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
 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
 *,
 2024 - d.model_year AS device_age
FROM
 intel.device_data AS d
 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 👇)

Based on the analysis, Intel's repurposing strategy demonstrates a thoughtful alignment between device age and usage purpose. Devices under 5 years old are most frequently repurposed for Corporate & Enterprise use, likely due to the higher performance demands in business environments. In contrast, older devices, those 5 years and older, are primarily repurposed for Education & Digital Literacy, where lower hardware requirements still allow for meaningful impact. This pattern suggests that Intel is effectively extending the lifecycle of devices by matching them to appropriate programs, maximizing both environmental sustainability and social value.

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
 *,
 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'
   ELSE 'older'
  END AS device_age_bucket
 FROM
  intel.device_data AS d
  JOIN intel.impact_data AS i
  ON d.device_id = i.device_id
```

— **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 👇)

Intel repurposed a total of **601,740** devices in 2024.

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 joined_data AS (
SELECT
 *,
 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'
  ELSE 'older'
 END AS device_age_bucket
FROM
 intel.device_data AS d
 JOIN intel.impact_data AS i
 ON d.device_id = i.device_id
 )

SELECT
 COUNT(*) AS total_devices_repurposed,
 ROUND(AVG(device_age), 2) AS avg_age,
 ROUND(AVG(energy_savings_yr), 2) AS
avg_energy_saving_kwh,
 ROUND(SUM(co2_saved_kg_yr) / 1000, 2) AS
total_co2_saved_tons
FROM joined_data
```

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 👇)

Intel's 2024 repurposing program extended the life of over 600,000 devices, with each saving an average of 25.74 kWh of energy annually and reducing CO_2 emissions by a total of 6,768.42 tons. This is roughly equivalent to powering more than 140 U.S. homes for a year and removing over 1,400 gasoline-powered cars from the road. These savings highlight how repurposing technology at scale can contribute meaningfully to energy conservation and carbon reduction, making it a valuable strategy in Intel's broader sustainability efforts.

– **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 joined_data AS (
  SELECT
    *,
    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'
      ELSE 'older'
    END AS device_age_bucket
  FROM
    intel.device_data AS d
    JOIN intel.impact_data AS i ON d.device_id =
i.device_id
)
SELECT
  device_type,
  COUNT(*) AS total_devices,
  ROUND(AVG(energy_savings_yr), 2) AS
avg_energy_saving_kwh,
  ROUND(AVG(co2_saved_kg_yr) / 1000, 4) AS
avg_co2_saved_tons
FROM
  joined_data
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 👇)

Based on the results, **Laptops** contribute the most to both total energy savings and CO2 reduction. Although the average energy savings and CO2 emissions saved per device are very similar between laptops and desktops (25.80 kWh vs. 25.62 kWh, and 0.0113 vs. 0.0112 tons), laptops were repurposed in much greater numbers : **408,064 laptops** compared to **193,676 desktops**.

This larger volume means that, overall, laptops have a greater cumulative environmental impact. This may be because laptops are more portable, in higher demand across sectors like education and nonprofits, and more often eligible for reuse due to their longer battery-backed usability and compact design.

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 joined_data AS (
  SELECT
    *,
    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'
      ELSE 'older'
    END AS device_age_bucket
  FROM
    intel.device_data AS d
    JOIN intel.impact_data AS i ON d.device_id =
i.device_id
)
SELECT
  device_age_bucket,
  COUNT(*) AS total_devices,
  ROUND(AVG(energy_savings_yr), 2) AS
avg_energy_saving_kwh,
  ROUND(AVG(co2_saved_kg_yr) / 1000, 4) AS
avg_co2_saved_tons
FROM
  joined_data
```

```
GROUP BY device_age_bucket
```

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 👇)

The data shows that **newer devices** are repurposed the **most**, but they save the **least amount of energy** and **CO2** per device. **Older devices**, on the other hand, are repurposed **much less often** but save the **most energy** and reduce the **most CO2**. **Mid-age devices** fall somewhere in between. This means that if Intel can find ways to safely repurpose **older devices**, the program could have an even **bigger positive impact** on the **environment**.

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 joined_data AS (
  SELECT
    *,
    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'
      ELSE 'older'
    END AS device_age_bucket
  FROM
    intel.device_data AS d
    JOIN intel.impact_data AS i ON d.device_id =
i.device_id
```

```
)
SELECT
  region,
  COUNT(*) AS total_devices,
  ROUND(AVG(energy_savings_yr), 2) AS
avg_energy_saving_kwh,
  ROUND(AVG(co2_saved_kg_yr) / 1000, 4) AS
avg_co2_saved_tons
FROM
  joined_data
GROUP 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 results show that while all three regions (Asia, Europe, and North America) have similar average energy savings per repurposed device (around **25.7 kWh**), the **CO2 emissions saved vary significantly**. Devices repurposed in **Asia** have the highest average CO2 savings (**0.0155 tons**), followed by **North America** (**0.0103 tons**) and **Europe** (**0.0064 tons**). This difference is likely due to the **carbon intensity** of electricity in each region. Since Asia relies more on fossil fuels like coal, saving electricity there prevents more CO2 emissions. In contrast, Europe's cleaner energy grid results in lower CO_2 savings for the same energy reduction. This suggests that Intel could **maximize environmental benefits** by prioritizing repurposing efforts in regions with **higher carbon intensity**, where each repurposed device leads to greater CO2 reduction.

— **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 👇)

- **Older devices save the most energy and CO_2 per unit**, but are repurposed far less frequently than newer or mid-age devices.
- **Newer devices (≤3 years) are the most commonly repurposed**, but offer the **least benefit per device**, suggesting the need to evaluate whether early replacement is necessary.
- **Laptops contribute more to overall savings** due to their higher repurposing volume, despite having nearly identical average impact as desktops.
- **Repurposing in regions with higher carbon intensity, like Asia, results in greater CO2 reductions**, even when energy savings per device are similar.

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 should prioritize repurposing **older devices** in regions with **higher carbon intensity**, such as **Asia**, to maximize environmental benefits. Although older devices make up a small portion of the program, they offer the **highest average energy savings (48.02 kWh)** and **CO2 reductions (0.0210 tons)** per unit. Targeting these devices more aggressively, especially for use in high-impact regions, could significantly increase total emissions savings. At the same time, Intel should review the early replacement of **newer devices**, which are currently the most repurposed but contribute the **least** per device in environmental value. Redirecting resources toward identifying, restoring, and deploying older yet functional devices would make the repurposing program more efficient, sustainable, and impactful.

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's suggestions helped me better understand the impact of carbon intensity by region, which I hadn't considered before. Highlighting that the same energy savings can lead to different CO_2 reductions depending on location made my recommendation more targeted 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 joined_data AS (
  SELECT
    *,
    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'
      ELSE 'older'
    END AS device_age_bucket
  FROM intel.device_data AS d
  JOIN intel.impact_data AS i ON d.device_id =
i.device_id
),
region_totals AS (
  SELECT
    region,
    SUM(energy_savings_yr) AS region_energy_total,
    SUM(co2_saved_kg_yr) AS region_co2_total
  FROM joined_data
  GROUP BY region
),
region_device_type AS (
  SELECT
    region,
    device_type,
    COUNT(*) AS total_devices,
    SUM(energy_savings_yr) AS device_energy_total,
    SUM(co2_saved_kg_yr) AS device_co2_total
```

```
  FROM joined_data
  GROUP BY region, device_type
)

SELECT
  rdt.region,
  rdt.device_type,
  rdt.total_devices,
  ROUND(rdt.device_energy_total, 2) AS
total_energy_savings_kwh,
  ROUND(rdt.device_co2_total / 1000, 4) AS
total_co2_saved_tons,
  ROUND((rdt.device_energy_total /
rt.region_energy_total) * 100, 2) AS
percent_energy_contribution,
  ROUND((rdt.device_co2_total / rt.region_co2_total) *
100, 2) AS percent_co2_contribution
FROM region_device_type rdt
JOIN region_totals rt ON rdt.region = rt.region
ORDER BY rdt.region, rdt.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 👇)

Based on the results, laptops consistently contribute the most to both energy savings and CO_2 reductions across all regions. In Asia, Europe, and North America, laptops account for around **68%** of the devices repurposed, and they also contribute **about 68% of the total energy and CO_2 savings** in each region. This means their environmental benefit is well-aligned with their volume. **Desktops, while fewer in**

number (around 32%), still contribute significantly, especially in **North America and Asia**, where total CO_2 savings from desktops are close to 950–990 tons.

This analysis can help Intel **prioritize laptops as the main focus** of the repurposing program globally, as they offer the greatest return in both volume and impact. However, it also shows that **desktops in regions with higher energy use and carbon intensity**, like **Asia and North America**, should not be overlooked. By targeting **both high-impact device types and high-carbon regions**, Intel can **maximize its environmental benefits** more strategically.

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 👇)

To incorporate cost-effectiveness into the analysis, Intel would need to include a new column in the dataset, such as **cost_per_device**,that represents the average cost to repurpose each device. The query could then be adjusted to calculate the **total cost** per region and device type, as well as key metrics like:

- **Energy saving per dollar** = total energy savings / total cost
- **CO2 savings per dollar** = total CO2 saved / total cost

These new columns would help Intel identify which device types and regions provide **the most environmental benefit per dollar spent**.

To balance sustainability goals with cost constraints, Intel could use the following strategies:

- **Prioritize devices with the highest energy or CO_2 savings per dollar**, not just per unit.

- **Focus on repurposing in regions where logistics and labor costs are lower**, to stretch sustainability impact further.
- **Target mid-age devices**, which often offer a strong balance between lower repair cost and high environmental return.
- **Use predictive models** to estimate success rates of repurposing older devices, reducing waste and unnecessary expense.

This approach allows Intel to be both environmentally and financially efficient, making the most of its resources while maximizing its sustainability outcomes.