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
    d.device_id,
    d.device_type,
    d.model_year,
    i.impact_id,
    i.usage_purpose,
    i.power_consumption,
    i.energy_savings_yr,
    i.co2_saved_kg_yr,
    i.recycling_rate,
    i.region
FROM intel.device_data d
INNER JOIN intel.impact_data 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.device_id,
    d.device_type,
    d.model_year,
    (2024 - d.model_year) AS device_age,
    i.impact_id,
    i.usage_purpose,
    i.power_consumption,
    i.energy_savings_yr,
    i.co2_saved_kg_yr,
```

```
    i.recycling_rate,
    i.region
FROM intel.device_data d
JOIN intel.impact_data 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 👇)

The data reveals that a larger proportion of repurposed devices are relatively new, typically under five years old. This suggests that Intel's repurposing program is effectively capturing newer, lightly used equipment that will still be strongly effective.

Repurposing newer devices not only extends their usable life but also maximizes energy efficiency and reduces the carbon footprint compared to manufacturing new devices. However, this trend may also indicate that older devices are either reaching the end of their functional lifespan and being given away or are not being collected efficiently through the program. Intel could benefit from investigating any abarriers to recovering and refurbishing older devices to ensure that sustainability gains are distributed across the full range of device ages.

Repurposing newer devices not only extends their usable life but also maximizes energy efficiency and reduces the carbon footprint compared to manufacturing new devices. But this also focus reflects both an efficient sustainability strategy and shifting consumer behavior, as many individuals and corporations upgrade devices frequently, creating a steady stream of newer technology for reuse. While this refurbishing plan strengthens Intel's positive social and environmental impact, it may also reveal missed opportunities to recover older equipment that still hold value. Intel could benefit from investigating barriers to collecting and refurbishing aging hardware and expanding outreach efforts to balance efficiency and more inclusivity, thereby reducing total waste and enhancing the overall reach of its circular economy initiatives.

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.device_id,
d.device_type,
d.model_year,
(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,
i.impact_id,
i.usage_purpose,
i.power_consumption,
i.energy_savings_yr,
i.co2_saved_kg_yr,
i.recycling_rate,
i.region
FROM intel.device_data d
JOIN intel.impact_data 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 👇)

According to my data, Intel repurposed a total of over 150,000 devices in 2024. This figure represents all devices included in the dataset, as each row corresponds to one repurposed device. The large volume highlights the scale and impact of Intel's sustainability efforts, demonstrating a significant commitment to reducing waste.

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
d.device_id,
d.device_type,
d.model_year,
(2024 - d.model_year) AS device_age,
i.energy_savings_yr,
i.co2_saved_kg_yr
FROM intel.device_data d
JOIN intel.impact_data i
ON d.device_id = i.device_id
)
SELECT
COUNT(device_id) AS total_devices_repurposed,
AVG(device_age) AS avg_device_age,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
SUM(co2_saved_kg_yr) / 1000 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 repurposing program in 2024 successfully repurposed over 600,000 devices, each averaging about 3.5 years old. On average, every device saved around 425 kWh of energy per year, leading to an overall reduction of roughly 8,420 tons of CO_2 emissions. These figures demonstrate how Intel's initiative is making a tangible environmental impact by extending the lifespan of devices that still hold strong performance potential.

To put this into perspective, the total energy saved is equivalent to powering nearly 24,000 average U.S. homes for an entire year, while the CO2 reduction equals removing about 1,800 gasoline-powered cars from the road or planting over 140,000 trees. These results highlight that repurposing is not only about recycling hardware, it's also truly about significantly lowering energy consumption and emissions that would otherwise result from manufacturing new devices, reinforcing Intel's commitment to a circular and sustainable technology ecosystem.

– **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
d.device_id,
d.device_type,
d.model_year,
(2024 - d.model_year) AS device_age,
i.energy_savings_yr,
i.co2_saved_kg_yr
FROM intel.device_data d
JOIN intel.impact_data i
ON d.device_id = i.device_id
)
SELECT
device_type,
COUNT(device_id) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 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, Intel laptops contribute the most to total energy savings and CO2 reduction. Intel repurposed 408,064 laptops compared to 193,676 desktops, which means laptops account for more than two-thirds of all repurposed devices. While each desktop saved about 625.6 kWh per year and each laptop saved 425.8 kWh, the total energy savings from laptops is much greater due to their larger quantity.

In total, laptops collectively saved an estimated 173.5 million kWh of energy (408,064 × 425.8), compared to about 121.1 million kWh from desktops (193,676 × 625.6). Both device types saved roughly 0.011 tons (11 kg) of CO_2 per device per year, meaning laptops prevented about 4,489 tons of CO_2 emissions versus 2,130 tons from desktops. These numbers show that, while desktops save more energy per unit, laptops have the bigger overall environmental impact because far more of them are being repurposed.

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
d.device_id,
d.device_type,
d.model_year,
(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,
i.energy_savings_yr,
i.co2_saved_kg_yr
FROM intel.device_data d
JOIN intel.impact_data i
ON d.device_id = i.device_id
)
SELECT
device_age_bucket,
COUNT(device_id) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 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 👇)

Based on the results, newer devices (317,191) make up the largest portion of Intel's repurposing program, followed by mid-age devices (264,310) and older devices (202,394). However, the average energy savings increases with device age — newer devices save about 119.1 kWh per year, mid-age devices save 132.0 kWh, and older devices save the most at 148.0 kWh per year.

This trend suggests that while Intel repurposes more newer devices, older devices deliver greater energy-saving benefits per unit when reused, likely because replacing an older model with a new one would require more energy-intensive manufacturing. The higher CO_2 savings for older devices (0.021 tons per year) also support this idea. Therefore, even though newer devices dominate the program by quantity, older and mid-age devices contribute more significantly on a per-device basis to overall sustainability impact.

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
d.device_id,
d.device_type,
d.model_year,
(2024 - d.model_year) AS device_age,
i.energy_savings_yr,
i.co2_saved_kg_yr,
i.region
FROM intel.device_data d
JOIN intel.impact_data i
ON d.device_id = i.device_id
)
SELECT
region,
COUNT(device_id) AS total_devices,
AVG(energy_savings_yr) AS avg_energy_savings_kwh,
AVG(co2_saved_kg_yr) / 1000 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 carbon intensity of electricity in each region strongly influences CO2 savings from repurposed devices. The regions that rely more heavily on fossil fuels, such as parts of Asia, tend to show higher CO2 savings because avoiding electricity use there prevents more emissions. The same amount of energy saved has a greater environmental effect when the local grid produces more carbon per kilowatt-hour.

In contrast, regions with cleaner energy sources, like Europe and North America, show lower CO2 savings per device since their power generation already emits less carbon. However, repurposing in these areas still provides major benefits by reducing e-waste, extending device lifespans, and conserving the resources required to manufacture new technology.

– **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 👇)

The data shows that newer devices make up the largest share of Intel's repurposing program, indicating that the company is efficiently capturing lightly used, high-performance equipment. However, older devices, while fewer in number, produce the greatest average energy and CO2 savings per unit, suggesting that extending the lifespan of aging hardware yields strong environmental benefits. Additionally, laptops dominate the program in quantity, resulting in the highest total energy and CO2 reductions overall, even though desktops offer slightly higher savings per device. Finally, regional differences reveal that repurposing in areas with higher carbon intensity, such as parts of Asia, delivers the most significant environmental impact, meaning Intel could maximize its sustainability outcomes by strengthening programs in those 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 👇)

I believe Intel should expand its repurposing efforts to include a greater share of mid-age and older devices while maintaining strong collection rates for newer ones. The data shows that although newer devices are repurposed most frequently, older devices deliver the highest average energy and CO2 savings per unit. By investing in targeted recovery campaigns, repair programs, or trade-in incentives for older hardware, Intel can significantly increase its overall sustainability impact. Additionally, prioritizing repurposing efforts in regions with higher carbon intensity, such as parts of Asia as it would further maximize CO2 reductions, since each kilowatt-hour saved prevents more emissions in those areas.

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 identify patterns I hadn't initially considered, such as how regional carbon intensity influences CO2 savings and how the balance between newer and older devices affects overall environmental impact. It also guided me to structure my recommendation with clear, data-driven reasoning, emphasizing both the global and regional dimensions of Intel's repurposing strategy.

– **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
d.device_id,
d.device_type,
```

```
d.model_year,
(2024 - d.model_year) AS device_age,
i.energy_savings_yr,
i.co2_saved_kg_yr,
i.region
FROM intel.device_data d
JOIN intel.impact_data i
ON d.device_id = i.device_id
),
region_totals AS (
SELECT
region,
SUM(energy_savings_yr) AS total_energy_region,
SUM(co2_saved_kg_yr) AS total_co2_region
FROM joined_data
GROUP BY region
)
SELECT
j.region,
j.device_type,
COUNT(j.device_id) AS total_devices,
AVG(j.energy_savings_yr) AS avg_energy_savings_kwh,
AVG(j.co2_saved_kg_yr) / 1000 AS avg_co2_saved_tons,
(SUM(j.energy_savings_yr) / rt.total_energy_region) *
100 AS pct_energy_savings,
(SUM(j.co2_saved_kg_yr) / rt.total_co2_region) * 100 AS
pct_co2_reduction
FROM joined_data j
JOIN region_totals rt
ON j.region = rt.region
GROUP BY j.region, j.device_type,
rt.total_energy_region, rt.total_co2_region
ORDER BY j.region, pct_energy_savings DESC;
```

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 contribute the most to total energy savings and CO2 reductions in every region, accounting for roughly 68 percent of both metrics across Asia, Europe, and North America. Desktops, while fewer in number, contribute around 32 percent of total savings but maintain slightly higher average energy and CO2 savings per device. This indicates that although each desktop has greater individual impact, laptops drive the majority of Intel's overall environmental gains because they are repurposed in much larger quantities.

For Intel's strategy, this means the company should continue prioritizing laptop repurposing programs globally, especially in regions like Asia, where higher carbon intensity amplifies the total CO2 reduction impact. At the same time, Intel could expand desktop recovery efforts in regions where these devices remain common in corporate or educational settings, as increasing their repurposing volume could yield additional high-impact savings. This balanced approach would help Intel maximize both scale through laptops and per-unit efficiency through desktops across all regions.

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 data, I would adjust the query by adding a cost_per_device column to the dataset, either from an additional table or as part of the existing impact data. The query could then calculate metrics such as average cost per device type or region, total program cost, and energy or CO_2 savings per dollar spent. For example, I could include expressions like SUM(energy_savings_yr) / SUM(cost_per_device) to measure the energy savings return on investment, helping Intel identify which regions or device types deliver the highest sustainability impact for the lowest cost.

To balance sustainability goals with cost constraints, Intel could use a data-driven optimization approach—prioritizing repurposing efforts that achieve the greatest environmental benefit per dollar. This might include focusing on regions where both energy savings and CO_2 reductions are high relative to cost, investing in refurbishing devices that require minimal repair, or forming partnerships with logistics and recycling vendors to reduce operational expenses. By combining environmental and financial performance metrics, Intel can strategically allocate resources to maximize both sustainability impact and cost-efficiency.

— 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