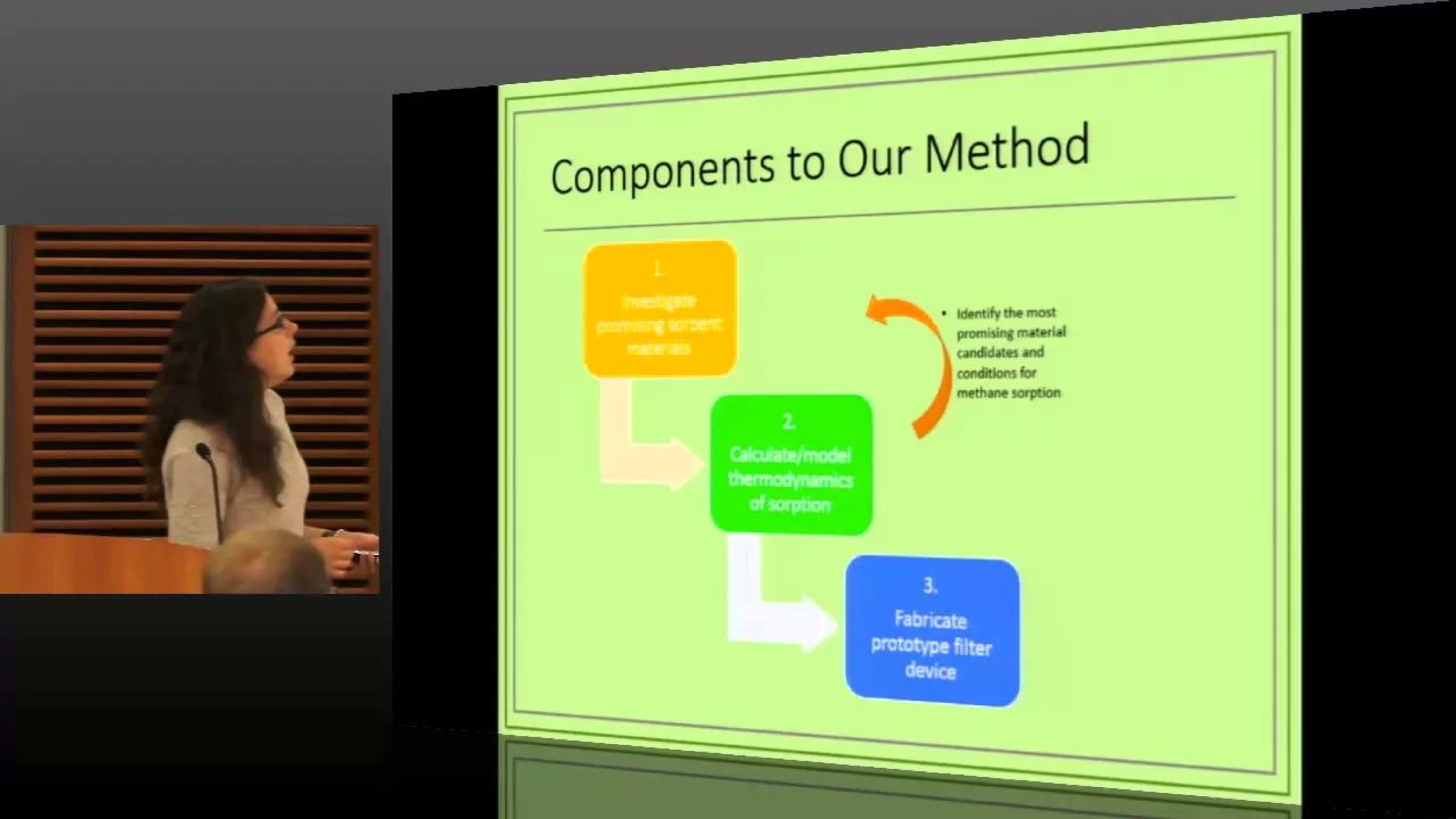
Components to Our Method
1.
2.
Calculate/model thermodynamics of sorption
3.
Fabricate prototype filter device
• Identify the most promising material candidates and conditions for methane sorption

1
00:00:12,250 --> 00:00:09,130
yeah so anyone who is not familiar with

2
00:00:15,460 --> 00:00:12,260
our FG this RF G stands for research

3
00:00:19,269 --> 00:00:15,470
focus group and it has been in

4
00:00:22,810 --> 00:00:19,279
conjunction with AB grad con for five

5
00:00:26,470 --> 00:00:22,820
years now is that right anyway so this

6
00:00:29,019 --> 00:00:26,480
is an opportunity for participants at AB

7
00:00:33,210 --> 00:00:29,029
grade grad con to get an experience

8
00:00:36,670 --> 00:00:33,220
writing research grants so these are

9
00:00:40,410 --> 00:00:36,680
grant proposals in the style of NASA

10
00:00:45,550 --> 00:00:40,420
proposals and SF do e that kind of thing

11
00:00:48,460 --> 00:00:45,560
and its unique opportunity to you've

12
00:00:50,920 --> 00:00:48,470
seen the diversity of our areas of

13
00:00:55,210 --> 00:00:50,930

research already at this conference and

14
00:01:00,520 --> 00:00:55,220
in just a short weekend the RFG event is

15
00:01:03,100 --> 00:01:00,530
a friday through sunday morning students

16
00:01:06,850 --> 00:01:03,110
come in and write a full research

17
00:01:09,910 --> 00:01:06,860
proposal from the science to the budget

18
00:01:14,679 --> 00:01:09,920
to the timeline everything in just a

19
00:01:16,630 --> 00:01:14,689
weekend and try to bring together and

20
00:01:19,029 --> 00:01:16,640
incorporate everyone's different

21
00:01:20,590 --> 00:01:19,039
backgrounds so it's perhaps a little

22
00:01:22,529 --> 00:01:20,600
different from what you might experience

23
00:01:27,389 --> 00:01:22,539
in the future but you still get that

24
00:01:32,190 --> 00:01:27,399
great first hand writing experience so

25
00:01:36,069 --> 00:01:32,200
with that I like to introduce the

26
00:01:39,069 --> 00:01:36,079
winning team from this year's rfg apart

27
00:01:42,660 --> 00:01:39,079
prasad sarah gillett and arshaum solari

28
00:01:51,519 --> 00:01:42,670
and they will talk about methane

29
00:01:55,449 --> 00:01:51,529
sequestration and recovery so I'm

30
00:01:57,819 --> 00:01:55,459
arshaum solari i'm here to talk about

31
00:02:01,199 --> 00:01:57,829
development of a solid-phase sovereign

32
00:02:09,520 --> 00:02:01,209
material for methane recovery filter

33
00:02:12,430 --> 00:02:09,530
here with the Sergio and Harper shot so

34
00:02:15,250 --> 00:02:12,440
to motivate the talk I'm going to talk

35
00:02:19,620 --> 00:02:15,260
about global warming for few slides what

36
00:02:27,550 --> 00:02:25,260
surface temperature estimates from the

37
00:02:30,400 --> 00:02:27,560
Intergovernmental Panel for climate

38
00:02:34,180 --> 00:02:30,410

change so the shaded regions are

39
00:02:38,050 --> 00:02:34,190
basically 11 star deviation from the

40
00:02:41,130 --> 00:02:38,060
mean and then the gray bars you see on

41
00:02:45,070 --> 00:02:41,140
the side are different scenarios that

42
00:02:47,820 --> 00:02:45,080
they can get predicted so this orange

43
00:02:53,220 --> 00:02:47,830
line is basically if we could freeze the

44
00:02:57,490 --> 00:02:53,230
greenhouse gas levels at the 2,000 level

45
00:03:00,070 --> 00:02:57,500
two thousand year 2000 level and these

46
00:03:04,300 --> 00:03:00,080
are the different projections from

47
00:03:07,390 --> 00:03:04,310
different you know groups and regardless

48
00:03:11,290 --> 00:03:07,400
of you know if you could end up here or

49
00:03:15,280 --> 00:03:11,300
here the neither scenario is really

50
00:03:17,980 --> 00:03:15,290
present at consequence of this to make

51
00:03:19,960 --> 00:03:17,990
it a little more understandable for

52
00:03:22,270 --> 00:03:19,970
somebody who doesn't know you know what

53
00:03:26,949 --> 00:03:22,280
at two or three degree change would mean

54
00:03:30,040 --> 00:03:26,959
is the difference in sea level so this

55
00:03:33,400 --> 00:03:30,050
is this this dashed line is year 2007

56
00:03:35,080 --> 00:03:33,410
and you know the shaded region here is

57
00:03:38,530 --> 00:03:35,090
the different scenarios that you're

58
00:03:40,960 --> 00:03:38,540
gonna see so the worst the best case

59
00:03:44,020 --> 00:03:40,970
scenario is 20 centimeters SI lo you

60
00:03:45,930 --> 00:03:44,030
know global sea-level rise and the worst

61
00:03:50,710 --> 00:03:45,940
case scenario is 50 centimeters I

62
00:03:53,110 --> 00:03:50,720
changed which you know is 0 you might

63
00:03:54,490 --> 00:03:53,120

agree it's very dangerous you know part

64
00:03:57,910 --> 00:03:54,500
of miami important manhattan will be

65
00:04:02,880 --> 00:03:57,920
underwater along with denise and many

66
00:04:06,790 --> 00:04:02,890
many many cities so this is the

67
00:04:08,800 --> 00:04:06,800
composition of greenhouse gases most of

68
00:04:12,400 --> 00:04:08,810
the carbon dioxide which gets a lot of

69
00:04:15,370 --> 00:04:12,410
attention appropriately so but there is

70
00:04:18,039 --> 00:04:15,380
this 14th person methane which is

71
00:04:20,320 --> 00:04:18,049
important because methane is 25 times

72
00:04:23,380 --> 00:04:20,330
more potent as a greenhouse gas than

73
00:04:25,930 --> 00:04:23,390
carbon dioxide and the problem we're

74
00:04:30,070 --> 00:04:25,940
having these days is that because of the

75
00:04:33,490 --> 00:04:30,080
global warming situation of you're in a

76
00:04:35,950 --> 00:04:33,500
lot of you know the natural gas industry

77
00:04:39,250 --> 00:04:35,960
and the general public prefer natural

78
00:04:41,710 --> 00:04:39,260
gas compared to cold because they think

79
00:04:44,290 --> 00:04:41,720
it's a clean air source of energy where

80
00:04:48,100 --> 00:04:44,300
the probe where the problem happens is

81
00:04:49,480 --> 00:04:48,110
that when you have a lot of activities

82
00:04:52,900 --> 00:04:49,490
around natural gas there's a lot of

83
00:04:55,540 --> 00:04:52,910
leakage so and you know power plants and

84
00:04:58,330 --> 00:04:55,550
natural gas production there is you know

85
00:05:00,700 --> 00:04:58,340
between 12 to two percent leakage and

86
00:05:04,960 --> 00:05:00,710
that two or three percent leakage x 25 x

87
00:05:08,110 --> 00:05:04,970
being more potent is a big problem so

88
00:05:11,520 --> 00:05:08,120

here is a breakdown of verdi all that

89
00:05:16,659 --> 00:05:11,530
you know methane emission sources are

90
00:05:18,840 --> 00:05:16,669
and the part that we are focusing on is

91
00:05:22,570 --> 00:05:18,850
the natural gas and petroleum systems

92
00:05:25,830 --> 00:05:22,580
there is a lot of capture mccann

93
00:05:28,600 --> 00:05:25,840
mechanisms for you know landfills and

94
00:05:33,190 --> 00:05:28,610
agricultural resources but not much has

95
00:05:36,400 --> 00:05:33,200
been done for petroleum sources so with

96
00:05:39,909 --> 00:05:36,410
that I will give it to Sarah to talk

97
00:05:41,230 --> 00:05:39,919
about the actual point so the basic

98
00:05:44,710 --> 00:05:41,240
overview of what we want to do here is

99
00:05:47,020 --> 00:05:44,720
have a solid phase filter that we can

100
00:05:48,430 --> 00:05:47,030
flow a stream of air over which is

101
00:05:51,280 --> 00:05:48,440
probably methane-rich because we're

102
00:05:53,140 --> 00:05:51,290
targeting these leakage sources and have

103
00:05:54,730 --> 00:05:53,150
it selectively bind methane while so

104
00:05:56,800 --> 00:05:54,740
passing through the other components of

105
00:05:57,700 --> 00:05:56,810
air so the requirements are a filter

106
00:05:59,170 --> 00:05:57,710
such as this is that you're going to

107
00:06:00,850 --> 00:05:59,180
need a strong binding and methane and

108
00:06:02,320 --> 00:06:00,860
the challenge of that is on methane is a

109
00:06:03,990 --> 00:06:02,330
non-polar molecule and so you're not

110
00:06:07,540 --> 00:06:04,000
going to have very strong interactions

111
00:06:09,670 --> 00:06:07,550
with this solid phase and so are our

112
00:06:12,130 --> 00:06:09,680
approach to maximize those interactions

113
00:06:15,480 --> 00:06:12,140

have a strong bonding and methane is

114
00:06:19,210 --> 00:06:15,490
that we're going to employ non-polar

115
00:06:20,140 --> 00:06:19,220
species on this filter to sort of

116
00:06:21,850 --> 00:06:20,150
enhance the non polar nonpolar

117
00:06:23,800 --> 00:06:21,860
interactions we're also going to

118
00:06:26,290 --> 00:06:23,810
incorporate some porosity in there to

119
00:06:29,740 --> 00:06:26,300
enhance the methane kind of sticking to

120
00:06:31,840 --> 00:06:29,750
that service okay so the second

121
00:06:33,640 --> 00:06:31,850
requirement is that we want to be able

122
00:06:35,680 --> 00:06:33,650
to have a fast flow of air through this

123
00:06:37,540 --> 00:06:35,690
filter so in order to do that we're

124
00:06:38,860 --> 00:06:37,550
gonna have to have a high selectivity of

125
00:06:40,840 --> 00:06:38,870
it binding methane versus the other

126
00:06:43,180 --> 00:06:40,850
components of the gas in order to do

127
00:06:46,180 --> 00:06:43,190
that we're going to target specific poor

128
00:06:47,270 --> 00:06:46,190
spacing of this solid solvent material

129
00:06:48,530 --> 00:06:47,280
and the Reese

130
00:06:51,710 --> 00:06:48,540
for that is that there's been studies

131
00:06:54,590 --> 00:06:51,720
that have shown that if you that if you

132
00:06:55,580 --> 00:06:54,600
take to methane molecules and you bring

133
00:06:58,670 --> 00:06:55,590
them together there's a certain point

134
00:07:00,379 --> 00:06:58,680
where they have a minimum of energy the

135
00:07:02,300 --> 00:07:00,389
distance between them and so if you if

136
00:07:03,590 --> 00:07:02,310
you have pores that are spaced right

137
00:07:05,540 --> 00:07:03,600
around that minimum of energy which is

138
00:07:08,570 --> 00:07:05,550

right around 4.2 angstroms then you're

139
00:07:11,990 --> 00:07:08,580
going to be able to maximize the binding

140
00:07:13,670 --> 00:07:12,000
of methane versus and to or co2 and the

141
00:07:15,170 --> 00:07:13,680
third component of or the third

142
00:07:17,180 --> 00:07:15,180
requirement for this kind of filter is

143
00:07:20,690 --> 00:07:17,190
that we want it to be reversibly vining

144
00:07:22,100 --> 00:07:20,700
methane so not only do we want mething

145
00:07:23,720 --> 00:07:22,110
to attach but we want to controllably

146
00:07:26,920 --> 00:07:23,730
then be able to release it so we can

147
00:07:29,330 --> 00:07:26,930
recover this methane as a usable fuel

148
00:07:30,980 --> 00:07:29,340
and for that we're going to look at

149
00:07:36,620 --> 00:07:30,990
things like changing the temperature and

150
00:07:39,110 --> 00:07:36,630
the pressure of the the filters so this

151
00:07:40,969 --> 00:07:39,120
is kind of a very general schematic of

152
00:07:45,320 --> 00:07:40,979
what this kind of filter would look like

153
00:07:47,210 --> 00:07:45,330
so you'd have an input of air where the

154
00:07:49,670 --> 00:07:47,220
methane is sorb is I desorbed onto the

155
00:07:51,290 --> 00:07:49,680
filter and the rest of the air flows out

156
00:07:53,240 --> 00:07:51,300
and then we would change the conditions

157
00:07:54,740 --> 00:07:53,250
of temperature pressure and the methane

158
00:07:56,870 --> 00:07:54,750
would release into a second output where

159
00:08:00,860 --> 00:07:56,880
we could store it or it could be stored

160
00:08:04,250 --> 00:08:00,870
and then transported and we have three

161
00:08:06,290 --> 00:08:04,260
approach three components approach the

162
00:08:07,400 --> 00:08:06,300
first is investigating promising sort of

163
00:08:09,320 --> 00:08:07,410

material so this would be kind of the

164
00:08:11,779 --> 00:08:09,330
wet chemistry part of this project the

165
00:08:13,250 --> 00:08:11,789
second is more on the theoretical side

166
00:08:16,460 --> 00:08:13,260
of things we look at the thermodynamics

167
00:08:17,930 --> 00:08:16,470
binding and air flow and the third is on

168
00:08:20,990 --> 00:08:17,940
them I cannot find gineering side of

169
00:08:22,670 --> 00:08:21,000
things actually starting to look at what

170
00:08:27,770 --> 00:08:22,680
goes into building a prototype for this

171
00:08:30,710 --> 00:08:27,780
build um so all the purpose of having

172
00:08:32,240 --> 00:08:30,720
approach like this is threefold is first

173
00:08:33,770 --> 00:08:32,250
of all the three of us are coming from

174
00:08:34,909 --> 00:08:33,780
very different backgrounds so each of

175
00:08:37,070 --> 00:08:34,919
these places one of our swings I'm

176
00:08:41,089 --> 00:08:37,080
materials chemists a pirate is a

177
00:08:42,790 --> 00:08:41,099
chemical ta thermodynamics asst and RM

178
00:08:44,810 --> 00:08:42,800
is in the kenaf engineer so our

179
00:08:48,350 --> 00:08:44,820
interests and our expertise fit right

180
00:08:50,930 --> 00:08:48,360
into these three different models the

181
00:08:51,980 --> 00:08:50,940
second advantage of this is that this is

182
00:08:53,810 --> 00:08:51,990
something that hasn't really been

183
00:08:55,760 --> 00:08:53,820
approached before methane filters isn't

184
00:08:57,230 --> 00:08:55,770
something that's really out there and so

185
00:08:58,699 --> 00:08:57,240
we're starting from first principles and

186
00:09:00,590 --> 00:08:58,709
we want to attack it from all different

187
00:09:00,960 --> 00:09:00,600
sides so we're not saying that we're

188
00:09:02,490 --> 00:09:00,970

going to be

189
00:09:04,920 --> 00:09:02,500
to produce a commercial product by the

190
00:09:06,679 --> 00:09:04,930
end of this proposal but we want to be

191
00:09:09,530 --> 00:09:06,689
able to lay a good foundation not only

192
00:09:11,879 --> 00:09:09,540
on the chemistry but also in the

193
00:09:13,290 --> 00:09:11,889
thermodynamics the modeling as well as

194
00:09:15,420 --> 00:09:13,300
you know started thinking about the

195
00:09:16,740 --> 00:09:15,430
engineering of thing so the the

196
00:09:18,809 --> 00:09:16,750
thermodynamics will help us then

197
00:09:21,090 --> 00:09:18,819
identify more promising chemical

198
00:09:22,710 --> 00:09:21,100
materials starting to look at the

199
00:09:25,079 --> 00:09:22,720
engineering will then help inform our

200
00:09:27,059 --> 00:09:25,089
our modeling systems and as we look at

201
00:09:29,699 --> 00:09:27,069
the engineering will be able to see what

202
00:09:32,429 --> 00:09:29,709
kind of constraints there are for

203
00:09:34,110 --> 00:09:32,439
developing material so eliminate any

204
00:09:38,369 --> 00:09:34,120
obstacles that might show up later on

205
00:09:40,170 --> 00:09:38,379
down the road and the way we're going to

206
00:09:41,369 --> 00:09:40,180
start going about identifying a serpent

207
00:09:42,929 --> 00:09:41,379
material like chemistry part of this

208
00:09:46,230 --> 00:09:42,939
we're going to start with the principles

209
00:09:47,550 --> 00:09:46,240
of gas chromatography so gas

210
00:09:50,129 --> 00:09:47,560
chromatography you're not familiar with

211
00:09:52,650 --> 00:09:50,139
it is a separation technique the way it

212
00:09:54,600 --> 00:09:52,660
works is you input your sample using a

213
00:09:56,119 --> 00:09:54,610

carrier gas into this column which is

214
00:09:58,769 --> 00:09:56,129
packed with a solid phase material

215
00:10:01,170 --> 00:09:58,779
something like this polymer here which

216
00:10:04,910 --> 00:10:01,180
has a silicon oxygen psylocke st.

217
00:10:07,799 --> 00:10:04,920
backbone and then these long and octal

218
00:10:09,780 --> 00:10:07,809
hydrophobic groups coming out of it and

219
00:10:13,079 --> 00:10:09,790
so your sample as it goes through the

220
00:10:14,759 --> 00:10:13,089
column will be in one of two phases will

221
00:10:16,230 --> 00:10:14,769
either be absorbed to the solid material

222
00:10:18,420 --> 00:10:16,240
or I'll begin the carrier gas which is

223
00:10:20,280 --> 00:10:18,430
flowing through the column in the amount

224
00:10:22,259 --> 00:10:20,290
of time that it spends adsorbed versus

225
00:10:25,549 --> 00:10:22,269
in the carrier gas that will determine

226
00:10:27,780 --> 00:10:25,559
the retention time of your molecule and

227
00:10:29,069 --> 00:10:27,790
that's how you can get separations of

228
00:10:31,079 --> 00:10:29,079
different molecules with different

229
00:10:32,189 --> 00:10:31,089
interactions with the absorbing material

230
00:10:34,110 --> 00:10:32,199
so what we want to do is take this

231
00:10:38,670 --> 00:10:34,120
principle and then just really enhance

232
00:10:40,920 --> 00:10:38,680
the adsorbing part of this the ads

233
00:10:41,999 --> 00:10:40,930
orbing phase of the samples going

234
00:10:43,410 --> 00:10:42,009
through the column and so we're really

235
00:10:48,210 --> 00:10:43,420
going to we're going to play around with

236
00:10:50,040 --> 00:10:48,220
the we're really going to play around

237
00:10:51,509 --> 00:10:50,050
with the groups that are coming off of

238
00:10:53,970 --> 00:10:51,519

the backbone and try and see if we can

239
00:10:55,829 --> 00:10:53,980
enhance the interactions of the methane

240
00:10:56,819 --> 00:10:55,839
molecules with those groups on the other

241
00:10:58,230 --> 00:10:56,829
thing we're going to look at as I

242
00:10:59,519 --> 00:10:58,240
mentioned this poor spacing and the way

243
00:11:02,759 --> 00:10:59,529
that you can do that is by playing

244
00:11:05,189 --> 00:11:02,769
around with the the branching the

245
00:11:08,910 --> 00:11:05,199
cross-linking of those polymers so

246
00:11:10,499 --> 00:11:08,920
studies have shown that the amount of

247
00:11:13,230 --> 00:11:10,509
cross-linking that you do will change

248
00:11:14,430 --> 00:11:13,240
your pore size and you there's been some

249
00:11:17,130 --> 00:11:14,440
body of research done

250
00:11:18,510 --> 00:11:17,140
hydrogen storage which they've shown you

251
00:11:22,200 --> 00:11:18,520
know with cross-linked polymers you can

252
00:11:23,820 --> 00:11:22,210
store hydrogen and the forces that's

253
00:11:25,980 --> 00:11:23,830
kind of the chemistry side of things and

254
00:11:31,740 --> 00:11:25,990
I will tell you about the thermodynamics

255
00:11:34,920 --> 00:11:31,750
and I have 23 seconds left so overall up

256
00:11:36,810 --> 00:11:34,930
we want to make a device which is

257
00:11:38,160 --> 00:11:36,820
thermodynamically feasible which means

258
00:11:41,130 --> 00:11:38,170
that the overall Gibbs free energy

259
00:11:44,670 --> 00:11:41,140
change of the process has to be negative

260
00:11:46,950 --> 00:11:44,680
because we want to have the system do

261
00:11:50,640 --> 00:11:46,960
some useful work and not require useful

262
00:11:52,430 --> 00:11:50,650
work and the thermodynamics of co2

263
00:11:56,760 --> 00:11:52,440

capture has been studied extensively

264
00:11:58,800 --> 00:11:56,770
this is from and the way you study this

265
00:12:00,810 --> 00:11:58,810
is by basically studying the Gibbs

266
00:12:02,850 --> 00:12:00,820
energy demands and gives any supplies on

267
00:12:06,480 --> 00:12:02,860
the left we have the Gibbs energy demand

268
00:12:09,270 --> 00:12:06,490
for co2 capture as you might note the

269
00:12:11,250 --> 00:12:09,280
numbers are positive and the Gibbs

270
00:12:14,160 --> 00:12:11,260
energy supply basically came from

271
00:12:17,280 --> 00:12:14,170
hydration of course we are working with

272
00:12:19,920 --> 00:12:17,290
methane sort of and not carbon dioxide

273
00:12:22,590 --> 00:12:19,930
so our while our gifts energy demands

274
00:12:26,430 --> 00:12:22,600
would be same our supply has to be

275
00:12:28,200 --> 00:12:26,440
different and that basically comes from

276
00:12:31,470 --> 00:12:28,210
the change in temperatures and pressure

277
00:12:35,700 --> 00:12:31,480
or surface thermodynamics of helium

278
00:12:38,700 --> 00:12:35,710
binding ah so to sum it up we need to

279
00:12:41,100 --> 00:12:38,710
maximize methane capture minimize

280
00:12:43,260 --> 00:12:41,110
methane consumption so I power

281
00:12:45,720 --> 00:12:43,270
consumption so that we have a negative

282
00:12:53,070 --> 00:12:45,730
carbon footprint which is actually the

283
00:12:54,510 --> 00:12:53,080
positive and set up the right in flow

284
00:12:57,450 --> 00:12:54,520
with the right amount of methane

285
00:12:59,730 --> 00:12:57,460
concentration and a right temperature

286
00:13:02,910 --> 00:12:59,740
humidity pressure to maximize our

287
00:13:06,480 --> 00:13:02,920
efficiency and test for greenhouse cash

288
00:13:10,350 --> 00:13:06,490

balance between the operation side so we

289
00:13:13,440 --> 00:13:10,360
have a very ambitious project over here

290
00:13:15,270 --> 00:13:13,450
and so they're going to be challenges on

291
00:13:18,030 --> 00:13:15,280
the way but we've tried to cover most

292
00:13:20,370 --> 00:13:18,040
paces and but it's something that needs

293
00:13:23,100 --> 00:13:20,380
to be done in this time of these times

294
00:13:26,040 --> 00:13:23,110
of anthropogenic climate change and

295
00:13:33,320 --> 00:13:26,050
rewards a huge so we look forward to

296
00:13:37,680 --> 00:13:35,790
we can take a question or two if anybody

297
00:13:43,110 --> 00:13:37,690
has a question about a very ambitious

298
00:13:46,020 --> 00:13:43,120
proposal I think everybody may be really