



ANITA 2023
B.ORG
GRACE HOPPER
CELEBRATION

THE WAY
FORWARD

Lead with Data

Using Goldman Sachs' Open-Sourced Legend Platform to
Unlock Sustainability Insights



Wazila Shikari

Vice President, Goldman Sachs

Leading Data Strategy for
Liquidity Management

*"Share the excitement and
transformative potential of
data and data modeling
with fellow women
engineers!"*



Beeke-Marie Nelke

Vice President, Goldman Sachs

Leading Global Product Team
for Legend

*"Show the power of Legend
and make more women
excited about data (it's really
cool!)"*



Garima Swaroop

Vice President, Goldman Sachs

Leading Product Strategy for
Liquidity Management

*"Want to bring more women
engineers into the world of
data, design, and product.
And it starts here!"*



Manjula Nagineni

Senior Solutions Architect, AWS

Leading adoption of AWS GenAI &
Data Analytics technologies in
Financial Services Industry

*"Strong believer in
the significance of
achieving equal representation
of Women in the Tech World"*

AGENDA

1. Legend Set Up
2. Introduction to Legend
3. Lab Session Goals
4. Data Sets
5. Data Exploration
6. Data Modeling Basics
7. Data Queries
8. Data Visualization



// Let's get you set up

- 1 Get access to your Workshop Studio AWS Account
- 2 Access the console of your AWS account
- 3 Set up Legend Workbench
- 4 Launch Legend

Workshop Studio > Sign in

A screenshot of the AWS Workshop Studio sign-in page. The page has a light grey background. At the top, it says "Workshop Studio > Sign in". Below that is a white box with a grey border. Inside the box, the heading "Sign in" is followed by the instruction "Choose a preferred sign-in method". There are three main options, each in a rounded rectangular button:

- The first option is "Email one-time password (OTP)", highlighted with an orange background. Below it is the text "Enter your personal or corporate email to receive a one-time password" and a white input field.
- The second option is "Login with Amazon", in a white button with a grey border. Below it is the text "Login with your Amazon.com retail account".
- The third option is "Amazon employee", in a white button with a grey border. Below it is the text "Login with your Amazon Corporate account. Only for Amazon Employees."

Go here → <https://github.com/finos/legend/wiki/GHC-Cheat-Sheet>



// One place to access ALL the data!



Data Engineer Workbench

Build Data Models, Connect to all Data Stores, Publish APIs in seconds



Self-service Data Queries

Build data queries, drag & drop style, no SQL needed!



Built-in Data Quality

Data Validations, Cardinality, Associations & more



Intuitive Interface

Build data models, diagrams & APIs with a few button clicks



Simple Integrations

Build model artifacts, generate other coding languages with a button click (e.g. JSON, Java, Python)



Streamlined Analytics

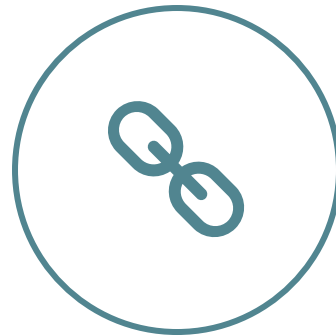
Use Legend data models in Business Intelligence & Developer tools

Lab Session Goals



Explore Data

Explore data models and data to capture values of interest.



Build Data Relationships

Formalize data relationships using joins to unlock meaningful insights.



Generate Data Insights

Execute queries to find insights, trends, and interesting patterns in data.

Data Sets

Annual Surface Temperature Change

Country	ISO2	ISO3	Indicator	Unit	Source	CTS Code	CTS Name	CTS Full Descriptor	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Albania, Islamic R.	AF	AFG	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	-0.113	-0.164	0.847	-0.764	-0.244	0.226	-0.371	-0.423	-0.539	0.813	0.619	-1.124	0.232	-0.489	-0.445	-0.286	0.513	0.129	0.361	0.6	0.483	-0.346	0.164	0.145	0.283	-0.141	0.391	0.919
Algeria	DZ	DZA	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.164	0.114	0.077	0.25	-0.1	0.433	-0.026	-0.067	0.291	0.116	-0.385	-0.348	-0.015	-0.503	-0.539	-0.782	0.504	0.012	0.654	0.232	0.215	0.399	0.56	-0.004	0.508	0.296	0.975	1.304
American Samoa	AS	ASM	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.079	-0.042	0.169	-0.14	-0.562	0.181	-0.368	-0.187	0.132	-0.047	-0.477	-0.067	0.33	-0.308	-0.118	-0.177	0.156	0.092	0.341	0.35	0.179	0.28	0.313	0.277	0.256	0.394	0.354	0.509
Andora, Principality of	AD	AND	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.736	0.112	-0.752	0.308	-0.49	0.415	0.637	0.018	-0.137	0.121	-0.326	-0.499	0.025	-0.371	0.246	-0.045	-0.093	-0.163	0.058	-0.168	0.178	1.044	0.859	-0.157	0.059	0.387	0.397	0.883
Angola	AO	AGO	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.041	-0.152	-0.19	-0.229	-0.196	0.175	-0.081	-0.193	0.188	0.248	-0.097	-0.035	0.475	-0.158	-0.029	-0.313	0.272	0.037	0.291	0.279	-0.071	0.164	0.487	0.631	0.694	0.176	0.689	0.572
Anguilla	AI	AIA	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.086	-0.024	0.234	0.189	-0.365	-0.001	-0.257	-0.2	0.317	0.082	-0.269	-0.179	0.17	-0.37	-0.334	-0.426	0.096	0.13	0.034	0.698	0.532	0.097	0.524	0.105	0.006	0.013	0.569	0.457
Antigua and Barbuda	AG	ATG	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.09	0.031	0.288	0.214	-0.385	0.097	-0.192	-0.225	0.271	0.109	-0.233	-0.214	0.164	-0.377	-0.419	-0.467	0.076	0.161	0.16	0.646	0.564	0.162	0.489	0.009	-0.051	-0.023	0.649	0.305
Argentina	AR	ARG	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.122	-0.046	0.162	-0.343	0.09	-0.163	0	0.472	0.292	0.438	-0.26	-0.008	-0.139	-0.106	-0.021	-0.321	0.432	0.362	0.266	0.373	0.359	0.046	-0.1	0.308	0.46	0.446	-0.162	
Armenia, Rep. of	AM	ARM	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.																												
Aruba, Kingdom of the	AW	ABW	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	-0.1	0.138	0.084	0.271	-0.18	0.122	-0.258	0.055	0.476	0.354	-0.349	-0.02	0.149	-0.448	-0.253	-0.518	0.182											
Australia	AU	AUS	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.157	0.126	-0.096	-0.012	0.14	-0.23	-0.093	-0.203	0.103	-0.007	-0.044	0.091	0.831	-0.354	0.048	-0.522	0.178	0.092	0.375	0.887	0.495	1.086	0.633	-0.157	0.349	0.388	0.363	0.96
Austria	AT	AUT	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	1.031	-0.621	-0.727	-0.371	-0.883	0.602	0.676	0.211	-0.126	-0.55	-0.06	0.103	-0.033	0.314	0.86	0.216	0.499	-0.476	-0.112	-0.274	0.277	0.384	1.062	-0.249	-0.568	0.319	-0.263	0.82
Azerbaijan, Rep. of	AZ	AZE	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.																												
Bahamas, The	BS	BHS	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.073	-0.082	-0.097	0.102	0.054	-0.172	-0.146	-0.324	-0.065	-0.469	-0.055	0.301	0.166	-0.056	0.334	-0.241	-0.04	0.04	0.133	0.377	-0.03	0.531	0.155	0.02	0.242	0.23	0.466	0.426
Bahrain, Kingdom of	BH	BHR	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	-0.471	0.397	0.635	-0.561	0.234	0.535	-0.362	-0.446	0.567	0.247	-0.248	-0.613	-0.273	-0.256	-0.217	-0.501	0.332	0.099	0.856	0.351	0.408	-0.086	-0.834	0.039	0.367	0.668	0.548	0.633
Bangladesh	BD	BGD	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.152	-0.265	-0.09	0.107	-0.195	0.308	-0.226	-0.236	-0.007	-0.021	-0.579	-0.012	0.168	-0.125	-0.102	-0.104	-0.275	-0.216	0.495	1.28	-0.17	-0.041	-0.132	-0.322	0.05	0.026	0.341	0.341
Barbados	BB	BRB	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.221	0.094	0.2	-0.011	-0.28	-0.149	-0.252	-0.363	0.31	0.074	-0.174	-0.015	0.006	-0.336	-0.556	-0.444	-0.054	0.248	0.042	0.485	0.304	0.165	0.281	-0.076	-0.263	-0.179	0.536	0.385
Belarus, Rep. of	BY	BLR	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.																												
Belgium	BE	BEL	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.																												
Belize	BZ	BLZ	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	-0.001	-0.137	-0.06	-0.055	-0.105	-0.195	-0.297	-0.205	0.26	-0.21	-0.275	0.442	0.347	0.101	-0.059	-0.416	0.134	-0.025	0.524	0.576	-0.088	0.526	0.685	0.254	0.455	0.135	0.35	0.46
Benin	BJ	BEN	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	-0.137	-0.24	0.152	-0.218	-0.094	-0.007	-0.252	-0.129	0.303	0.305	-0.183	0.08	0.627	0.089	-0.274	-0.194	-0.357	-0.045	0.499	0.425	0.161	0.211	0.548	0.542	0.411	0.307	0.977	0.631
Bhutan	BT	BTN	Temperature change with res...	Degree Celsius	Food and Agriculture Organiz...	ECSS	Surface Temperature Change	Environment, Climate Chang.	0.213	-0.292	-0.22	0.065	-0.965	0.14	-0.378	-0.478	0.102	-0.027	-0.227	-0.014	0.31	0.188	0.103	-0.042	-0.059	-0.213	0.414	0.081	0.212	-0.111	-0.286	-0.055	0.113	-0.068	0.256	0.507

Code editor showing file explorer with folders like 'scripts', 'ghignore', 'README.md', 'owid-co2-codebook.csv', and 'owid-co2-data.csv'. The main editor displays a table with columns 'column' and 'description' for the 'owid-co2-data' dataset, listing various CO2 and greenhouse gas emission indicators such as 'co2', 'co2_growth_tot', 'co2_including_land', etc.

IMF Annual Surface Temperature Change
<https://climatedata.imf.org/pages/climatechange-data>
Food and Agriculture Organization of the United Nations (FAO), 2022. FAOSTAT Climate Change, Climate Indicators, Temperature change. License: CC BY-NC-SA 3.0 IGO. Extracted from: <https://www.fao.org/faostat/en/#data/ET>. Accessed on 2023-03-28.

Data on CO2 and Greenhouse Gas Emissions by Our World in Data
<https://github.com/owid/co2-data>
Hannah Ritchie, Max Roser and Pablo Rosado (2020) - "CO2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/co2-and-greenhouse-gas-emissions' [Online Resource]



THE WAY FORWARD



Explore Data

Let's take a quick look at our
emissions dataset!





Let's build data relationships!

// Expand data models

// Create consistency

// Unlock insights

Follow along:

- 1 Define the schema for surface temperature
- 2 Build joins between the datasets

Try it yourself:

- 3 Create the new surface temperature class
- 4 Map the data model to datastore
- 5 Visualize the expanded model in a diagram

Go here for detailed instruction:

<https://github.com/finos/legend/wiki/GHC-Cheat-Sheet#data-modelling-guide>



Generate Data Insights

Part 1:

Get the number of distinct countries that have production-based carbon dioxide emission statistics

Part 2:

Get the list of distinct countries that have production-based carbon dioxide emission statistics

Hint: There are countries with empty values



Generate Data Insights

Query 2:

Get the top 10 countries with highest carbon dioxide emissions in 2021

Hint: There are countries with empty values



Generate Data Insights

Query 3:

Get top 10 countries by average emissions across all years available in the data set.

Hint: There are countries with empty values



Generate Data Insights

Query 4:

List all countries and their
surface temperature change in 2020

Hint: There are countries with empty values



Generate Data Insights

Query 5:

Get top 10 countries with largest
surface temperature change between 2016
and 2021

Hint: There are countries with empty values



Generate Data Insights

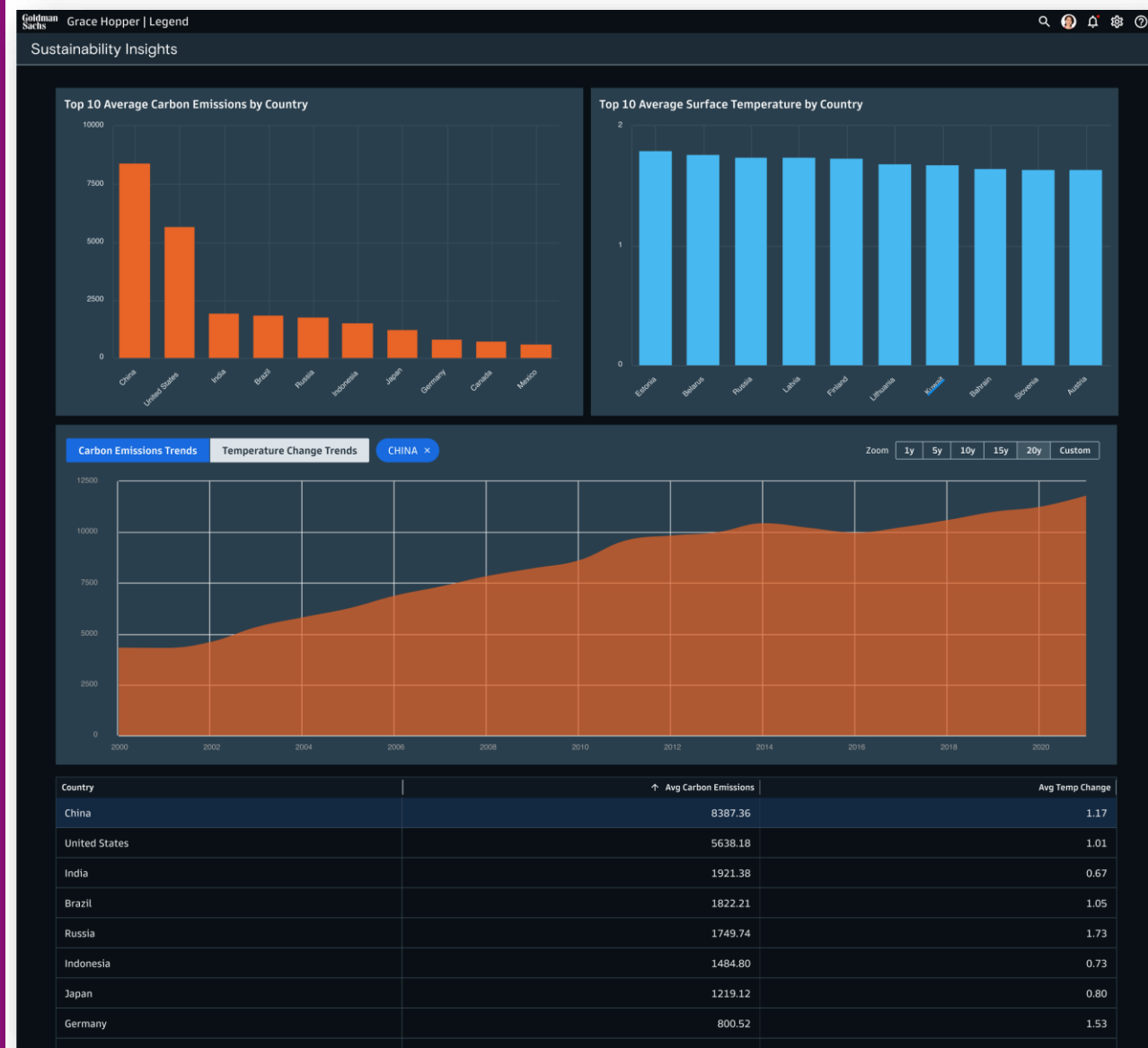
Query 6:

Query and sort countries by
average (1) surface temperature & then by
average (2) carbon dioxide across all
years since 2001

Hint: There are countries with empty values



- 1 Take data relationships + insights all the way to the front end
- 2 Use the right data viz to showcase the story
- 3 Highlight the insights but plan for extensibility



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THANK YOU

