- Agrees Raspberry Pi is too powerful for the task, low end microcontrollers will work as well
- Power Consumption. Power savings are inconsequential for this task. You can get it down to mW and uW but don't worry too much.
- Fractions of a percentage in efficiency gains might not be worth it.
- Software system already made, might be changing a lot of design for little efficiency gain
- **Power Budget** is important to determine (~60-300 W)

Would other components work for heating?
- PCB heating is as cheap as it gets
- Not uniform heating, if that's something we care about
- Heating is on the side. No contact with liquid
- Heating pad to transfer heat

- Move to Pi Pico without full Raspberry Pi without substantial changes
- Overall Pi vs STM vs Arduino is going to all be about the same

Connecting multiple devices to the same pin. What about using 1 microcontroller for multiple bioreactors.

Targeting good microcontrollers is the most important thing. Existing firmware would be best to align with but if you are open to developing your own, it might be better to separate. 1 MCU doing tasks on multiple bioreactors as once

Recommended: A natural microcontroller over Raspberry pi bc mid-range STM32 will have more than enough power for sensors, loops. You can also get higher pin counts, with more than enough channels to run multiple units. Pin count is more important than the CPU channels.

I^2C communication protocol. FG/H series with high pin count. Some have up to 6 I^2C controllers so even if the devices don't have separate I^2C addresses, and much lower unit cost.

Calculation constraints?
100 MHz frequency is enough.

User-Friendliness?
Raspberry Pi allows more front-end items than an STM.
Get requirements clear first (power budget, user stories, planned user interactions → then do UI and targets). See what the UI should have to determine what we need.

If the task is more complicated, like computing tasks. Then Raspberry Pi makes more sense.

Power Management:

Challenges of being able to print, design, run 96 bioreactors simultaneously in a lab

Location: Donnelly Centre,
12 bioreactors ~ 300 W → 2.4 kW is too much for the circuits. It will probably need to be divided by 48 each because it will set off breaker. 1200 W for 48.

Groups of 300 W → 4 clusters of 12 each. One microcontroller operating 12 units at once

2 x 4 x `12.

PRIORITY: USER STORIES

Preliminary requirements:

- Imagining a slow temperature control loop.
- Low optical density.
- Stirring (using magnet to spin stirring rod), ideally fixed rate → but ask wetlab
  - 12 PWM - Stirring
  - Maybe multiple speeds
- 2 SLOW PWM - HEATER CONTROL
- 12 ADC OR I2C - TEMP FB
- 12 ADC OR I2C - OPTICAL FB
- + Physical UI

DRV89xx --> STIRRING
DRV89xx --> HEATER
(Might need external driver but not costly)

Estimated BOM Cost:
EST BOM: 12*4 + 12 + SENSORS + HEATER DRIVER → $50 without sensors and physical user interface

STM32F/G/H Series

Architecting this system, envisions a mid-range STM product with enough ADC lines and I^2C to do temperature/sensing
Stirring and heating can be done externally and directly. Give a speed setting per motor and do its own thing without a microcontroller. No need for pin usage for these constants.

Shared doc for requirements & features (send to him?)
Suggestion: Muiro board for architecture diagram.