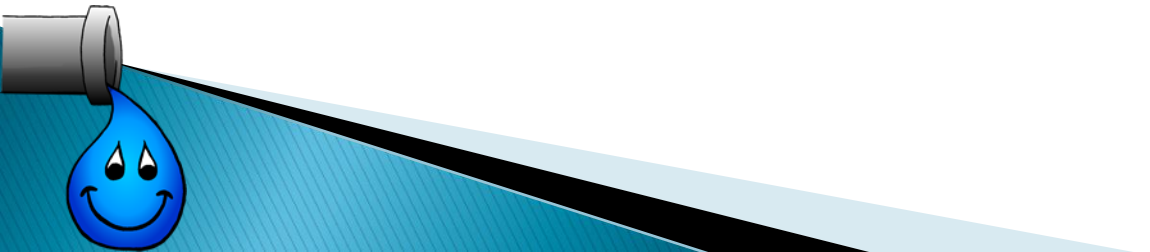
IPRO 348
Designing a System to Recycle Condensate From Residential Air Conditioners

Presented by:
Cari Hesser
Jessica Martinez
Rachel Yanover

OUTLINE

- Introduction
- Objectives
- Project Planning
- Results
- Prototype Design
- Obstacles
- Future IPROs

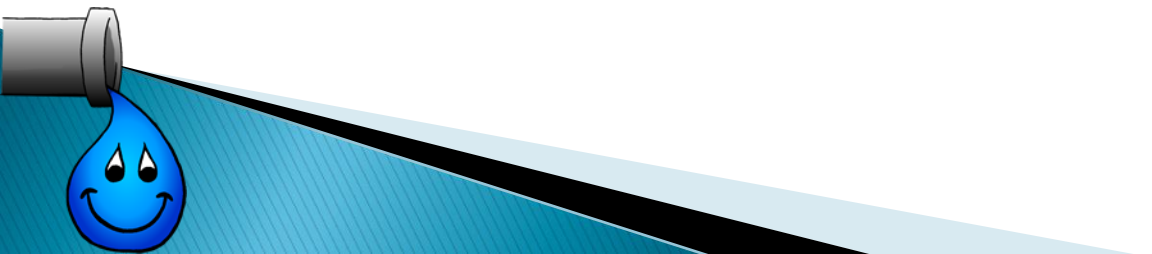


INTRODUCTION

- What is condensate?
- What can it be used for?
- Is it currently being utilized?
- How much is there?
  - Typical house can produce ~25 gallons/week
    - 1.9 million homes in Chicagoland → 45 million gallons/week

Objectives

- Determine amount of condensate available
- Identify possible contaminants within condensate
- Create a product
  - Marketable
  - Scalable
  - Economical



Team Structure

PHASE 1

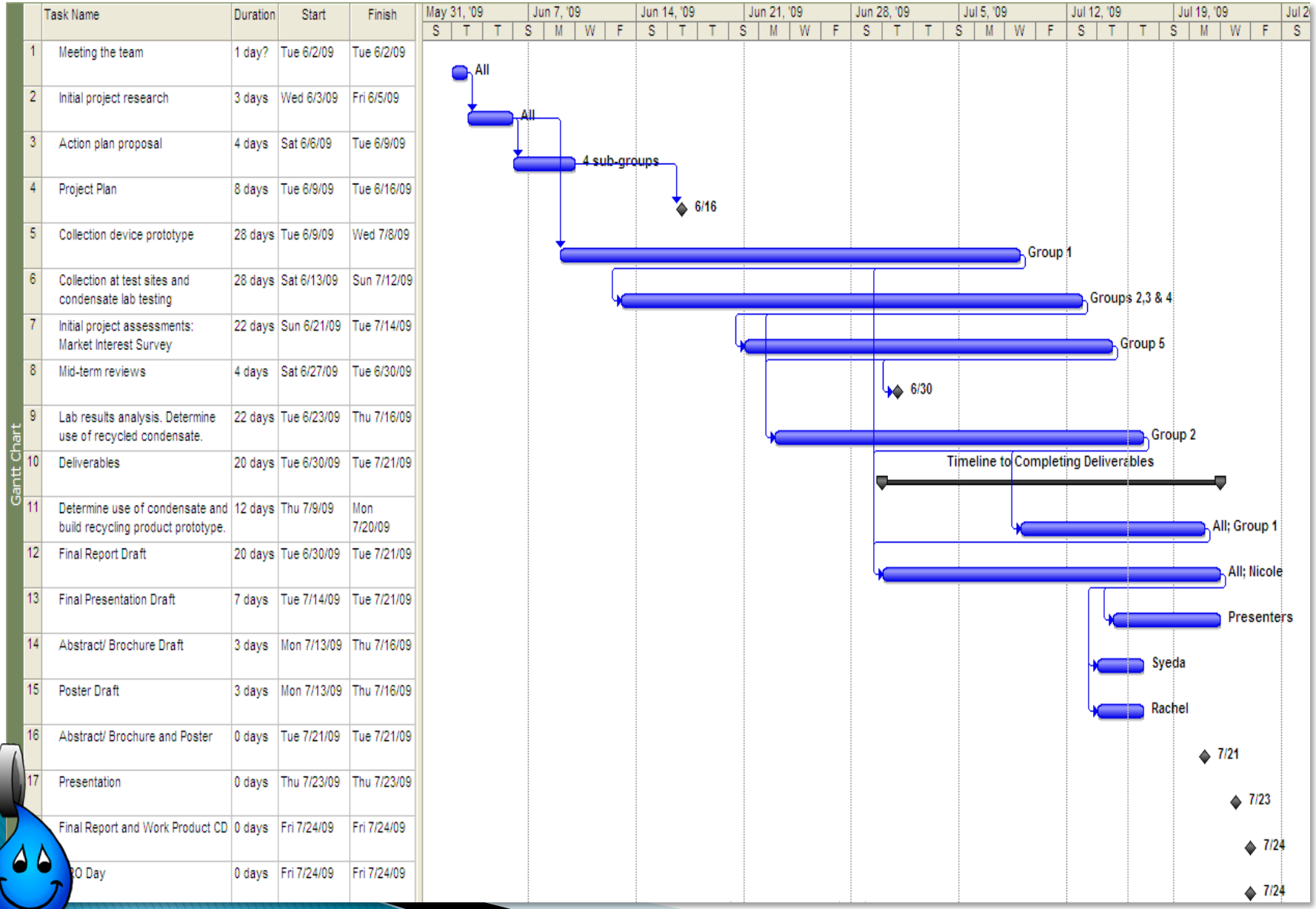
Site Investigation	Standards	Lab Testing	Hardware Design	Marketing
Cari Hesser**	Erich Ruszczak*	Nicole Specht	Nirav Hazariwala	Malisa Ismail
Rachel Yanover	Malisa Ismail	Anam Abro	Sid Raghuvanshi	Anam Abro
Jessica Martinez		Syeda Ahmed		Nirav Hazariwala
				Sid Raghuvanshi
				Erich Ruszczak

PHASE 2

Final Report	Poster	Brochure	Final Presentation
All Members	Rachel Yanover	Syeda Ahmed	Cari Hesser
Nicole Specht***			Jessica Martinez
			Rachel Yanover

*Team Leader **Team Secretary ***Compilation and Formatting

Gantt Chart



Gantt Chart

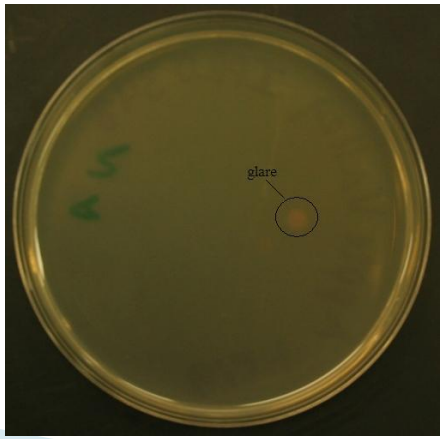
	Task Name	Duration	Start	Finish
1	Meeting the team	1 day?	Tue 6/2/09	Tue 6/2/09
2	Initial project research	3 days	Wed 6/3/09	Fri 6/5/09
3	Action plan proposal	4 days	Sat 6/6/09	Tue 6/9/09
4	Project Plan	8 days	Tue 6/9/09	Tue 6/16/09
5	Collection device prototype	28 days	Tue 6/9/09	Wed 7/8/09
6	Collection at test sites and condensate lab testing	28 days	Sat 6/13/09	Sun 7/12/09
7	Initial project assessments: Market Interest Survey	22 days	Sun 6/21/09	Tue 7/14/09
8	Mid-term reviews	4 days	Sat 6/27/09	Tue 6/30/09
9	Lab results analysis. Determine use of recycled condensate.	22 days	Tue 6/23/09	Thu 7/16/09
10	Deliverables	20 days	Tue 6/30/09	Tue 7/21/09
11	Determine use of condensate and build recycling product prototype.	12 days	Thu 7/9/09	Mon 7/20/09
12	Final Report Draft	20 days	Tue 6/30/09	Tue 7/21/09
13	Final Presentation Draft	7 days	Tue 7/14/09	Tue 7/21/09
14	Abstract/ Brochure Draft	3 days	Mon 7/13/09	Thu 7/16/09
15	Poster Draft	3 days	Mon 7/13/09	Thu 7/16/09
16	Abstract/ Brochure and Poster	0 days	Tue 7/21/09	Tue 7/21/09
17	Presentation	0 days	Thu 7/23/09	Thu 7/23/09
	Final Report and Work Product CD	0 days	Fri 7/24/09	Fri 7/24/09
	O Day	0 days	Fri 7/24/09	Fri 7/24/09

Results: Biological Testing

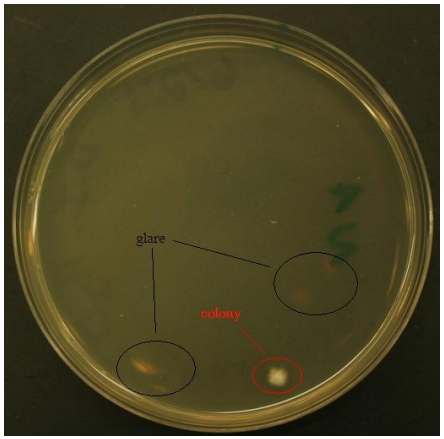
- Collection Method
- Test Results
- Conclusions

Sample	Presence of Bacteria	Number of Colonies
Apple Valley, MN	no	0
Country Club Hills, IL	yes *	2
St. Charles, IL	no	0
Distilled Water (control)	yes *	1

Apple Valley, MN

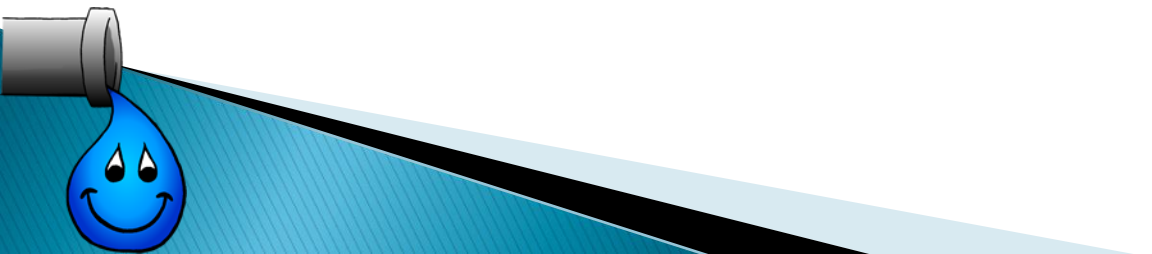


Distilled Water



Results: Chemical Testing

- Difficulties
  - Facilities
  - Compromised data
- Proper Collection Procedure
  - Metals
  - pH
  - VOCs



Results: Condensate Collection

- First Methodology

Location	Volume* (gal)	Temp. (F)	Humidity (%)	Power Rating (Tons)	Efficiency (SEER)
Apple Valley, MN	4.31	77.31	41.72	2.5	15
Country Club Hills, IL	3	80.84	61.94	2.5	10
St. Charles, IL (1)	9.74	86.14	60.42	3.5	na
Bridgeview, IL	2.87	83.19	41.18	3	10
Phoenix, AZ	0.75	103.1	14.5	3	12
Rockford, IL	4.2	76.91	53.18	3.4	11

- Average: 3.6-4 gallons/8 hours

Results: Continued

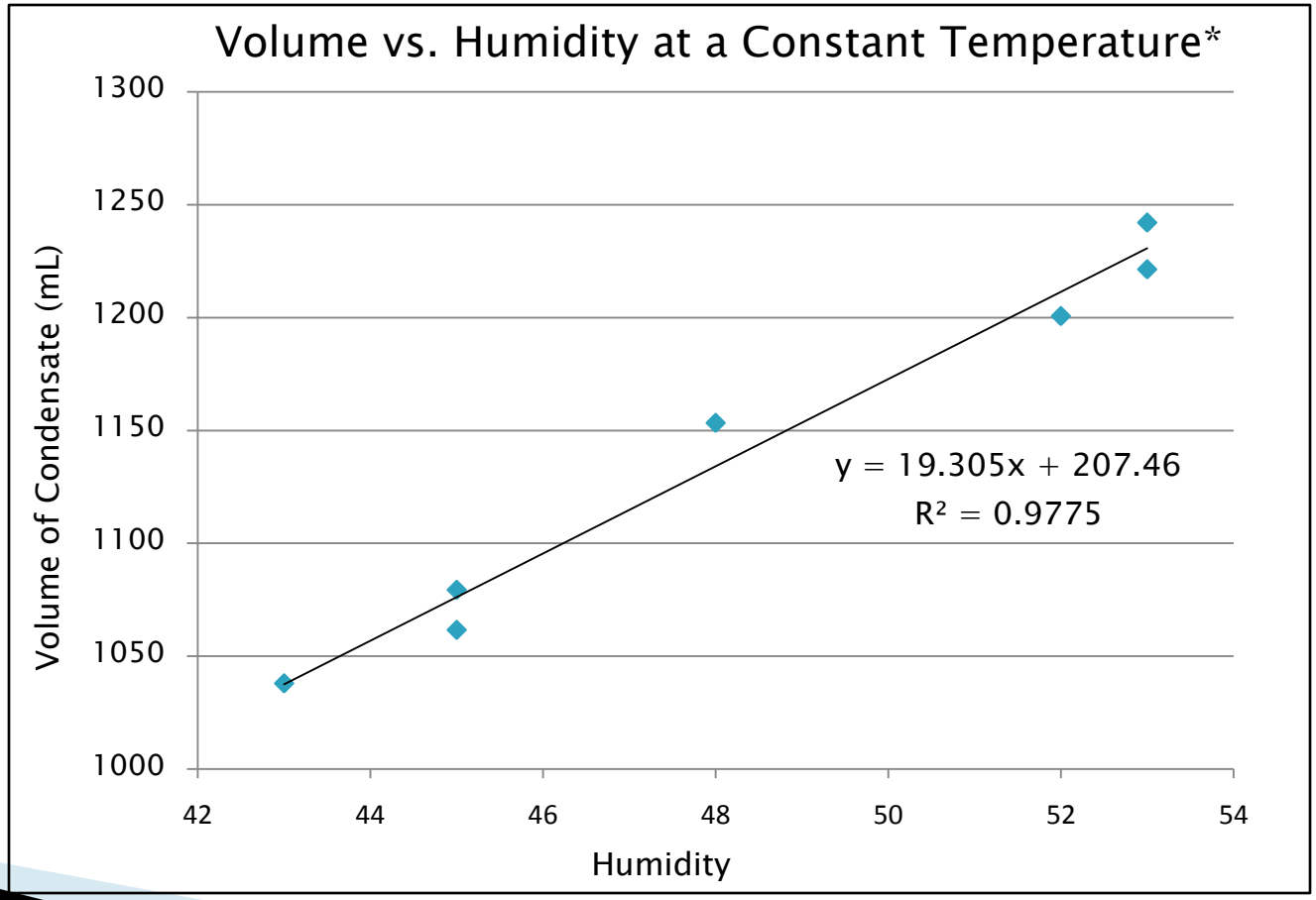
- Second Methodology

Location		Volume (gal)	Temp. (F)	Humidity (%)	Power Rating (Tons)	Efficiency (SEER)
St. Charles, IL (2)	Day 1	2.377	70.83	68.71	3	10
	Day 2	2.377+	71.54	78.58		
	Day 3	2.377+	76.25	65.58		
	Day 4	4.754	70.29	56.54		
	Day 5	4.754+	71.75	52.41		
	Day 6	7.131	70	51.92		
	Day 7	9.508	76.54	65.58		

- Total volume: 9.5 gallons/week
- Inconsistencies and flaws

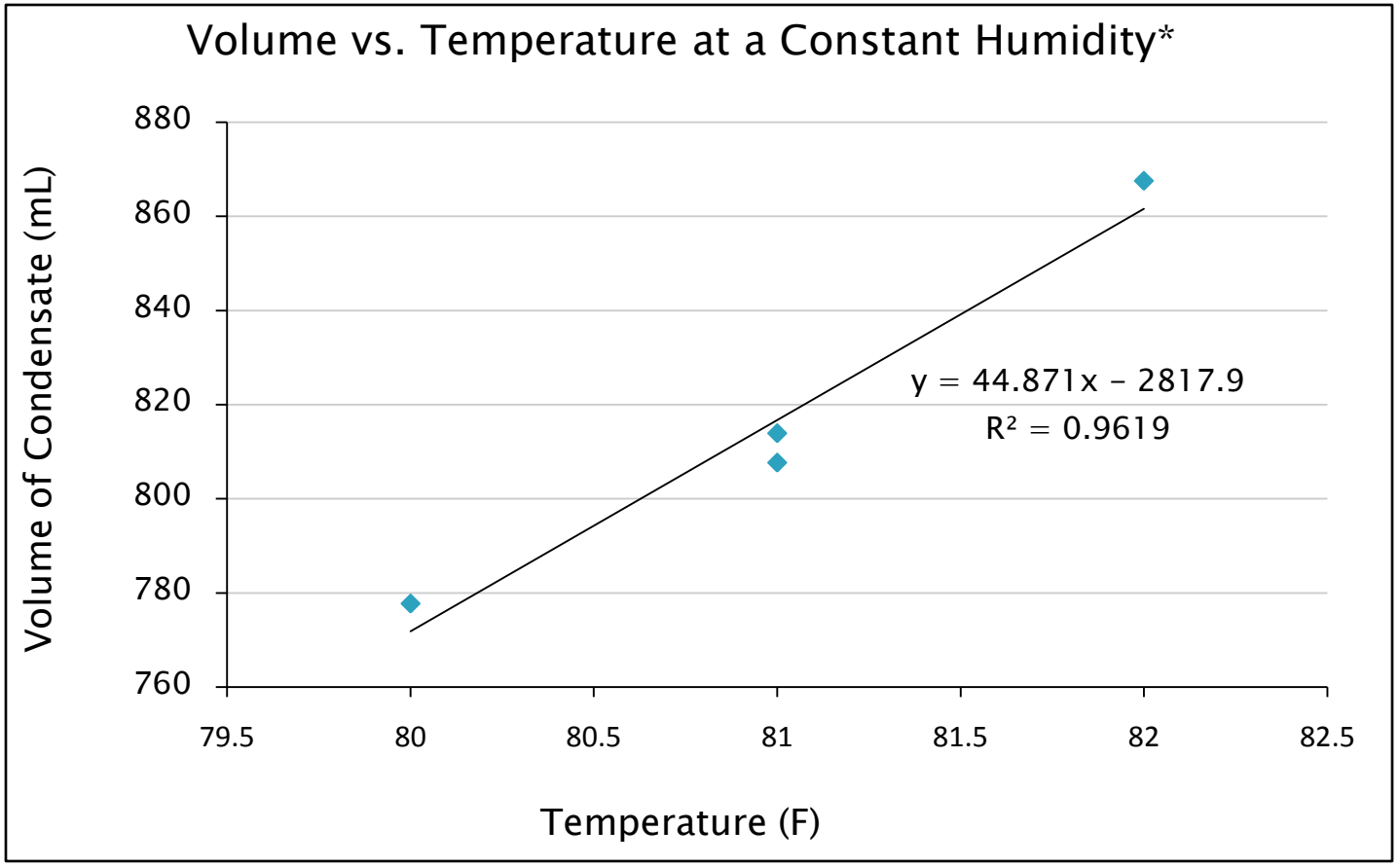
Results: Condensation Rate Factors

- Methodology for determining factors
- Results



*volume generated in 30 minutes at 75 F

Results: Continued



*Volume generated in 30 minutes at 36% humidity

Results: Continued

- Factors: humidity, temperature, efficiency, and potentially power

Site	Volume (gal)	Temp. (F)	Humidity (%)	Power Rating (Tons)	Efficiency (SEER)
1	4.31	77.31	41.72	2.5	15
2	3	80.84	61.94	2.5	10
3	2.87	83.19	41.18	3	10
4	0.75	103.1	14.5	3	12
5	4.2	76.91	53.18	3.4	11

- An increase in ‘A’ equals an increase in condensate

Results: So How Much Is There?

- How much condensate is wasted each day in Chicago?
  - More than all the water in Shedd Aquarium?

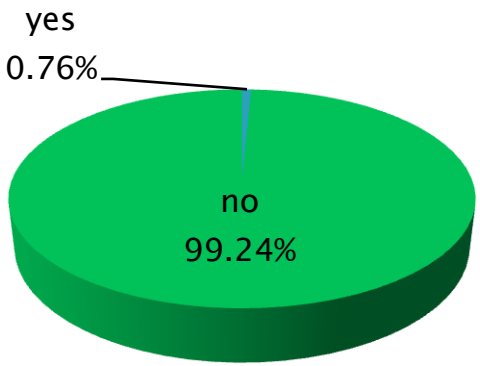
	Households_	% households with central air	Households with Central Air
Subtotal	2601225	68.05	1770027
Total	2906925		1978043
Average volume generated/household (gal)			**3.6**
Total volume of wasted condensate (gal)*			**~7124000**

*assuming ~8hrs of run time

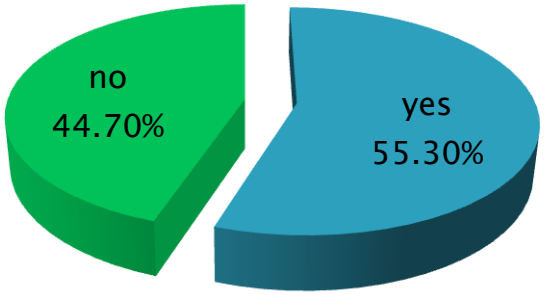
Results: Marketability

- Survey

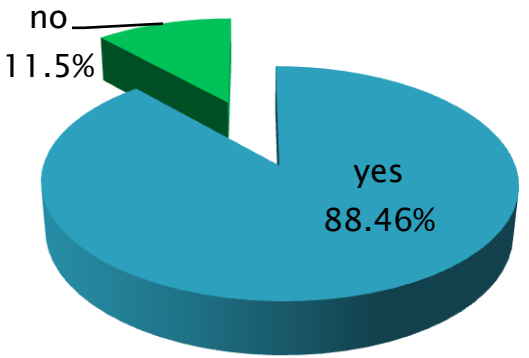
Are you currently recycling your A/C condensate?

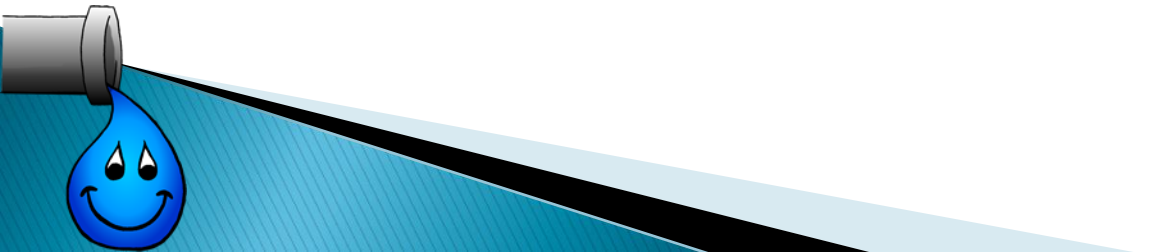


Did you know your A/C generates condensate?



Would you be interested in purchasing a system to recycle your A/C condensate?

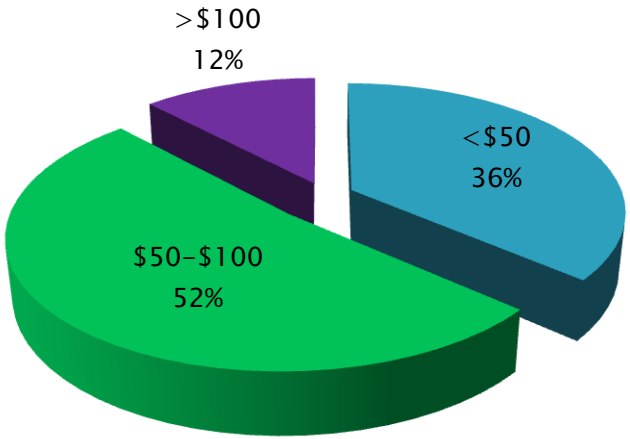


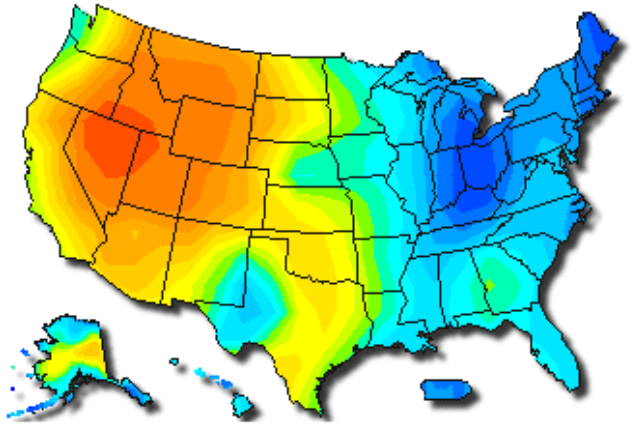


Results: Continued

- Survey Continued
- Initial Marketing Ideas
  - Name: ACRU
  - Packaging
  - Price

How much would you be willing to pay for such a device?



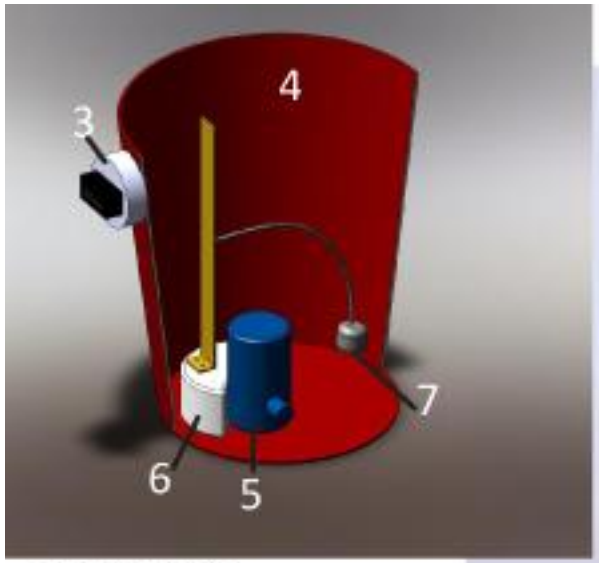


Wunderground.com

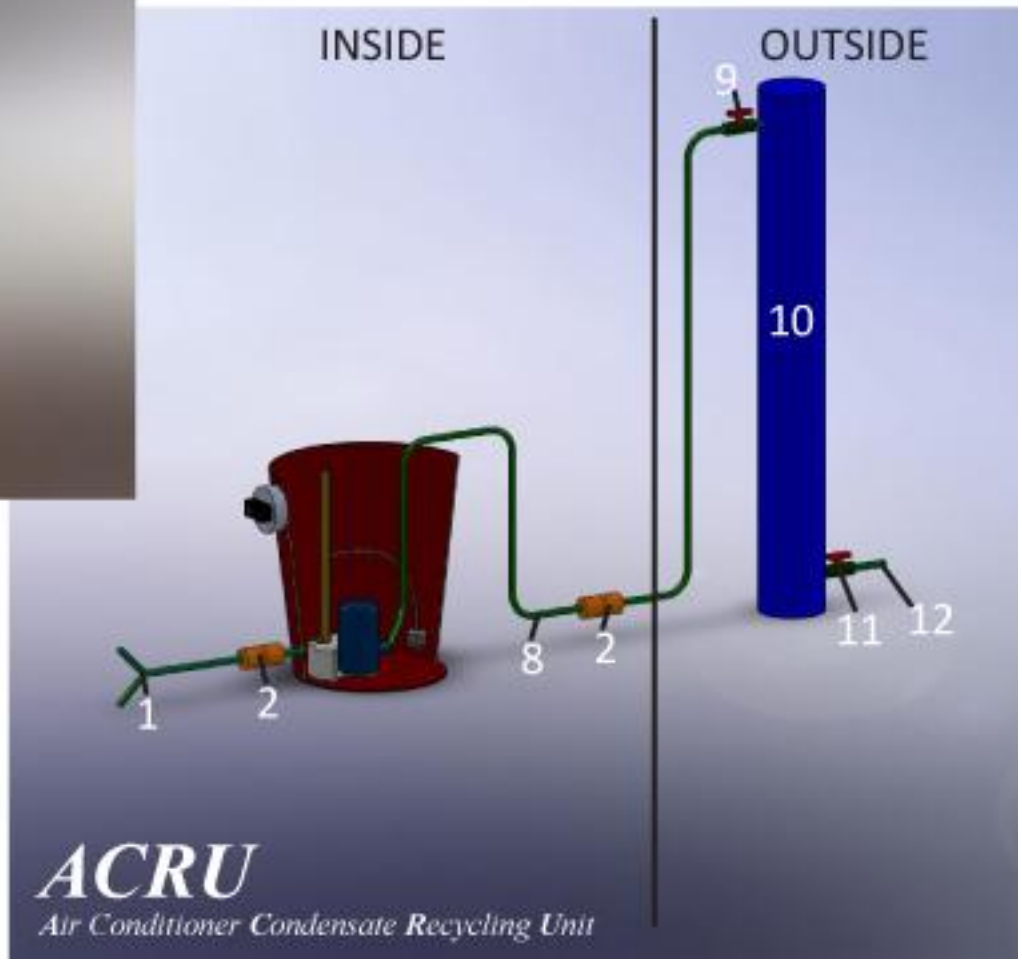
Ethical Issues

- Law
- Professional Code of Ethics
- Industry Standards
- Social, Civil & Geographic Communities
- Personal Relations
- Moral & Spiritual Values

Product Prototype

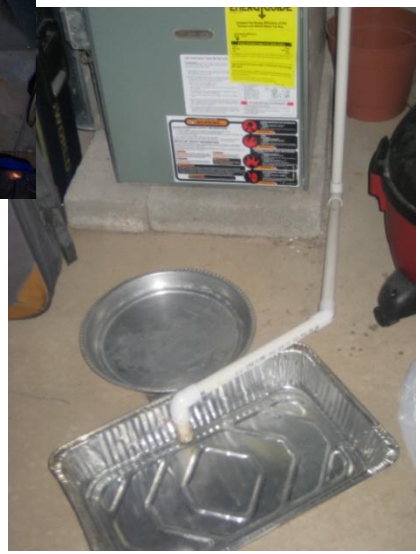


1. 3 WAY VALVE
2. CHECK VALVE
3. CYCLE COUNTER
4. TEMPORARY CONTAINER (5 GALLON BUCKET)
5. BILGE PUMP
6. 5" PINE BUN
7. FLOAT SWITCH
8. FLEXIBLE TUBING
9. PVC FITTING
10. STORAGE TANK (10' LENGTH OF 6" DIA. PVC PIPE)
11. BALL VALVE
12. ACCESSORY HOSE



Obstacles

- Collection
  - Finding Sites
  - Time
- Testing
  - Lab space & materials
  - Collection Methods
- Market
- Applications/Uses



Future IPROs

- Collection
  - Test Early
  - Multiple Sites
- Testing
- Market
- Applications/Uses
  - Prototype
  - Scale

Acknowledgements

Many thanks to the following people…

- For providing Data Collection & Test Sites
  - Donna Beaver (AZ), Kristy Hesser (MN), Syed N. Ahmed (IL), Raymond & Allison Specht (IL), Phil Lewis (IL) & Michael Lewis (IL)
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Questions