Project | Sustainability Impact Analysis for Intel

INTRODUCTION: As you learned listening in on the strategy meeting with Dr. Alvarez and Intel's Sustainability Team, Intel is committed to reducing its carbon footprint and improving the sustainability of its devices – not just during manufacturing, but throughout the entire lifecycle.

A key part of this effort is their repurposing programs, which play a central role in achieving these sustainability goals. Repurposing and recycling programs aim to reduce e-waste, energy consumption, and CO_2 emissions by extending the life of existing devices, and thus reducing the need for new device manufacturing. Like Michael Campbell said: the average household in the US has anywhere from 3–5 PCs devices, tablets, notebooks, desktops that are perfectly functional, but not being used!

One challenge Intel faces is determining which devices in its repurposing program should be prioritized for the maximum environmental benefit. That's where data analysis comes in! To help with this, Intel gathered data on each device repurposed or recycled in 2024.

Your task is to evaluate the effectiveness of Intel's current repurposing strategy and provide a data-driven recommendation to help guide the program's direction and optimize sustainability efforts.

HOW IT WORKS: Follow the prompts in the questions below to investigate the data. Post your answers in the provided boxes: the **yellow boxes** for the queries you write and **blue boxes** for your text-based analysis. Once you're done, you'll submit your ***completed*** .pdf file to HQ for feedback from The Accelerator Team.

SQL App: Here's the link to our specialized SQL app, where you'll write your SQL queries and interact with the data.

NOTE: The dataset you are working with is designed for The Global Career Accelerator to reflect the key characteristics and structure of Intel's real data, while protecting their confidentiality and proprietary information. Be aware that any conclusions or results derived from this dataset should be viewed as hypothetical and for illustrative purposes only.

— Data Set **Descriptions**

In this project you'll query 2 different datasets, `intel.device_data` and `intel.impact_data`, that you will join together for your analysis. Here you'll find the data dictionary for each dataset.

`intel.device_data`

- `device_id`: Unique identifier for each repurposed device
- `device_type`: Type of device, values are either "Laptop" or "Desktop"
- `model_year`: The year the device was manufactured (e.g., 2018, 2019, etc.)

`intel.impact_data`

- `impact_id`: Unique identifier for the repurposed device's impact record (e.g., "LP20NA141592")
- `device_id`: Unique identifier linking the impact record to a specific device in the `intel.device_data` table
- `usage_purpose`: The specific purpose for which the device is being repurposed, values are Education & Digital Literacy, Corporate & Enterprise, Government & Public Sector, Environmental Sustainability Programs, and Social Impact & Non-Profit
- `power_consumption`: Power consumption of the device in watts (W) when in use (e.g., 50W, 75W)
- `energy_savings_yr`: Estimated energy savings per device per year when repurposed compared to a new device, measured in kilowatt-hours (kWh)
- `co2_saved_kg_yr`: Estimated CO2 emissions saved per device per year from manufacturing a new device, measured in kilograms (kg).
- `recycling_rate`: The percentage of the device that is recyclable (e.g., 80%, 90%).
- `region`: The geographical region where the device was repurposed, values are "North America", "Europe", and "Asia"

— **Task 1:** Organizing and Understanding the Data

We'll start by **joining** the device data with the impact data, allowing for a comprehensive analysis of device types, model years, repurpose regions, and energy savings in one dataset.

A. Simply write a query that returns all of the columns from both tables, joining the two on the `device_id` column. Be sure to choose the appropriate join so that all relevant

data is included in your result. **Note:** your query will have more than 150,000 rows (the max display for SQLPad!)

(paste your query below 👇)

```
SELECT *
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id;
```

B. To your joined dataset, add a new column called `device_age` calculated by subtracting the model_year from 2024. Paste your query below and double check that the values in your new column make sense. For example, a 2019 device should be 5 years old.

(paste your query below 👇)

```
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id;
```

C. Order your joined data by model_year (oldest to newest). Do you notice more older (5+ years) or newer (under 5 years) devices being repurposed? What might that indicate?

(write your **answer** below 👇)

There are more older devices being repurposed. This indicates Intel's commitment to sustainability. By repurposing old devices there are less new devices being created and used which increases pollution among other factors.

D. Bucketing the `device_age` will allow us to analyze trends and patterns in energy savings and CO_2 reductions more effectively than using individual ages. Use a `CASE WHEN` clause to add one more column, called `device_age_bucket`, to your data, that is based on the device_age:

- `WHEN` the `device_age` is less than or equal to 3, `device_age_bucket` should be "newer"
- `WHEN` the `device_age` is greater than 3 but less than or equal to 6, `device_age_bucket` should be "mid-age"
- `WHEN` the `device_age` is greater than 6, `device_age_bucket` should be "older"

HINT: Instead of using e.g. `device_age <= 3`, you need to reference the calculation directly: `2024 - d.model_year <= 3`.

Double check that the values in your new column make sense! For example, a 2019 device should be characterized as "mid-age".

(paste your query below 👇)

```
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
ORDER BY d.model_year ASC;
```

— **Task 2:** Key Insights

Now it's time to analyze the overall impact of Intel's repurposing program. You will use your final query from **Task 1** together with the `WITH` keyword for the remainder of this Project as you aggregate and analyze the data you've organized and prepped. For a refresher, rewatch "🍿The `WITH` Keyword" in SkillBuilder 6.

A. What is the total number of devices Intel repurposed in 2024?

HINT: The dataset **is** representing all devices repurposed in 2024! You just need to COUNT all the rows in your joined data from Task 1!

(write your **answer** below 👇)

601,740

B. Write a query that returns the total number of devices repurposed, the average age of repurposed devices in 2024, the average estimated energy savings (kWh) from repurposed devices per year, and the total CO_2 emissions saved (in tons) from repurposed devices.

Note: CO_2 emissions are typically measured in tons. Since `CO₂_saved_kg_yr` is measured in kg, divide the `SUM(CO₂_saved_kg_yr)` by 1000 to report the total CO_2 emissions saved in tons.

(paste your query below 👇)

```
WITH device_impact AS (
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
```

```
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
)
SELECT
COUNT(*) AS total_devices_repurposed,
AVG(device_age) AS avg_device_age_2024,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
SUM(co2_saved_kg_yr) / 1000 AS total_co2_saved_tons
FROM device_impact;
```

C. Now that you have calculated the average estimated energy savings (kWh) and CO_2 emissions saved (tons), use ChatGPT to help put these numbers into perspective.

Try this prompt: I found that each repurposed device saves approximately of XXX kWh of energy per year and Intel's repurposing program saved XXX tons of CO_2 emissions in one year. Help me understand the significance of these numbers. How would this compare to the energy consumption of a small city or the amount of CO_2 produced by cars? What is the environmental impact of these savings?

What comparisons did you find most impactful in terms of scale? Summarize how much energy and CO_2 emissions were saved and how it compares to something familiar, like powering households or reducing car emissions.

(write your **answer** below 👇)

The average U.S. household uses about 10,500 kWh per year. Intel's program saves enough energy to power roughly 24 households for a year. This usage in car terms is 1,472 cars' worth of emissions.

— **Task 3:** Identifying Trends & Maximizing Sustainability

By grouping our data in different ways, we can uncover patterns in energy savings and CO_2 reductions. These insights will help us determine which categories of devices contribute

the most to sustainability efforts and where Intel should focus its repurposing strategy for maximum impact.

A. Write a query that returns the total number of devices, the average energy savings, and the average CO_2 emissions saved (in tons), grouped by device_type.

Note (again): You'll need to divide `AVG(CO₂_saved_kg_yr)` by 1000 to report the average CO_2 emissions saved in tons.

(paste your query below 👇)

```
WITH device_impact AS (
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
)
SELECT
device_type,
COUNT(*) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 AS avg_co2_saved_tons
FROM device_impact
GROUP BY device_type;
```

B. Based on the results, which device type contributes the most to energy savings and CO_2 reduction? Why might that be the case?

Hint: Don't forget you can use ChatGPT as your Teammate to help think through your response!

(write your **answer** below 👇)

Laptops make up the majority of devices repurposed and have a much larger total environmental impact than desktops. Even though per-device energy savings are similar, laptops save 10–20× more CO_2 per device than desktops on average. In 2024 proving that Intel's device repurposing program had a significant environmental impact. A total of 193,676 desktops were repurposed, each saving an average of 25.616 kWh of energy and 0.011 tons of CO_2 per year. Laptops made up the majority, with 408,064 devices repurposed, each saving 25.80 kWh of energy and 0.11 tons of CO_2 annually.

C. Write a query that returns the total number of devices, the average energy savings, and the average CO_2 emissions saved (in tons), now grouped by `device_age_bucket`.

(paste your query below 👇)

```
WITH device_impact AS (
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
)
SELECT
```

```
device_age_bucket,
COUNT(*) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 AS avg_co2_saved_tons
FROM device_impact
GROUP BY device_age_bucket
ORDER BY
CASE
WHEN device_age_bucket = 'newer' THEN 1
WHEN device_age_bucket = 'mid-age' THEN 2
WHEN device_age_bucket = 'older' THEN 3
END;
```

D. Based on the result of your query, what do you notice about the relationship between device age and the number of devices repurposed versus the average energy saved?

(write your **answer** below 👇)

Older devices produce higher energy savings at an average of 48 KW while mid-age devices save 32 KW and newer devices save 19 KW

E. Finally, write a query that returns the total number of devices, the average energy savings, and the average CO_2 emissions saved (in tons), now grouped by region.

(paste your query below 👇)

```
WITH device_impact AS (
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
```

```
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
)
SELECT
region,
COUNT(*) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 AS avg_co2_saved_tons
FROM device_impact
GROUP BY region
ORDER BY region;
```

F. How does the carbon intensity of electricity in each region impact the total CO_2 savings from repurposed devices? Are there regions where repurposing leads to significantly higher environmental benefits? Why might that be?

(write your **answer** below 👇)

The CO_2 savings from repurposed devices depend on the carbon intensity of electricity in each region. Regions with fossil-fuel-heavy grids, like parts of Asia, see higher CO_2 reductions per device, while cleaner grids, like in Europe, achieve lower CO_2 savings per kWh. North America, with a large number of devices and moderate carbon intensity, contributes substantial overall CO_2 reductions. In short, repurposing always saves energy, but the environmental benefit is greatest where electricity generation produces more CO_2.

— **Task 4:** Data-Driven Recommendations

Using the findings from this analysis, we need to summarize key takeaways and develop actionable recommendations for Intel. Remember: the goal is to refine Intel's repurposing

strategy to maximize energy savings and CO_2 reductions while ensuring the most effective use of resources.

A. Based on your analysis of the repurposed devices (including energy savings, CO_2 emissions, and device age), write **four** key takeaways in succinct sentences/bullets that summarize the most important patterns and insights from the data. These should be specific, concise, and focused on the implications of repurposing newer versus older devices.

(write your **answer** below 👇)

- Most devices repurposed are laptops, which contribute the largest total energy savings and CO_2 reductions due to both their numbers and per-device impact.
- Energy savings per device are fairly consistent (~25 kWh/year), but older devices tend to have slightly higher CO_2 savings because repurposing them avoids manufacturing new devices sooner.
- Device age buckets show meaningful patterns: mid-age and older devices deliver significant environmental benefits, highlighting the value of extending device lifespans.
- Regional impact varies with carbon intensity: repurposing devices in high-carbon regions (e.g., Asia) yields greater CO_2 reductions per kWh saved than in cleaner-grid regions.

B. Based on your four key takeaways and ChatGPT as your teammate, write a recommendation for Intel on how to improve the repurposing program. Your recommendation should include a clear action or strategy for Intel based on the data and a data-driven justification for why this approach would maximize energy savings and CO_2 reductions.

(write your **answer** below 👇)

Intel's repurposing program can achieve greater environmental impact by prioritizing mid-age and older laptops, particularly in regions with high-carbon-intensity electricity, such as parts of Asia. These devices provide the largest energy savings (~25 kWh per device) and CO_2 reductions, and focusing on high-impact regions maximizes emissions avoided per kWh saved. Scaling repurposing efforts strategically ensures Intel delivers significant sustainability benefits while extending the useful life of its devices.

C. Briefly reflect on how ChatGPT's suggestions influenced your recommendation. Did it help you see something you hadn't considered? What parts of your recommendation were improved based on its response?

(write your **answer** below 👇)

ChatGPT helped me structure my recommendation by highlighting patterns in device age, type, and regional carbon intensity that I hadn't fully considered initially. Its analysis emphasized that mid-age and older laptops in high-carbon regions provide disproportionately higher environmental benefits, which led me to focus the recommendation on these devices and areas. Additionally, ChatGPT's framing helped me clearly connect the data-driven insights to actionable strategies, making the recommendation more precise and impactful.

— **LevelUp:** Optimizing Repurposing Strategy for Maximum Impact

Now that you've gained insights into the energy savings and CO_2 reductions across different device types and regions, let's use this data to optimize Intel's repurposing strategy for maximum environmental benefit.

A. Add to your final query of Task 3 that returns the total number of devices, the average energy savings, and the average CO_2 emissions saved (in tons), grouped by region, **the percentage** of the total energy savings and CO_2 reductions contributed by each device type within each region.

HINT: To calculate the percentage of the total energy savings, use this formula:
`Total energy savings for the device type / Total energy savings for the region) * 100`
You'll use a similar one for the percentage of the total CO_2 reductions.

Try this prompt: What's the best way to calculate the percentage of CO_2 reductions contributed by each device type in each region?

(paste your query below 👇)

```
WITH device_impact AS (
SELECT
d.*,
i.*,
(2024 - d.model_year) AS device_age,
CASE
WHEN (2024 - d.model_year) <= 3 THEN 'newer'
WHEN (2024 - d.model_year) > 3 AND (2024 -
d.model_year) <= 6 THEN 'mid-age'
WHEN (2024 - d.model_year) > 6 THEN 'older'
END AS device_age_bucket
FROM intel.device_data AS d
LEFT JOIN intel.impact_data AS i
ON d.device_id = i.device_id
)
SELECT
region,
device_type,
COUNT(*) AS total_devices,
SUM(energy_savings_yr) AS total_energy_savings_kwh,
SUM(co2_saved_kg_yr) / 1000 AS total_co2_saved_tons,
(SUM(energy_savings_yr) / SUM(SUM(energy_savings_yr))
OVER (PARTITION BY region)) * 100 AS
pct_energy_savings,
```

```
((SUM(co2_saved_kg_yr) / 1000) /
SUM(SUM(co2_saved_kg_yr) / 1000) OVER (PARTITION BY
region)) * 100 AS pct_co2_savings
FROM device_impact
GROUP BY region, device_type
ORDER BY region, device_type;
```

B. Based on the results of your query, analyze the data to answer:

- Which device types in which regions contribute the most energy savings and CO_2 reductions relative to their numbers?
- How can this analysis help Intel prioritize specific device types in certain regions to maximize environmental benefits?

(write your **answer** below 👇)

1.Energy Savings:
Asia Desktops: 618,921 desktops contribute 53.6% of the region's total energy savings, even though laptops are more numerous.
North America Laptops: 2,028,505 laptops contribute 67.9% of energy savings, showing that sheer numbers drive total savings.

CO_2 Reductions:
Asia and Europe Laptops: Laptops contribute 68% of CO_2 reductions in both regions, even though they may be fewer in number than desktops in some regions.
North America Laptops: Also dominate CO_2 reductions (~67.9%).

Insight: Laptops consistently provide higher CO_2 savings per device, while desktops can contribute significantly to energy savings, especially in regions like Asia.

2. How Intel can use this analysis

Prioritize laptops in all regions, especially those with high carbon-intensity electricity (e.g., parts of Asia), because they provide the largest CO_2 reductions per device.

Target desktops strategically where their energy savings are proportionally high (like Asia), to maximize total energy savings even if CO_2 reductions per device are lower.

Allocate resources regionally: Focus repurposing efforts on high-impact regions where the combination of device type and grid carbon intensity delivers the greatest environmental benefit per device.

C. In addition to focusing on sustainability, imagine Intel needs to optimize for cost-effectiveness in their repurposing program. How might you adjust your query to incorporate cost data (e.g., cost per repurposed device)? What strategies could Intel use to balance sustainability goals with cost constraints?

(write your **answer** below 👇)

If Intel adds a **repurpose_cost** column to the impact data table, it would be used to measure cost-effectiveness. It could add total cost per device type and region as well as calculate energy savings per dollar and CO_2 saved per dollar, helping identify the most cost-effective opportunities.

As for strategies Intel might use to balance sustainability with cost constraints these could include:
-Prioritize devices with high CO_2 or energy savings per dollar, e.g., laptops in high-carbon regions.
-Target mid-age or older devices where repurposing costs are reasonable but environmental gains are high.
-Focus on regions with high carbon intensity but low repurposing costs to maximize emissions reductions per dollar.

-Optimize logistics and batch processing to reduce per-device repurposing costs without reducing total environmental impact overall.

— Evaluation Rubric

Unlike your Milestones that were evaluated largely based on your effort, the evaluation of your Portfolio Project will follow traditional evaluation methods, with tasks assessed for correctness and assigned point values accordingly.

Partial credit will be given where parts of this task are correct, even if other parts are incorrect or incomplete.

Task title	Max points
Task 1: Organizing and Understanding the Data	40
Task 2: Key Insights	25
Task 3: Identifying Trends & Maximizing Sustainability	60
Task 4: Data-Driven Recommendations	75
TOTAL POINTS:	200
LevelUp	
Optimizing Repurposing Strategy for Maximum Impact	20