Here are the assumptions that we can use for our revenue assumptions (All these assumptions are from HSO report of the trail project which did 71 households)

1. **Households in Orkney**: Approximately 10,000 households, based on the 2018 National Records of Scotland.
2. **Retrofitting Preexisting Devices**: The HSO scheme focuses on retrofitting existing heating devices with Home Hub units to connect them to the Kaluza ACP. The costs for the initial purchase, installation, and maintenance of the heating devices themselves are not included in the HSO scheme.
3. **Turbine Costs Exclusion**: The HSO project does not factor in the costs related to purchasing and maintaining turbines.

**Device Specifications**: Households are expected to have DSM heating devices similar to the immersion and Dimplex heaters used in the HSO trial, with an average load of 2.3 kW and approximately 1.7 devices per household.

Revenue Opportunity-

* **Curtailment Opportunity**: On average, each turbine generates about 1.0 GWh of curtailed energy annually (equivalent to a constant waste of 0.11 MW). This figure is based on an analysis of 23 turbines, but it may be recalculated for a larger number of turbines if needed.Please note: This is an approx. number for only 23 turbines, given Nicos findings for all the 33 turbines and 500+ micro turbines, we can calculate this number ourselves.
* **System Efficiency**: The efficiency of utilizing curtailed energy improves with the addition of more turbines, estimated to be about 50% for up to 5 turbines and increasing to 90% for 21-23 turbines. So whatever you will get as the MAX output, take 90% of that to account for downtime for some turbines
* **Device Capacity and Consumption: Each device is assumed to use approximately 2.9 MWh per year.** This figure is derived from an average 2.3 kW device operating up to 7 hours per day, 365 days a year, with adjustments for non-uniform distribution of curtailment throughout the year.**:** The maximum volume of mitigated curtailment that a single device can accept is assumed to be 2.9 MWh p.a., based on an average 2.3 kW device, operating for up to 7 hours per day (based on a typical E7 tariff window for storage heaters), and 365 days a year (5.9 MWh). A further 50% haircut is applied (resulting in 2.9 MWh p.a.), to reflect that the distribution of curtailment throughout the year is non-uniform and could at times far exceed the 0.11 MW and 1.0 GWh average per turbine figures, and thus may not be captured

How is Revenue Gonna be generated:

**Formula for Revenue**:

* Revenue is generated from mitigated curtailment, calculated as: *Revenue*=*Mitigated Curtailment* (*MWh*)×*Value of Avoided Curtailment*(15*p*/*kWh*)
* Mitigated curtailment (MWh) = Annual consumption per device (MWh) ✕ Device count

Therefore:

Revenue = Annual consumption per device (MWh) ✕ Device count ✕ Value of avoided curtailment (15 p/kWh)

AND:

The curtailment opportunity per year is assumed as:

**Curtailment Opportunity**:

* The total potential energy savings from curtailment, varying with the number of turbines and their efficiency.

*Curtailment Opportunity (MWh)= Curtailment per Turbine (1GWh)× Turbine Count × System Efficiency(50−90%)*

Annual consumption per device (MWh) (2.9 MWh) = Curtailment opportunity (MWh) / Device count

**Assumptions**

1. **Total Number of Households**: Approximately 10,000 households across Orkney.
2. **Retrofitting Preexisting Devices**: Only costs associated with retrofitting a Home Hub device are considered. The initial cost, installation, and maintenance of the heating devices themselves are not covered by HSO.
3. **Turbine Costs**: Costs related to the turbine (like purchase and maintenance) are not included in the HSO scheme.
4. **Number of Devices and Load per Device**: Each household is expected to have devices similar to the immersion and Dimplex heaters used in the trial. The average load of these devices is 2.3 kW, and there's an average of 1.7 devices per household.
5. **Curtailment Opportunity**: Each of the 23 turbines has approximately 1.0 GWh of curtailed energy per year. System efficiency in using this energy varies with the number of turbines, assumed to be up to 90% efficient with 21-23 turbines.
6. **Device Capacity and Consumption**: Each device is assumed to use approximately 2.9 MWh per year.

**Revenue Calculation Formula**

1. **Mitigated Curtailment**:
   * This is the total energy that can be saved from being wasted (curtailed).
   * Calculated as **Annual consumption per device (MWh) × Device count**.
2. **Revenue Generation**:
   * Revenue is generated from this mitigated curtailment.
   * Formula: **Revenue = Mitigated curtailment (MWh) × Value of avoided curtailment (15 p/kWh)**.
3. **Curtailment Opportunity**:
   * Calculated as **Curtailment per turbine (1 GWh) × Turbine count × System efficiency (50-90%)**.

**Example Calculation**

To give an example, let's calculate the revenue for a scenario where we have 1,000 devices and 23 turbines:

1. **Mitigated Curtailment for 1,000 Devices**:
   * Each device uses 2.9 MWh/year.
   * Total = 2.9 MWh/device/year × 1,000 devices = 2,900 MWh/year.
2. **Curtailment Opportunity**:
   * Assuming all 23 turbines, each with 1 GWh curtailed energy per year, and 90% system efficiency.
   * Total = 1 GWh/turbine × 23 turbines × 90% = 20.7 GWh/year.
3. **Revenue**:
   * Assuming the value of avoided curtailment is 15 pence per kWh.
   * Total Revenue = 2,900 MWh × £0.15/kWh = £435,000/year.

Please note that the actual revenue may vary depending on the exact number of devices, the efficiency of the system, and the actual curtailment opportunity. The formula and assumptions should be adjusted based on the specific details of the project and the available data.

**Fixed Costs (Vary with Device Count)**

1. **Home Hub Capital Investment**:
   * **Cost**: £100 per device.
   * **Lifetime**: 5 years.
   * **Explanation**: This is the upfront cost for each home hub, a device necessary for the project. It's a one-time investment, and it's expected to last for 5 years.
2. **Home Hub Installation**:
   * **Cost**: 3 hours of work by a contractor at £30 per hour.
   * **Lifetime**: 5 years.
   * **Explanation**: This is the cost of installing the home hub. It's calculated based on the amount of time a contractor needs to set it up (3 hours) and their hourly rate (£30).

**Variable Costs (Vary with Device Count)**

1. **Home Hub Maintenance**:
   * **Cost**: 2 hours of work by a contractor at £30 per hour, annually.
   * **Assumption**: 5% device failure rate.
   * **Explanation**: Each year, some home hubs might fail or need maintenance. Assuming a 5% failure rate, this cost covers the contractor's time (2 hours at £30 per hour) for maintaining or repairing the home hubs.
2. **Kaluza ACP Cloud Platform Operational Costs**:
   * **Cost**: Varies based on the number of devices:
     + £22,000 per year for 100 devices.
     + £45,000 per year for 1,000 devices.
     + £112,000 per year for 5,000 devices.
     + £224,000 per year for 10,000 devices.
   * **Components**: Includes costs for the Kubernetes orchestration system, Datastore database, BigQuery data warehouse, Azure cloud computing, Azure IoT hub, Kafka platform, and Elasticsearch analytics.
   * **Explanation**: This is the cost of running the cloud platform that manages and coordinates the home hubs. It increases as more devices are added, as more resources are required to manage them.
3. **Software Engineering Support**:
   * **Cost**: 10% of a Full-Time Equivalent (FTE) at £60,000 per year, increased by 1.4, for every 100 devices. This cost increases by 20% for every additional 100 devices.
   * **Explanation**: This cost is for the software engineers who support and maintain the system. The base cost is based on a portion of a full-time software engineer's salary, adjusted upwards by 40% (probably to account for taxes, benefits, and other overheads). This cost increases as more devices are added, requiring more engineering time.

Costs Yearly:

**Yearly Cost Calculation**

1. Fixed Costs (Annualized)

* **Home Hub Capital Investment**:
  + £100 per device with a 5-year lifetime.
  + Annualized Cost = £100 / 5 years = **£20 per device per year.**
* **Home Hub Installation**:
  + 3 hours at £30/hour, once every 5 years.
  + Total Installation Cost = 3 hours × £30/hour = £90.
  + Annualized Cost = £90 / 5 years = **£18 per device per year.**

2. Variable Costs (Annual)

* **Home Hub Maintenance**:
  + Assuming a 5% failure rate, with 2 hours of work at £30/hour per device per year.
  + Annual Maintenance Cost per device = 2 hours × £30/hour = £60.
  + Only 5% of the devices are expected to need this maintenance each year.
  + Annualized Maintenance Cost = £60 × 5% = **£3 per device per year.**
* **Kaluza ACP Cloud Platform Operational Costs**:
  + These costs depend on the number of devices. Let's assume a specific number of devices to calculate this. For example, for 1,000 devices, the cost is £45,000 per year. To carry this cost we will just round up to the nearest 1000s

• £22,000 per year for 100 devices.

• £45,000 per year for 1,000 devices.

• £112,000 per year for 5,000 devices.

• £224,000 per year for 10,000 devices.

* **Software Engineering Support**:
  + For 100 devices: 10% of a Full-Time Equivalent (FTE) at an adjusted salary of £84,000 (£60,000 × 1.4).
  + Cost for 100 devices = 10% of £84,000 = £8,400.
  + This cost increases by 20% for every additional 100 devices. For simplicity, let's use the base figure for 100 devices as a reference. (I AM EXPLAINING THIS LATER, KINDA TRICKY TO UNDERSTAND)

Total Yearly Cost

To find the total yearly cost, let's add these up. For simplicity, I'll calculate for 100 devices:

* **Fixed Costs (Per Device Per Year)**:
  + Home Hub (Capital + Installation): £20 + £18 = £38.
* **Variable Costs (Per Device Per Year)**:
  + Home Hub Maintenance: £3.
* **Total Per Device Per Year**:
  + Fixed + Variable = £38 + £3 = £41.
* **Total for 100 Devices Per Year**:
  + £41 × 100 = £4,100.
* **Additional Costs for 100 Devices**:
  + Kaluza ACP Cloud Platform: £22,000.
  + Software Engineering Support: £8,400.
* **Grand Total for 100 Devices Per Year**:
  + Device Costs + Cloud Platform + Engineering Support = £4,100 + £22,000 + £8,400 = £34,500.

**Understanding the Cost Structure (SOFTWARE ENGIRNEER)**

1. **Base Salary of a Full-Time Equivalent (FTE) Software Engineer**:
   * The base annual salary for a software engineer is given as £60,000.
2. **Adjustment Factor**:
   * This salary is increased by a factor of 1.4. This adjustment likely accounts for additional costs associated with employment, such as taxes, benefits, administrative overhead, equipment, and other resources needed for the engineer to work effectively.
3. **Adjusted Annual Salary**:
   * Adjusted Salary = Base Salary × Adjustment Factor = £60,000 × 1.4 = £84,000.
4. **Percentage Allocation for 100 Devices**:
   * For every 100 devices, 10% of one FTE is allocated. This means that 10% of the adjusted salary is assigned to the cost of maintaining 100 devices.
   * Cost for 100 devices = 10% of £84,000 = £8,400 per year.
5. **Incremental Increase for Additional Devices**:
   * For every additional set of 100 devices, this cost increases by 20%.
   * This increment reflects the increased workload and complexity as more devices are added to the system, requiring more engineering time and resources.

**Example Calculations**

* **Cost for the First 100 Devices**:
  + £8,400 per year (as calculated above).
* **Cost for the Next 100 Devices (200 Devices in Total)**:
  + The cost for the second set of 100 devices is 20% more than the first set.
  + Incremental Increase = 20% of £8,400 = £1,680.
  + Total Cost for the next 100 devices = £8,400 + £1,680 = £10,080.
  + Cumulative Cost for 200 devices = £8,400 (first 100 devices) + £10,080 (next 100 devices) = £18,480 per year.
* **Further Increments**:
  + This pattern continues for each additional set of 100 devices, adding 20% of the original £8,400 for each new set.

**Explanation**

* The cost for software engineering support is designed to scale with the number of devices in the system. As more devices are added, more engineering time and resources are needed for maintenance, upgrades, and ensuring smooth operation of the system.
* The initial allocation for 100 devices is based on a reasonable estimation of the engineering resources needed. The incremental increase for each additional set of 100 devices reflects the growing complexity and workload.

**Calculation for 1,000 Devices:**

* We have 10 sets of 100 devices in 1,000 devices.
* The cost for the first set of 100 devices is £8,400.
* For each of the remaining 9 sets (since we already calculated the first set), the cost increases incrementally.

The total cost would be the sum of these incremental costs for each set of 100 devices, plus the initial cost for the first 100 devices. Let's calculate this:

1. **Initial Cost for First 100 Devices**: £8,400.
2. **Total Incremental Cost for Remaining 900 Devices**: 9 sets × £1,680 per set = £15,120.
3. **Total Cost for 1,000 Devices**: £8,400 (initial cost) + £15,120 (incremental cost) = £23,520 per year.

So, the total annual cost of software engineering support for 1,000 devices in the HSO project is £23,520.

Here's a table showing the annual software engineering support cost for different numbers of devices:

| Number of Devices | Annual Cost (£) |

|-------------------|-----------------|

| 100 Devices | 8,400 |

| 200 Devices | 10,080 |

| 1,000 Devices | 23,520 |

| 2,000 Devices | 40,320 |

| 5,000 Devices | 90,720 |

This table illustrates how the cost increases with the number of devices. The cost for the first 100 devices is £8,400, and for each additional set of 100 devices, the cost increases by 20% of the initial £8,400.