO	n.o.	n.o.
AIRS	2002	ss	0.5	global	no	45	passive TIR	6200, 8200	XO_3, XSO_2, XCO, XCH_4, XCO_2	n.o.	1.5
IASI	2007	ss	0.5	regional/global	no	12	passive TIR	7100, 8300	XO_3, XCH_4, XCO_2, XH_2O	n.o.	1.2
IASI-NG	2021	ss	0.5	regional/global	no	12	passive TIR	7100, 8300	XO_3, XCH_4, XCO_2, XH_2O	n.o.	n.o.
CrIS	2011	ss	0.5	global	no	14	passive TIR	7300, 8000	XCH_4	n.o.	1.5

GLOBAL – CRUDE STEEL PRODUCTION



GLOBAL – CRUDE STEEL PRODUCTION

	No. of Facilities		Crude Steel Production Capacity (Mt)			Estimated CO2 Emissions from Crude Steel Production (Mt)	Emissions/ Capacity
Company Name	**Integrated**	**EAF**	**Blast Furnace**	**EAF**	**Total**		
Africa	4	30	10.0	25.1	35.1	25.0	0.7
Asia	30	177	160.0	142.5	302.5	253.0	0.8
China	105	37	480.6	54.0	534.6	865.6	1.6
Eurasia	11	14	33.7	10.9	44.6	65.2	1.5
Europe	34	162	120.2	122.4	242.6	194.6	0.8
India	40	31	64.1	31.2	95.3	232.9	2.4
North America	14	116	48.9	97.1	146.0	92.3	0.6
Oceania	2	3	5.1	1.7	6.7	6.7	1.0
Russia	14	31	51.7	35.6	87.3	98.8	1.1
South America	29	36	44.3	26.5	70.7	100.0	1.4
Global Total	**283**	**637**	**1018.5**	**547.0**	**1565.5**	**1934.1**	

Note: Based on dataset still in development

MOST EMITTING COUNTRIES

	No. of Facilities			Crude Steel Production Capacity (Mt)			Estimated CO2 Emissions from Crude Steel Production (Mt)
Company Name	**Integrated**	**EAF**	**Other**	**Blast Furnace**	**EAF**	**Total**	
China	105	37	155	480.6	54.0	534.6	865.6
India	40	31	71	64.1	31.2	95.3	232.9
Japan	13	46	28	89.0	27.6	116.6	121.6
Russian Federation	14	31	29	51.7	35.6	87.3	98.7
Brazil	23	17	15	38.4	12.2	50.7	83.2
United States	10	84	123	38.8	69.0	107.7	65.9
Ukraine	10	5	16	28.4	4.5	32.9	56.1
Korea, Republic of	3	17	20	45.7	22.5	68.2	53.2
Germany	7	24	51	22.4	19.4	41.9	42.3
Taiwan	2	16	17	16.3	11.2	27.5	23.8
Turkey	3	21	19	12.1	25.1	37.1	21.6
Italy	2	31	32	11.5	25.5	37.0	21.4
France	3	18	23	11.9	7.6	19.4	16.3
Mexico	2	17	18	4.2	19.6	23.8	15.1
Iran	2	11	5	3.2	16.7	19.9	14.6
Other Countries	44	231	346	100.3	165.2	265.5	201.8
Total	**283**	**637**	**968**	**1018.5**	**547.0**	**1565.5**	**1934.1**

Note: Based on dataset still in development

MOST EMITTING STEEL PRODUCERS

Company Name	No. of Facilities			Crude Steel Production Capacity (Mt)			Estimated CO2 Emissions from Crude Steel Production (Mt)
	Integrated	EAF	Other	Blast Furnace	EAF	Total	
China Baowu Steel Group Corp Ltd	11	2	3	88.63	6.94	95.57	166.68
Arcelormittal SA	23	19	49	97.51	30.70	128.21	143.45
Ansteel Group Corp Ltd	7	2	3	35.68	2.32	38.00	72.38
Nippon Steel Corp	8	8	17	52.22	3.29	55.51	64.61
Steel Authority of India Ltd	6	2	0	19.69	0.41	20.10	61.33
Shandong Iron & Steel Group Co Ltd	3	0	0	26.88	0.00	26.88	54.55
Shougang Group Co Ltd	5	1	2	32.74	1.10	33.84	53.98
HBIS Group Co Ltd	6	1	1	28.90	1.80	30.70	53.48
Tata Steel Ltd	6	2	12	25.10	1.48	26.58	49.47
JSW Steel Ltd	4	2	4	10.46	6.83	17.29	42.81
POSCO	3	2	13	36.65	3.25	39.90	41.79
JFE Steel Corp	3	3	6	28.14	3.06	31.20	36.42
Jiangsu Shagang Group Co., Ltd	4	3	0	22.45	12.08	34.53	35.86
Techint Holdings SARL	4	8	9	18.00	7.32	25.32	35.41
Liaoning Provincial Government	2	0	0	16.63	0.00	16.63	31.90
Other Producers	188	582	849	478.83	466.37	945.20	989.95
Total	**283**	**637**	**968**	**1018.50**	**546.95**	**1565.45**	**1934.07**

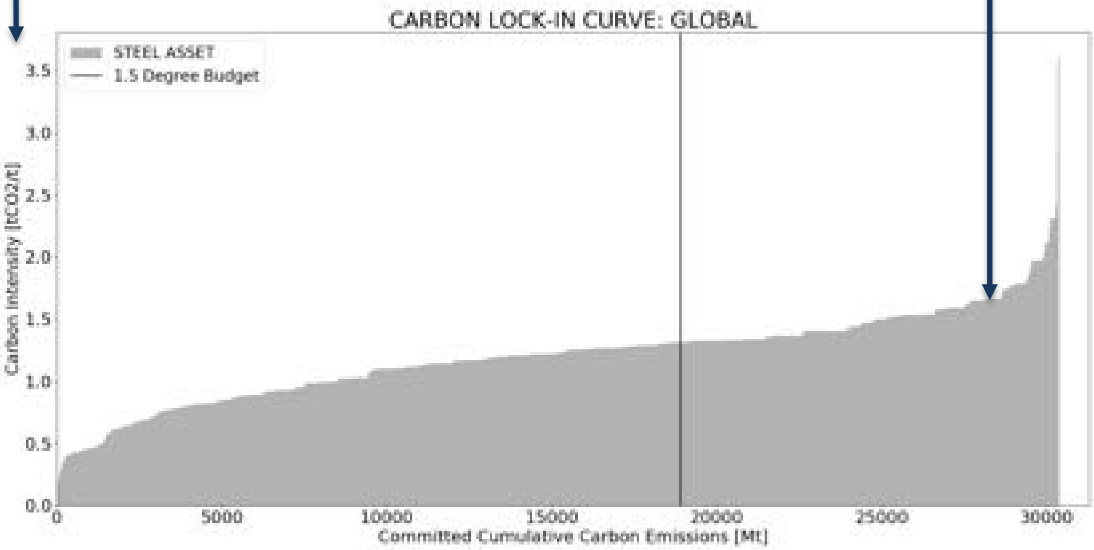
Note: Based on dataset still in development

CARBON LOCK-IN CURVES

- Steel plants on the x-axis are ordered by an ordering metric on the y axis.
- This graph is ordered by carbon intensity which is emissions produced per tonne of steel produced.

- The black vertical line is the carbon budget.
- A carbon budget is the cumulative amount of CO_2 emissions permitted over a period to keep within a certain temperature threshold.
- Steel plants to the right of the black line are incompatible with that carbon budget

- The x-axis shows an estimate of what the cumulative emissions of all steel plants globally are likely to produce over their remaining life.
- Each bar represents a crude steel production asset.
- The width of each line represents the amount of carbon emission associated with each steel production asset.

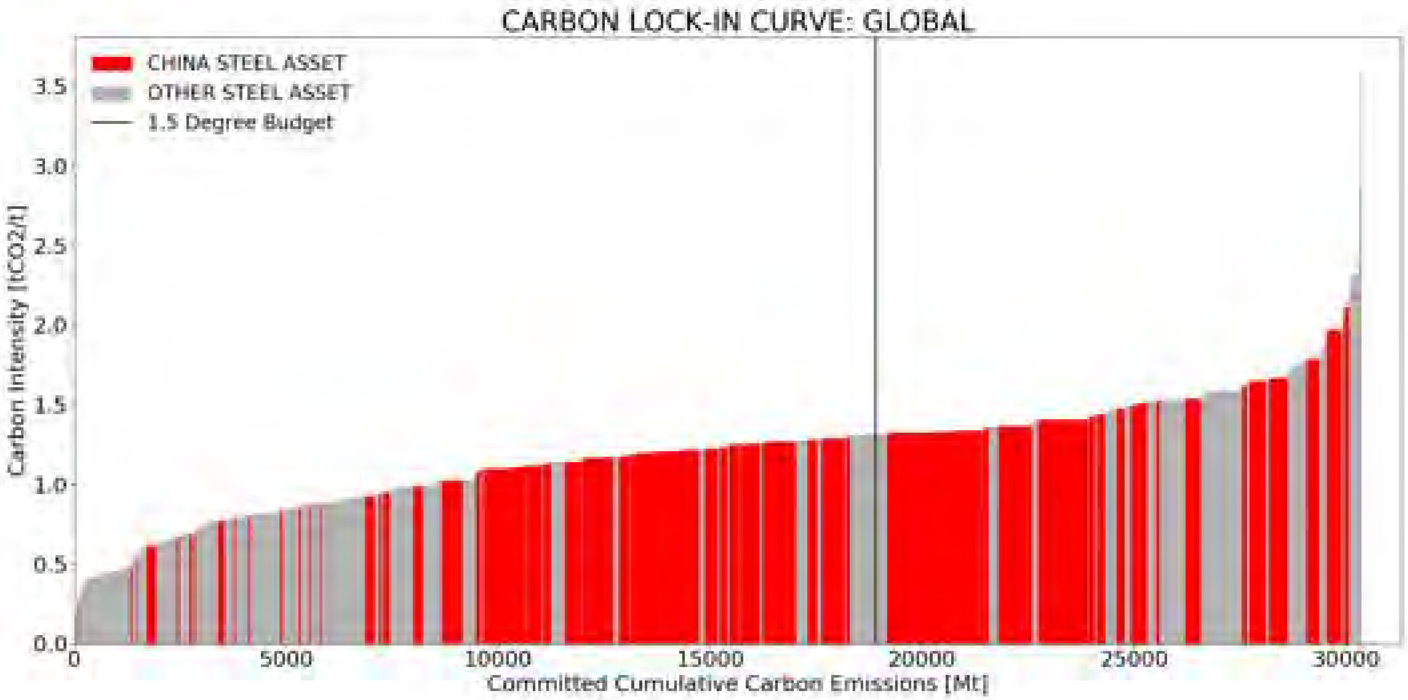


24.8% of GLOBAL crude steel producing assets incompatible SR 1.5°C
18.6% of GLOBAL crude steel capacity incompatible SR 1.5°C

- SR 1.5°C is the IPCC's latest estimate of a carbon budget that corresponds to 1.5°C with a 66% probability.

Note: Based on dataset still in development

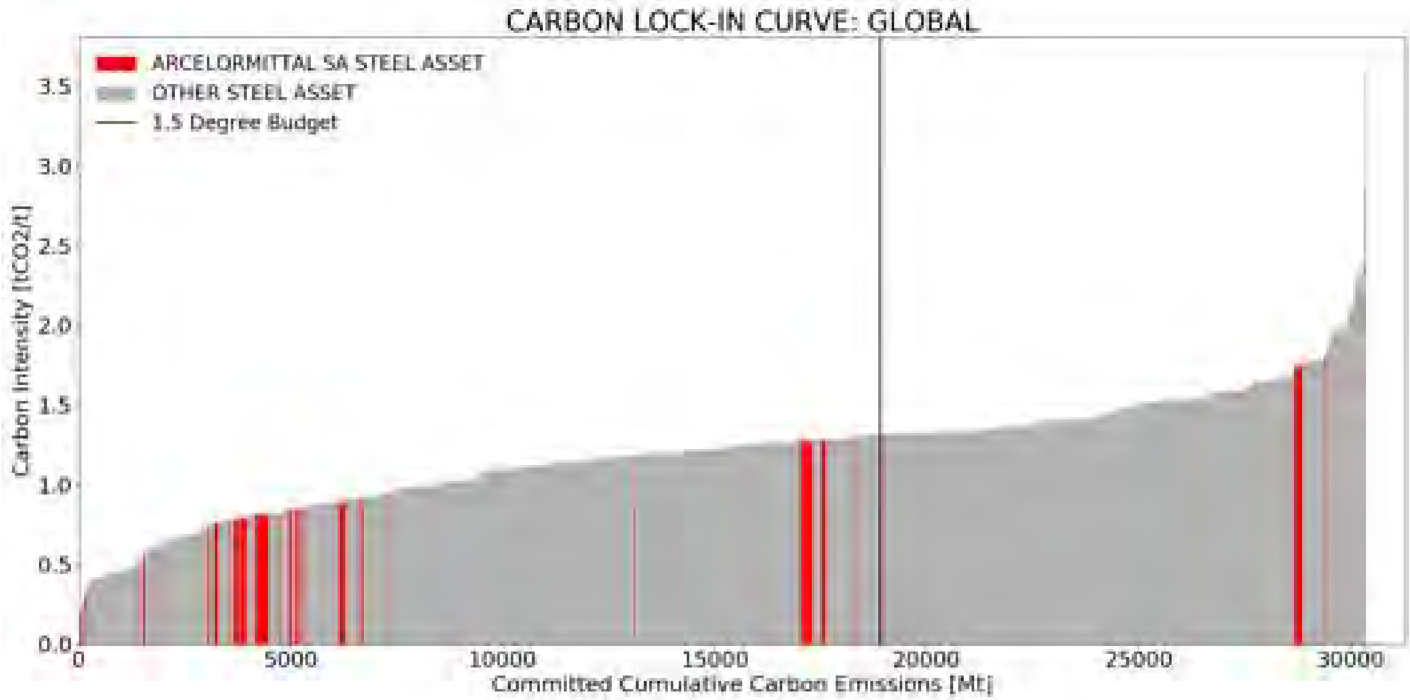
CARBON LOCK-IN CURVES



34.6% of CHINA crude steel producing assets incompatible SR 1.5°C
29.7% of CHINA crude steel capacity incompatible SR 1.5°C

Note: Based on dataset still in development

CARBON LOCK-IN CURVES



22.2% of GLOBAL crude steel producing assets incompatible SR 1.5ºC
8.7% of GLOBAL crude steel capacity incompatible SR 1.5ºC

Note: Based on dataset still in development

LEAST ALIGNED COUNTRIES

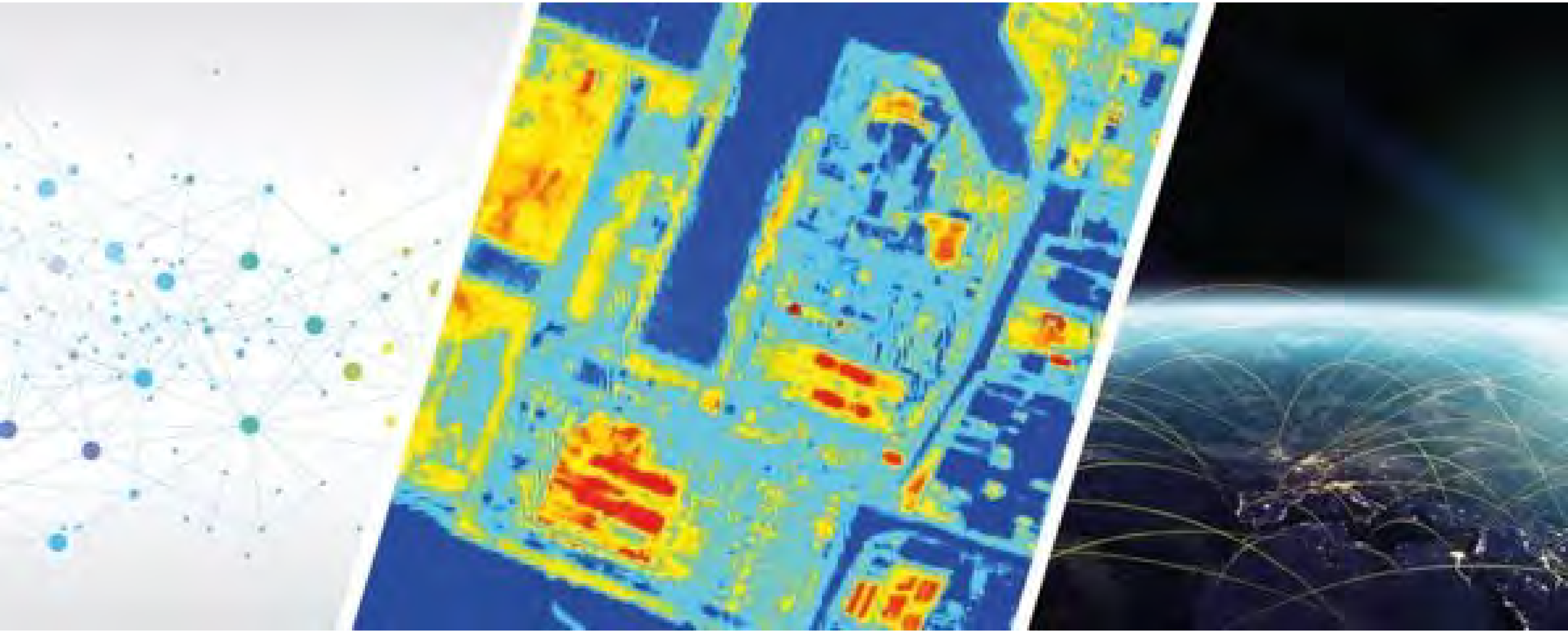
Country	No. of Facilities			Capacity			Total CO2 Emissions (Mt/yr)	Total Committed Emissions (Mt)
	>1.5 Budget	Total		>1.5 Budget	Total			
India	70	102	68.6%	81.12	97.80	82.9%	232.92	3515.63
South Africa	8	13	61.5%	8.02	11.97	67.1%	11.05	109.53
Iran	7	13	53.8%	13.20	19.88	66.4%	14.56	166.45
Indonesia	5	17	29.4%	6.43	11.57	55.6%	10.90	187.08
Taiwan	1	18	5.6%	10.30	27.53	37.4%	23.83	420.35
China	63	182	34.6%	159.04	534.64	29.7%	865.65	17075.03
Egypt	3	15	20.0%	2.15	13.03	16.5%	7.98	122.73
Brazil	14	45	31.1%	3.39	50.67	6.7%	83.16	1002.74
Japan	4	62	6.5%	0.30	116.62	0.3%	121.65	1227.56
Other Countries	97	629	15.4%	10.30	697.39	1.5%	562.38	7458.69

Note: Based on dataset still in development

LEAST ALIGNED STEEL PRODUCERS

Company Name	No. of Facilities			Capacity			Total CO2 Emissions (Mt/yr)	Total Committed Emissions (Mt)
	>1.5 Budget	Total		>1.5 Budget	Total			
Steel Authority of India Ltd	6	8	75.0%	22.29	22.60	98.7%	61.33	432.15
JSW Steel Ltd	4	6	66.7%	15.88	17.29	91.9%	42.81	895.56
Ansteel Group Corp Ltd	4	9	44.4%	26.49	38.00	69.7%	72.38	1371.39
Liaoning Provincial Government	1	2	50.0%	9.70	16.63	58.3%	31.90	865.70
Tata Steel Ltd	4	9	44.4%	13.40	26.58	50.4%	49.47	961.50
Jindal Steel And Power Ltd	3	4	75.0%	5.96	11.96	49.8%	19.00	318.12
HBIS Group Co Ltd	2	7	28.6%	12.50	30.70	40.7%	53.48	1114.93
China Baowu Steel Group Corp Ltd	5	14	35.7%	37.63	95.57	39.4%	166.68	2926.06
Shougang Group Co Ltd	2	6	33.3%	12.84	33.84	37.9%	53.98	879.07
Jiangsu Shagang Group Co., Ltd	1	7	14.3%	13.00	34.53	37.6%	35.86	522.27
Shandong Iron & Steel Group Co Ltd	2	3	66.7%	8.80	26.88	32.7%	54.55	1000.55
Shanxi Provincial Government	1	3	33.3%	3.75	12.35	30.4%	25.49	391.87
Jianlong Group	1	7	14.3%	1.20	12.83	9.4%	16.58	252.53
Arcelormittal SA	12	54	22.2%	11.39	130.21	8.7%	143.45	1826.35
Other Producers	224	957	23.4%	99.42	1071.13	9.3%	1107.12	17527.72

Note: Based on dataset still in development



Towards Spatial Finance

HYPOTHESES NEED TO BE DEFINED AND THEN MEASURED ‘BOTTOM UP’

How should exposure to environmental risk and opportunity be measured?

PHYSICAL CLIMATE CHANGE IMPACTS

- HEAT STRESS PROJECTIONS
- FLOODING PROJECTIONS
- PRECIPITATION PROJECTIONS

INCREASING STRINGENCY OF ENVIRONMENTAL REGULATION

- ASSETS PARTICULARLY EXPOSED
- PRICING OF EXTERNALITIES
- ASSETS IN JURISDICTIONS PARTICULALRY AT RISK

COMPETITION FROM CLEAN TECH

- PACE OF DEPLOYMENT IN KEY MARKETS
- UTILISATION RATES
- POLICY SUPPORT

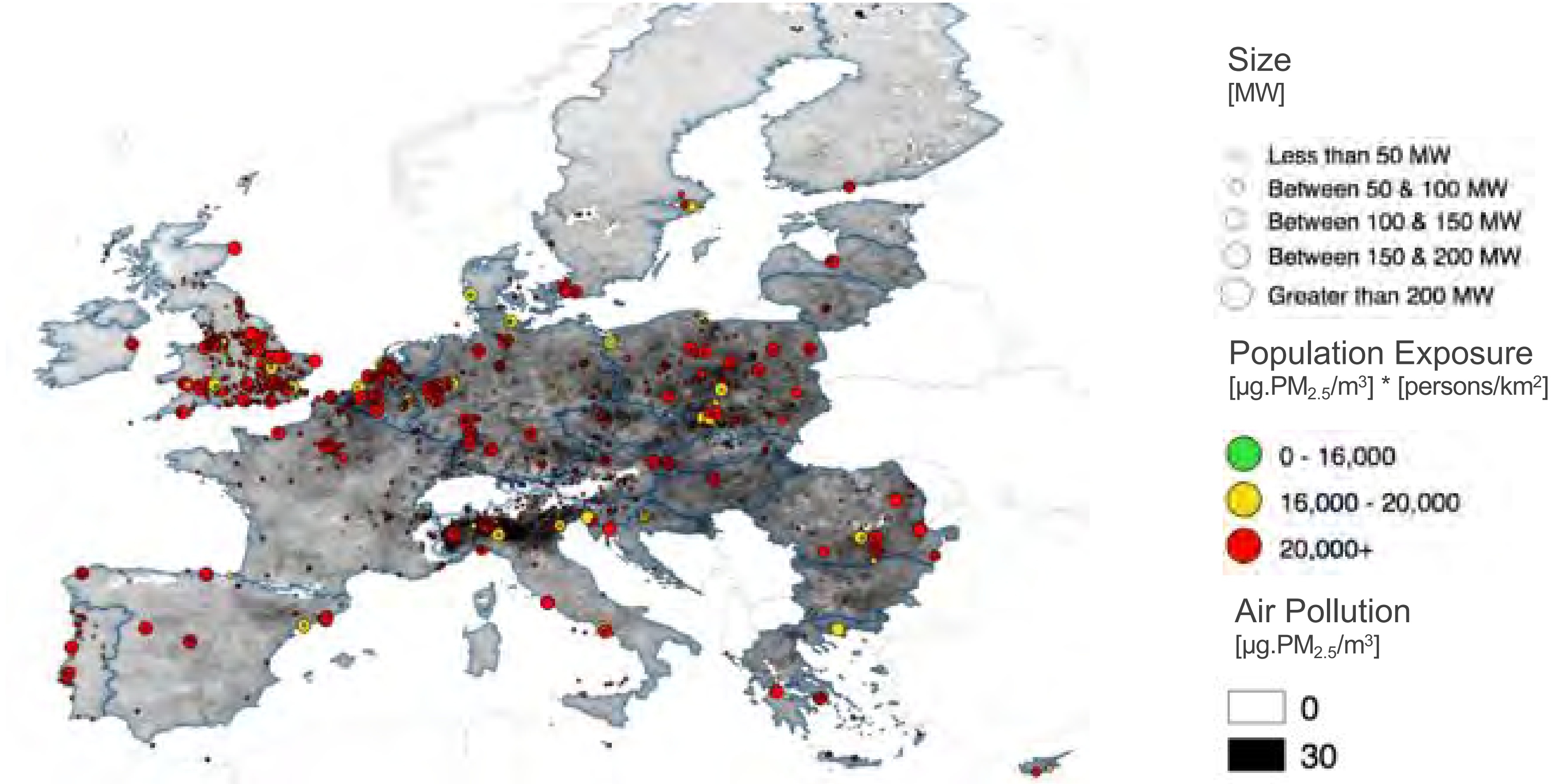
INCREASED REPUTATIONAL RISK

- ASSETS IN PROXIMITY TO NATIONAL PARKS
- SALIENCE OF AREAS AFFECTED
- SOCIAL MEDIA

BIG PICTURE:
MANAGEMENT OF ENVIRONMENTAL RISK, OPPORTUNITY, AND IMPACT

- Asset-level data tied to ownership
- Measures of current and future environmental risk, opportunity, and impact
- Scenarios to linked to measures
- How is management managing these risks, opportunities, and impacts?
- Impact on valuation via financial and/or economic model

RISK HYPOTHESES (LRHs)
LRH-4: LOCAL AIR POLLUTION



RISK HYPOTHESES (LRHs)
LRH-6: ACUTE DROUGHT RISK
BAU

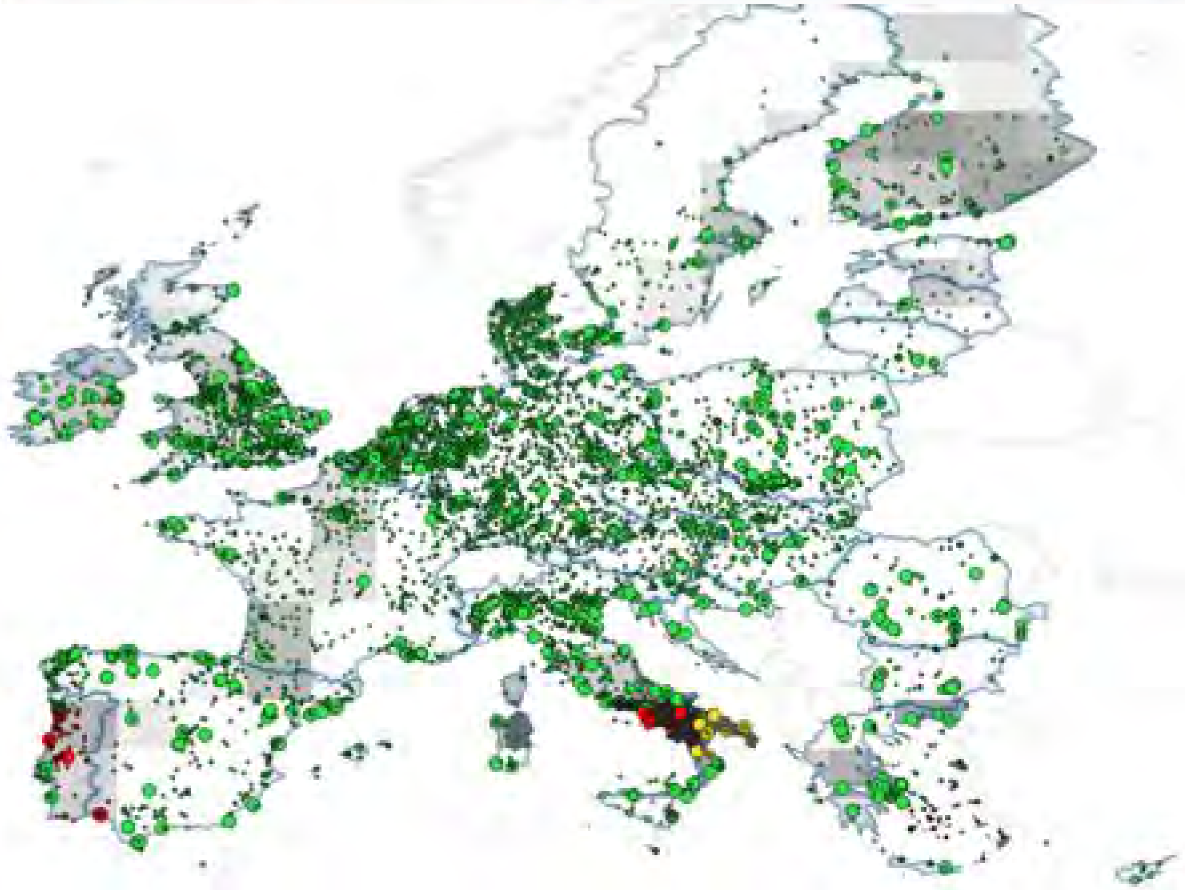
Size
[MW]

- Less than 50 MW
- Between 50 & 100 MW
- Between 100 & 150 MW
- Between 150 & 200 MW
- Greater than 200 MW

Consecutive Dry Days
[2030, additional days]

- -7 to 1
- 1 to 3
- 3 to 12

RISK HYPOTHESES (LRHs)
LRH-6: ACUTE DROUGHT RISK 1.5S



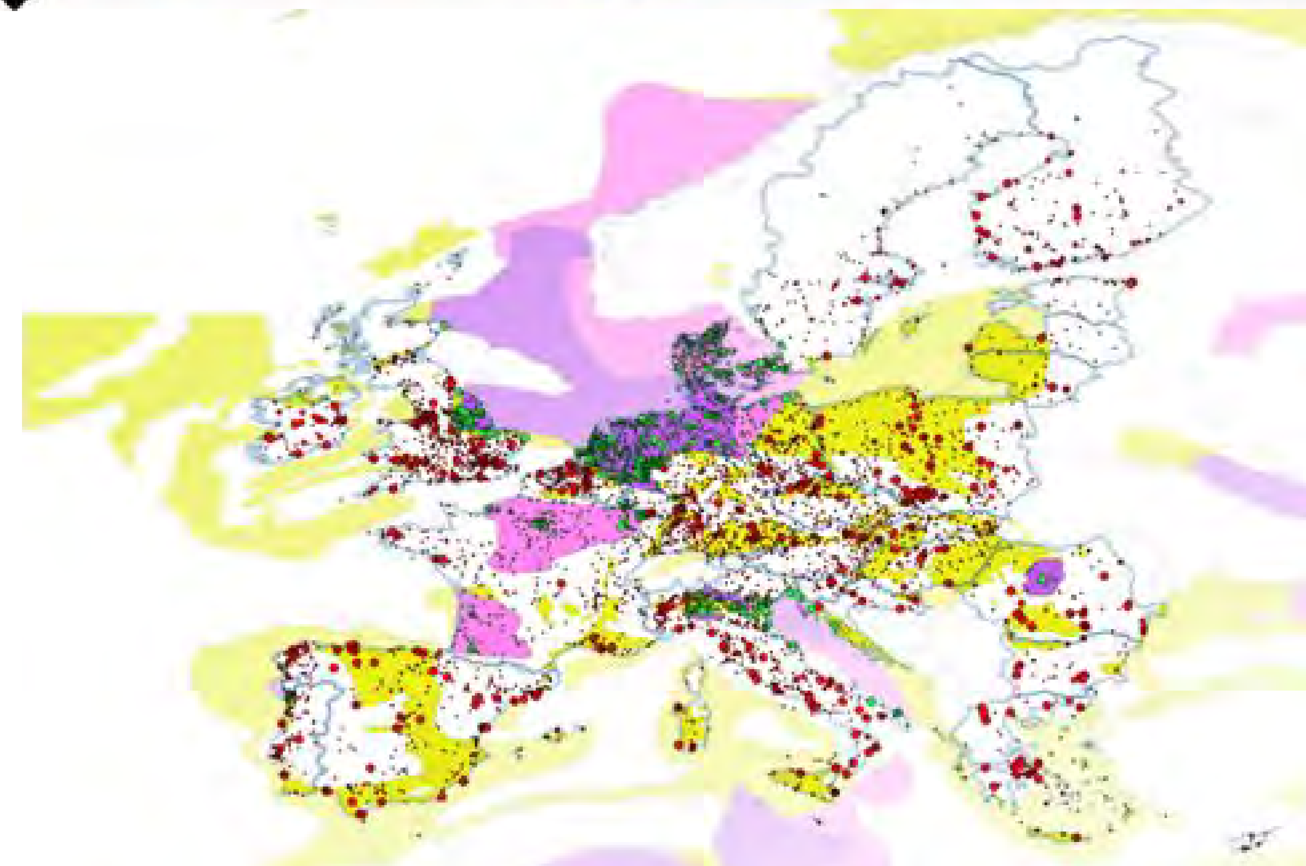
Size
[MW]

- Less than 50 MW
- Between 50 & 100 MW
- Between 100 & 150 MW
- Between 150 & 200 MW
- Greater than 200 MW

Consecutive Dry Days
[2030, additional days]

- -7 to 1
- 1 to 3
- 3 to 12

RISK HYPOTHESES (LRHs)
LRH-8: CCS RETROFITABILITY
Onshore and Offshore



Size
[MW]

- Less than 50 MW
- Between 50 & 100 MW
- Between 100 & 150 MW
- Between 150 & 200 MW
- Greater than 200 MW

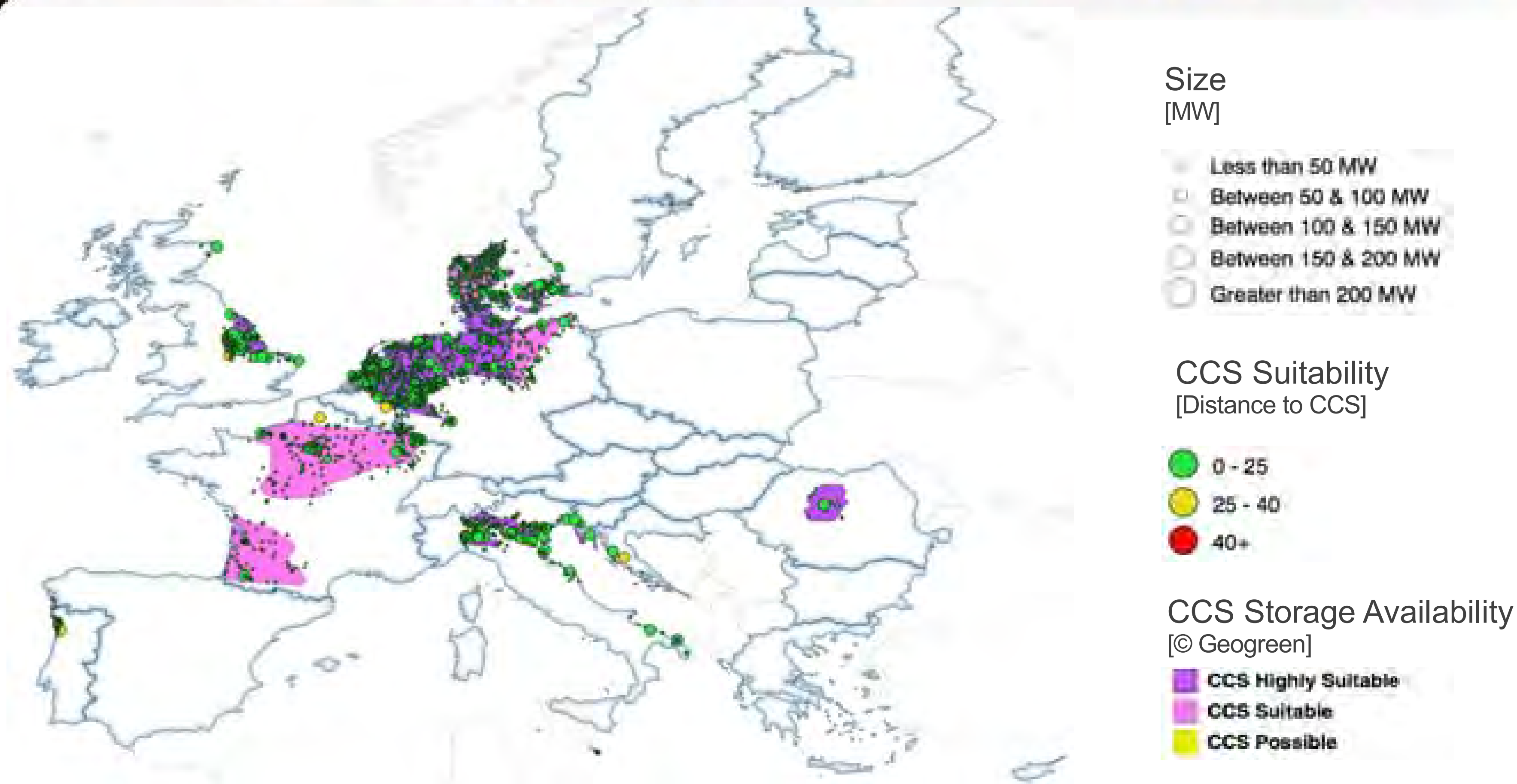
CCS Suitability
[Distance to CCS]

- 0 - 25
- 25 - 40
- 40+

CCS Storage Availability
[© Geogreen]

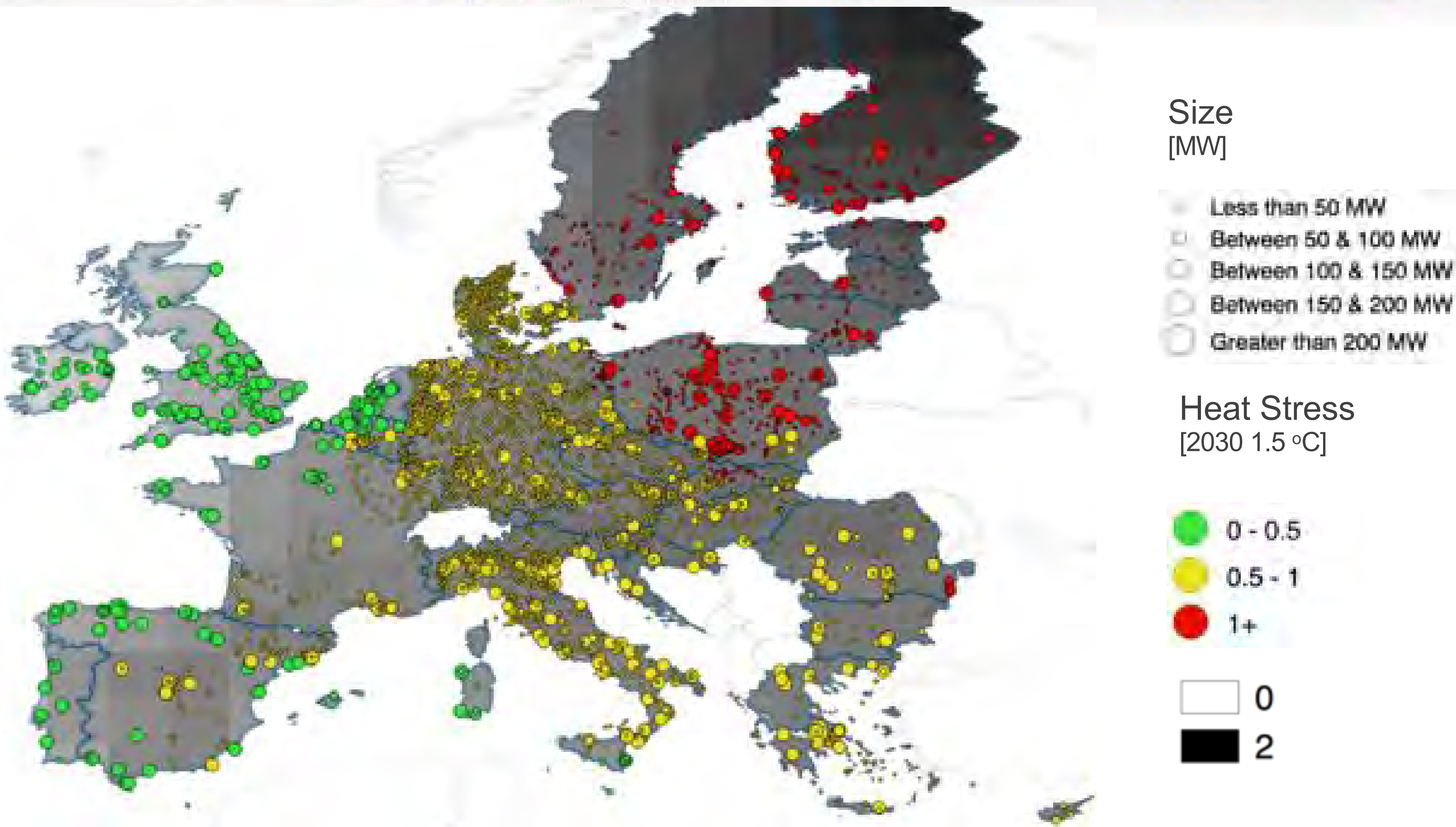
- CCS Highly Suitable
- CCS Suitable
- CCS Possible

RISK HYPOTHESES (LRHs)
LRH-8: CCS RETROFITABILITY

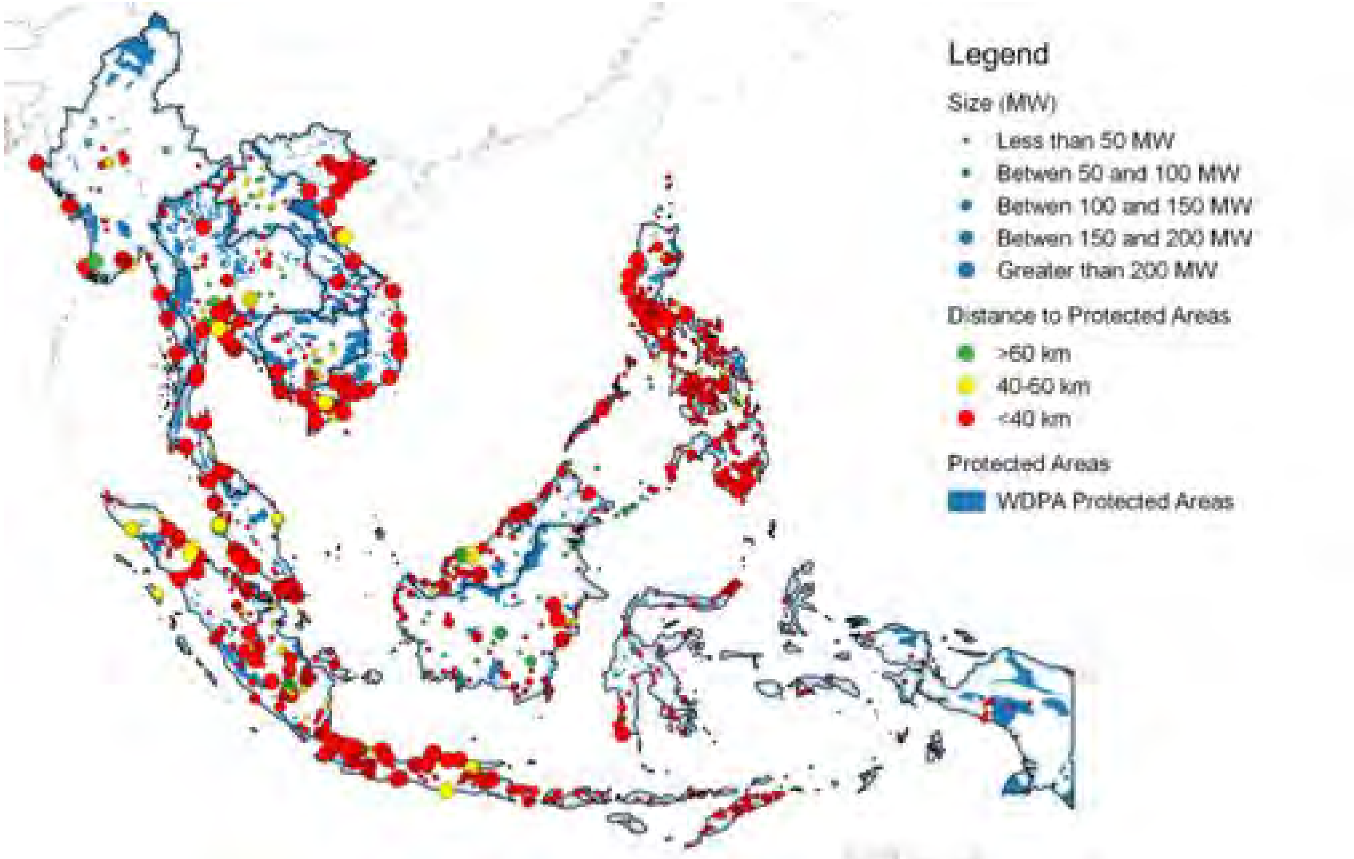


RISK HYPOTHESES (LRHs)
LRH-9: CHRONIC HEAT STRESS
BAU

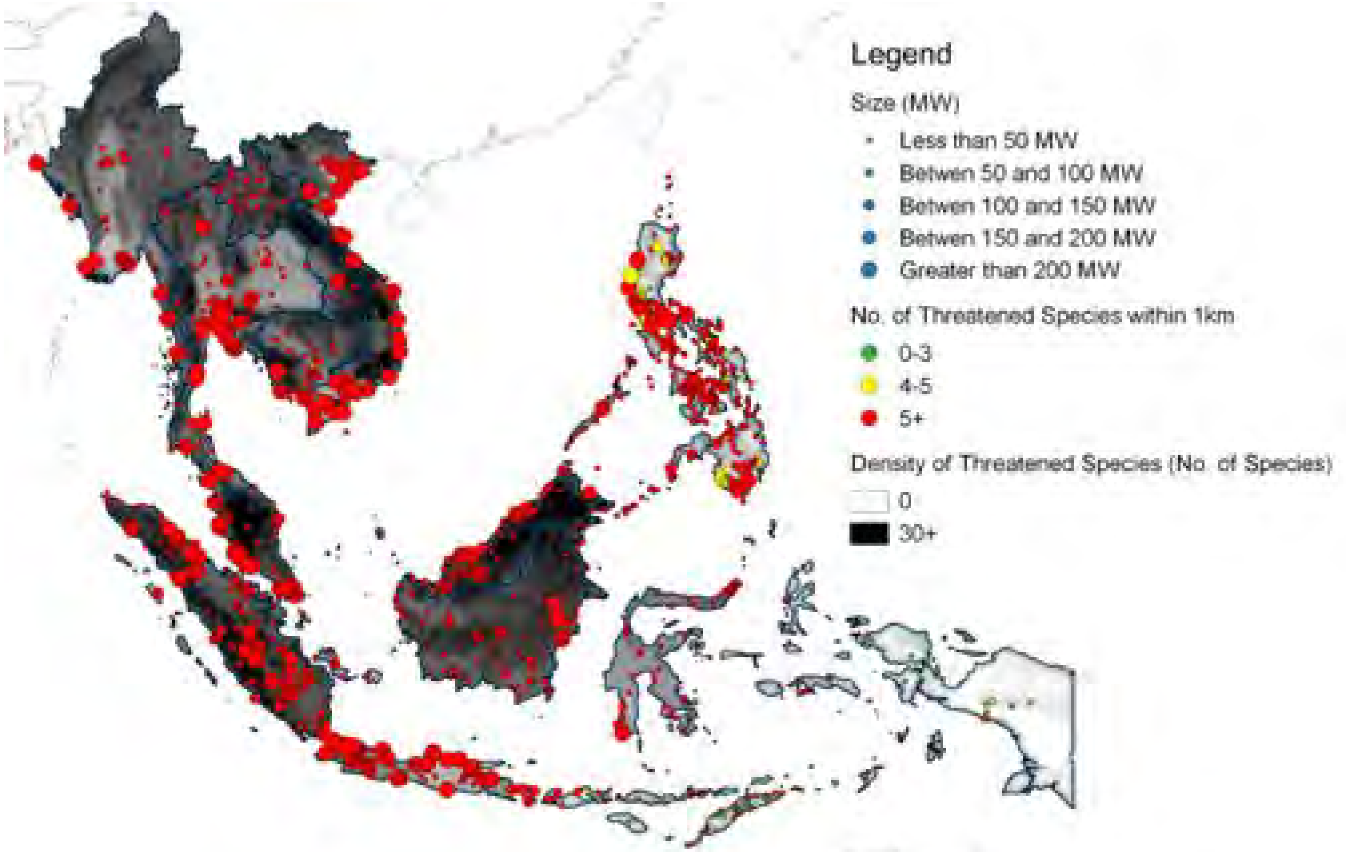
RISK HYPOTHESES (LRHs)
LRH-9: CHRONIC HEAT STRESS 1.5S



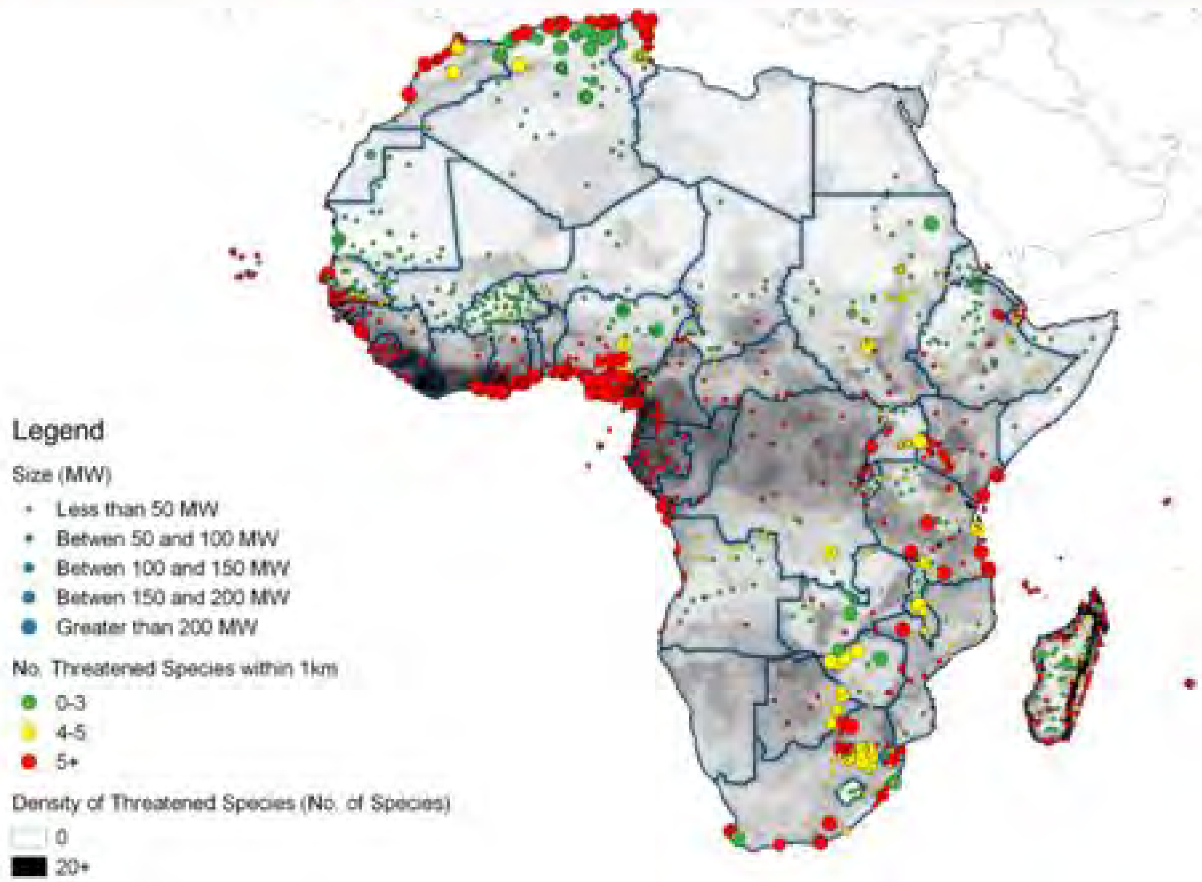
RISK HYPOTHESES
- Proximity to Protected Areas – SOUTHEAST ASIA



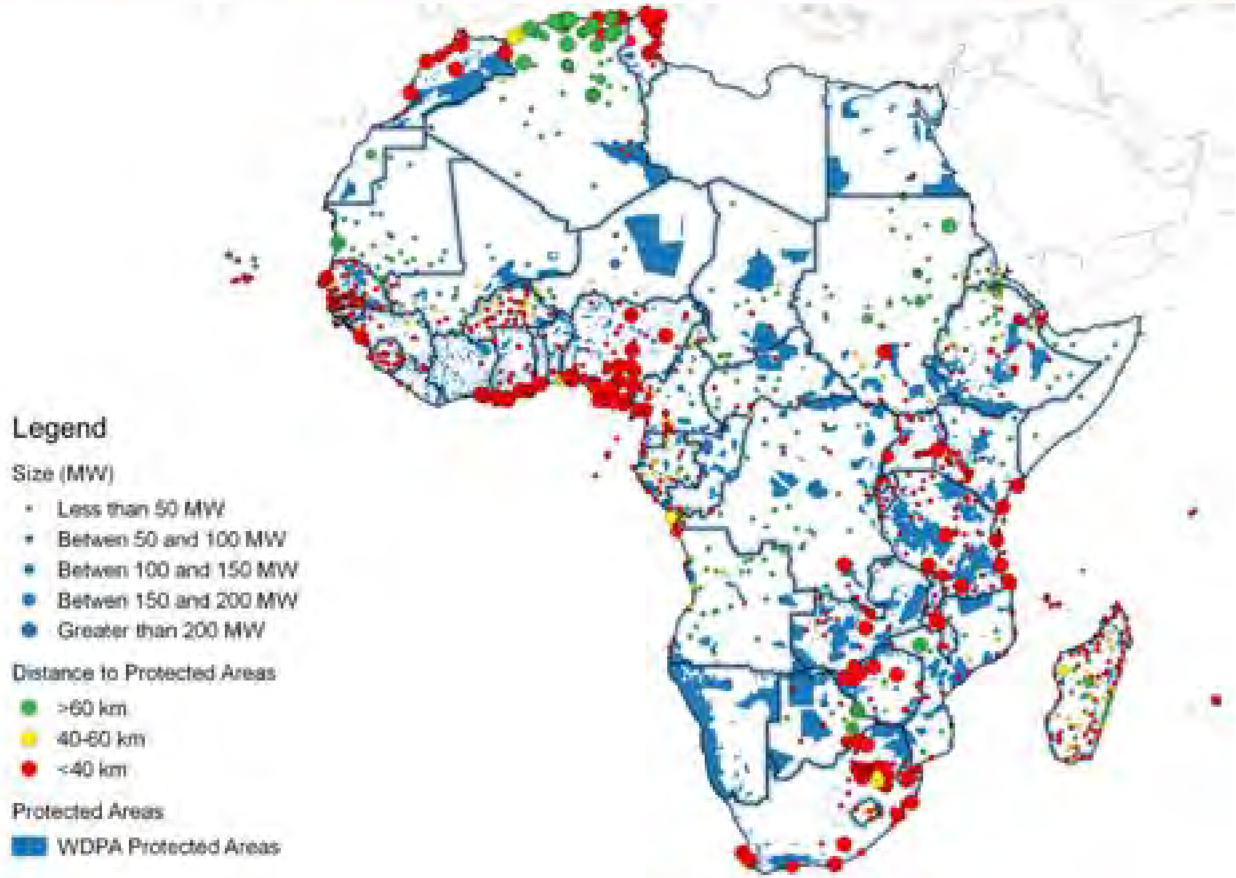
RISK HYPOTHESES
- Density of Threatened Species – SOUTHEAST ASIA



RISK HYPOTHESES
- Density of Threatened Species – AFRICA



RISK HYPOTHESES
- Proximity to Protected Areas – AFRICA

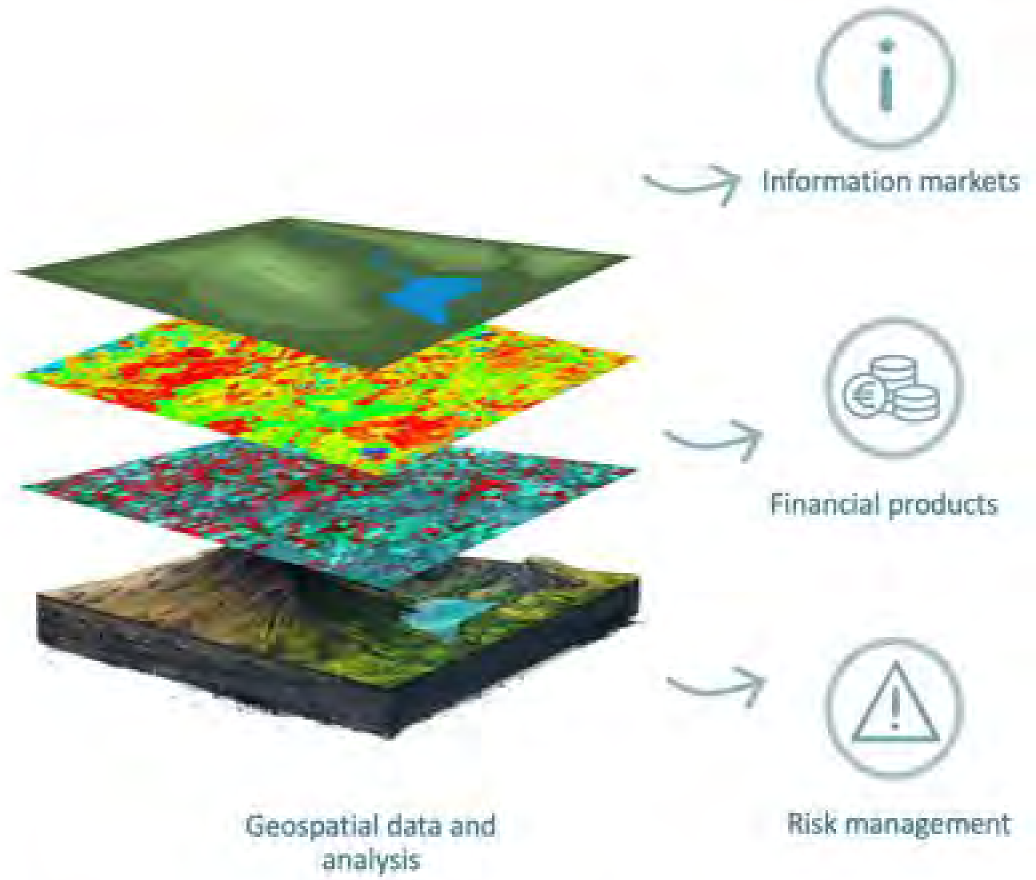


Spatial Finance

'Spatial finance' is the integration of geospatial data and analysis into financial theory and practice.

Increasing availability and quality of spatial information will profoundly change how [climate] **risks, opportunities, and impacts** are measured and managed by financial institutions.

In tandem: reliable, consistent **asset-level datasets** tying physical & natural assets to ownership structures can deliver a step change in **accountability and transparency**



Commodification of space is generating huge amount of Earth Observation (EO) data

Key enablers include:

- Satellite hardware miniaturization, cost reduction and technical improvement
- Reusable rocket launchers

Where we are now:

- **Free** medium resolution (>10m) data available globally
- **Commercial** very high resolution (~0.3m) of targeted sites available on a daily basis
- Multispectral sensors For insights beyond the visible spectrum (e.g. infrared – methane leaks from gas infrastructure)

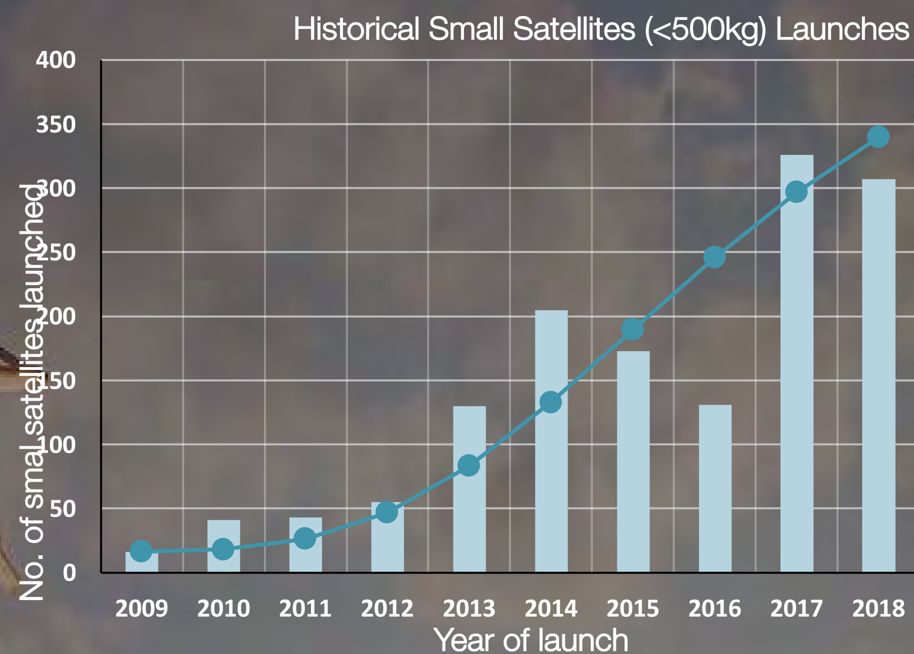
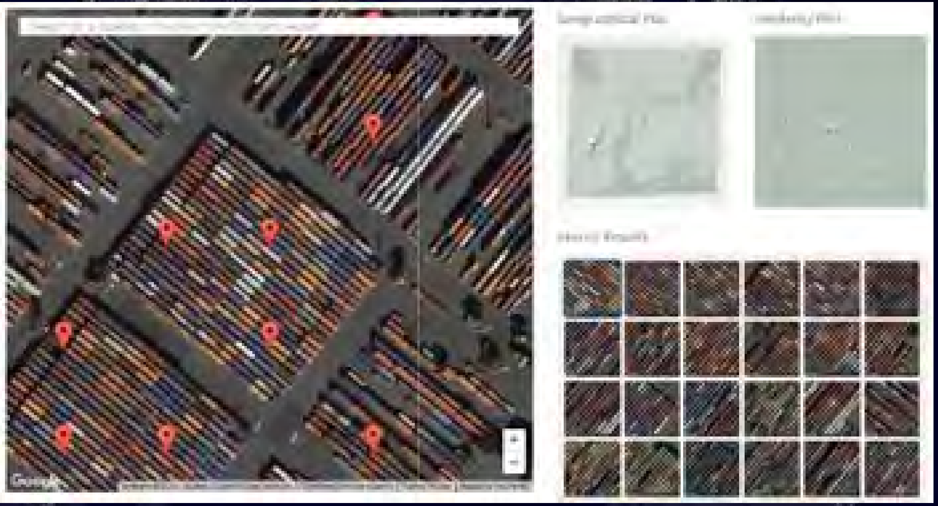


Image credits: SPACE EXPLORATION TECHNOLOGIES CORP

Artificial intelligence is helping to process and interpret this data at the asset level

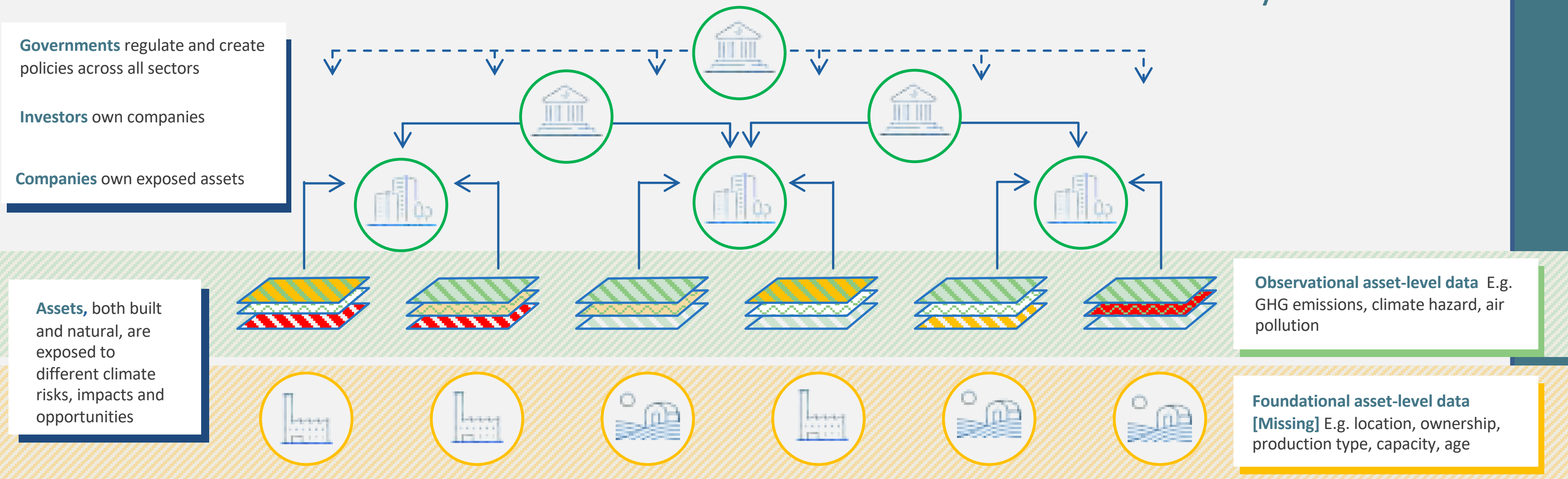
Advances in AI and machine learning allow for automated analysis of large, complex EO datasets and matching with other data sources:

- Assets identified by algorithmic collection of features (e.g. edges, shapes, colours)
- Convolutional Neural Networks learn sophisticated features of the input image to identify similar objects and features
- Applying computer vision techniques to global remote sensing datasets enables localisation of assets & asset types



Asset-level data: an essential enabler for climate action in finance

Bottom-up, asset-level analysis is essential to accurately assess physical and transition climate risks, opportunities and impacts across all sectors of the economy.



Barriers to asset-level data creation and adoption

A **lack of foundational asset-level data** remains the primary barrier to.

Availability, Completeness and Cost

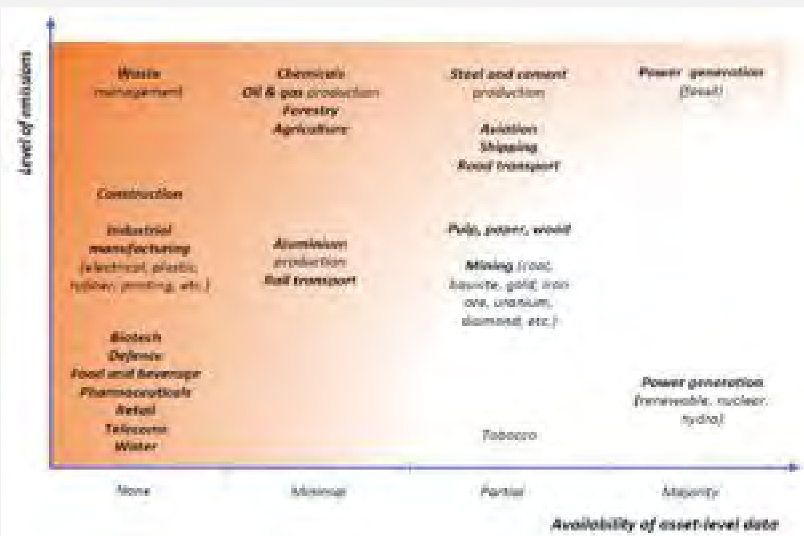
Most global asset-level datasets for emissions-intensive industries are incomplete, inaccurate, and/or prohibitively expensive

Transaction Costs

Current data access approaches, using disclosures and bilateral engagement, multiplies both the costs of accessing data, and the costs of providing it

Market Failure

Financial sector climate data efforts and strategies are dispersed and rely on company disclosure, which is too slow a process to drive effective action now



The Alan Turing Institute

Green Finance Institute

Sustainable Finance

University of Oxford

Catapult Satellite Applications

OPEN FOUNDATIONAL ASSET-LEVEL DATASETS AS FUNDAMENTAL ENABLER

Foundational asset-level data tied to ownership

Measures of current and future risks, opportunities and impacts

Accurate climate risk and impact assessments and forward looking scenarios

Foundational asset-level data for both built and natural assets provides information on asset location, type, and ownership, and is a critical enabler for a wide range of climate-related analyses.

Observational asset-level data on climate-related risks (e.g. heat stress, exposure to natural disasters, sea level rise) and impacts (e.g. air pollution, greenhouse gas emissions) can be combined with foundational data to create truly actionable insights.

Open global asset-level datasets will drive an **increasing usage of existing public data initiatives**

- Public satellite data programmes
  (E.g. Copernicus, LandSat)
- Public climate data and models
  (E.g. UNFCC, MetOffice, ESA CCI)
- Public environmental data
  (E.g. Defra, Environment Agency, UK Centre for Ecology & Hydrology)

The Alan Turing Institute

Green Finance Institute

Sustainable Finance Programme

Oxford

CATAPULT Satellite Applications

Use cases in finance and policy: mutual benefits from geospatial analysis

Asset managers

- Differentiate between companies and projects based on risk and impact
- Support active ownership, risk management and high-res stress testing

Asset owners

- Assess asset manger portfolios against investment beliefs

Corporates

- Verify internal data collection
- Peer benchmarking

Regulators

- Assess and manage systemic risks
- Verify and enhance regulation on corporate disclosures

Policymakers

- Track and manage Paris and SDG implementation

Civil society

- Verify company disclosures and track asset financing

CONCLUSION

- **Time to focus on ACO not just CRM**

- **Three pillars of alignment, including (in)compatibility**
  - Current approaches to measuring (in)compatibility aren’t good enough

- **We need better ‘bottom-up’ approach for measuring (in)compatibility**
    - CLICs + confidence levels

- **Towards Spatial Finance**
  - Let’s sequence the real economy in a way that is analogous to the Human Genome Project!
  - Plethora of different use cases