

Prof. Gary T. Rochelle

CPE 5.462, 10 PhD (5 Graduated in 2011)

Projects/funding for 7 students

Technology Area

CO₂ Capture from Flue Gas

(to address Global Climate Change)

By **Aqueous Amine Absorption/Stripping**

Funded by consortium of 32 companies

Fundamental Areas

Mass Transfer with Reaction in the Boundary Layer

Applied Aqueous Solution Chemistry

Aqueous Thermodynamics

Aqueous Reaction Kinetics/Engineering

Crystallization in Aqueous Solutions

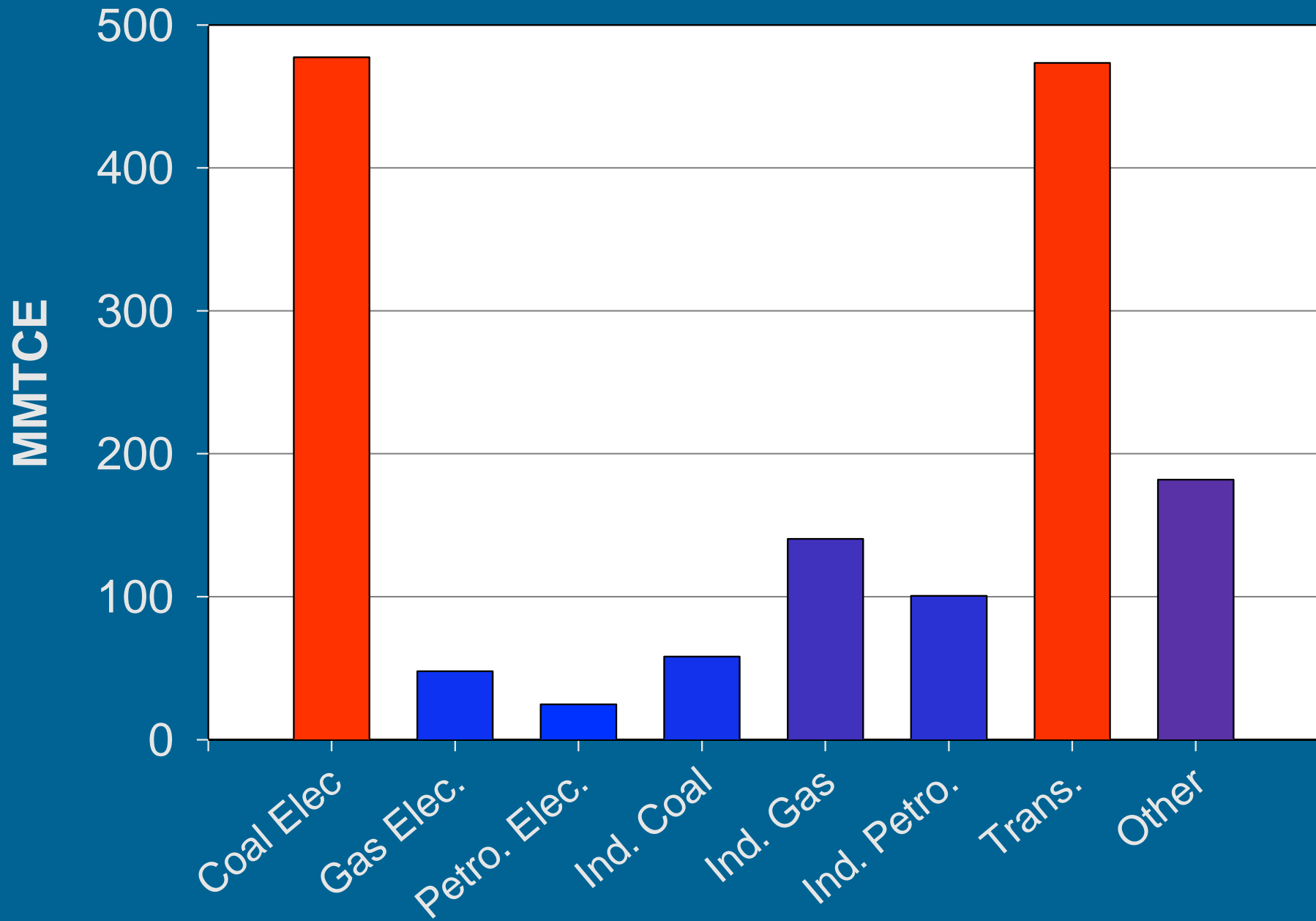
Applied Process Simulation & Optimization

Mass Transfer in Gas/Liquid Contactors

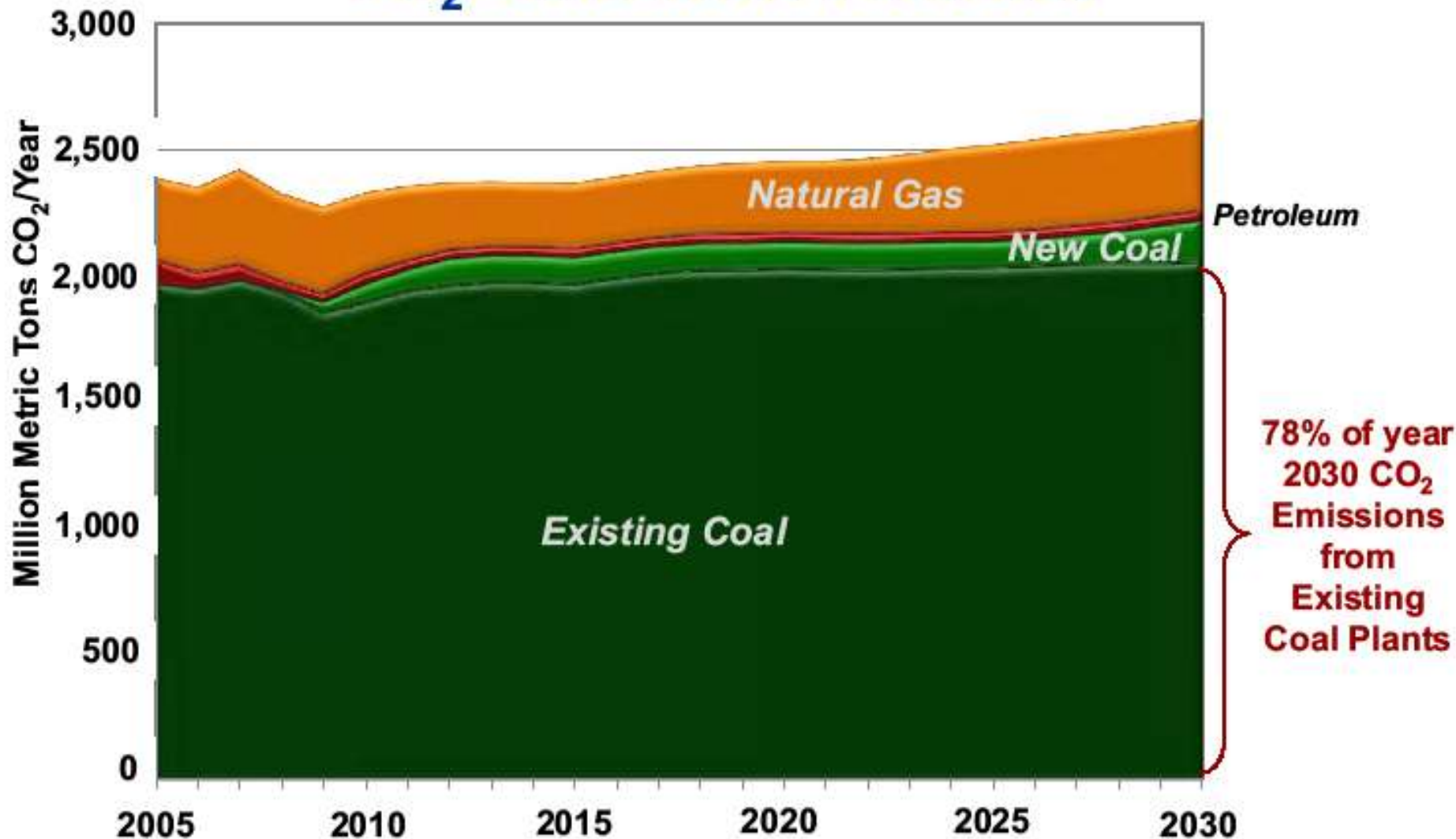
The Present Problem

- Global climate change is happening
- Because of CO₂ emissions
- From Coal Combustion

CO₂ Emissions by Source (1998)

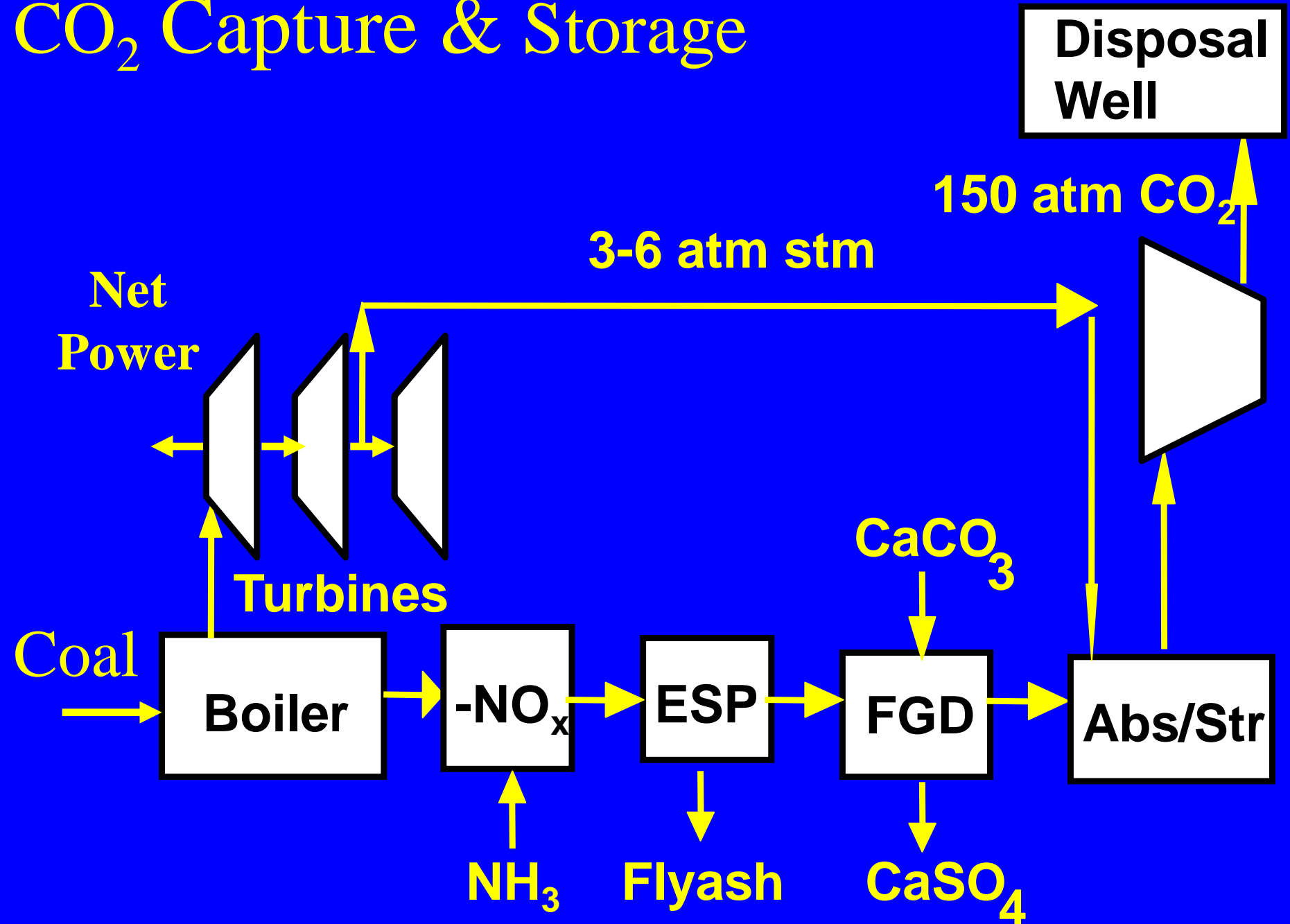


U.S. Electricity Generation CO₂ Emissions Forecast



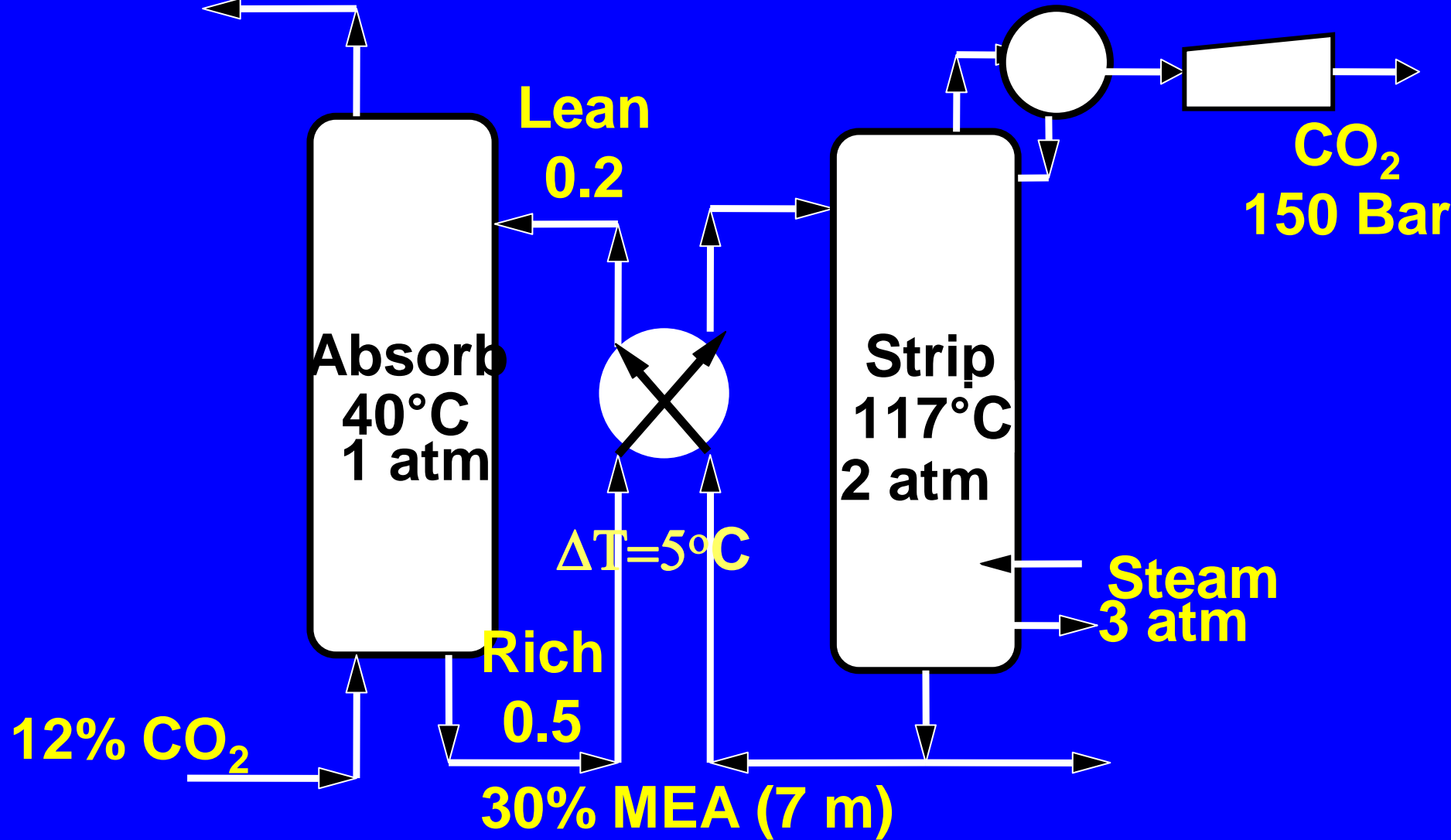
78% of year
2030 CO₂
Emissions
from
Existing
Coal Plants

CO₂ Capture & Storage



MonoEthanolAmine Absorption/Stripping

1.2% CO₂



Practical Problems

- Energy = 20-30% of power plant output
 - Steam for stripping
 - CO₂ Compression
 - Gas pressure drop
- Amine degradation
 - 10% of cost
 - Environmental impact
- Capital Cost
 - 5 x 50 ft diameter absorbers and strippers
 - 50 ft packing

Approaches to Practical Problems

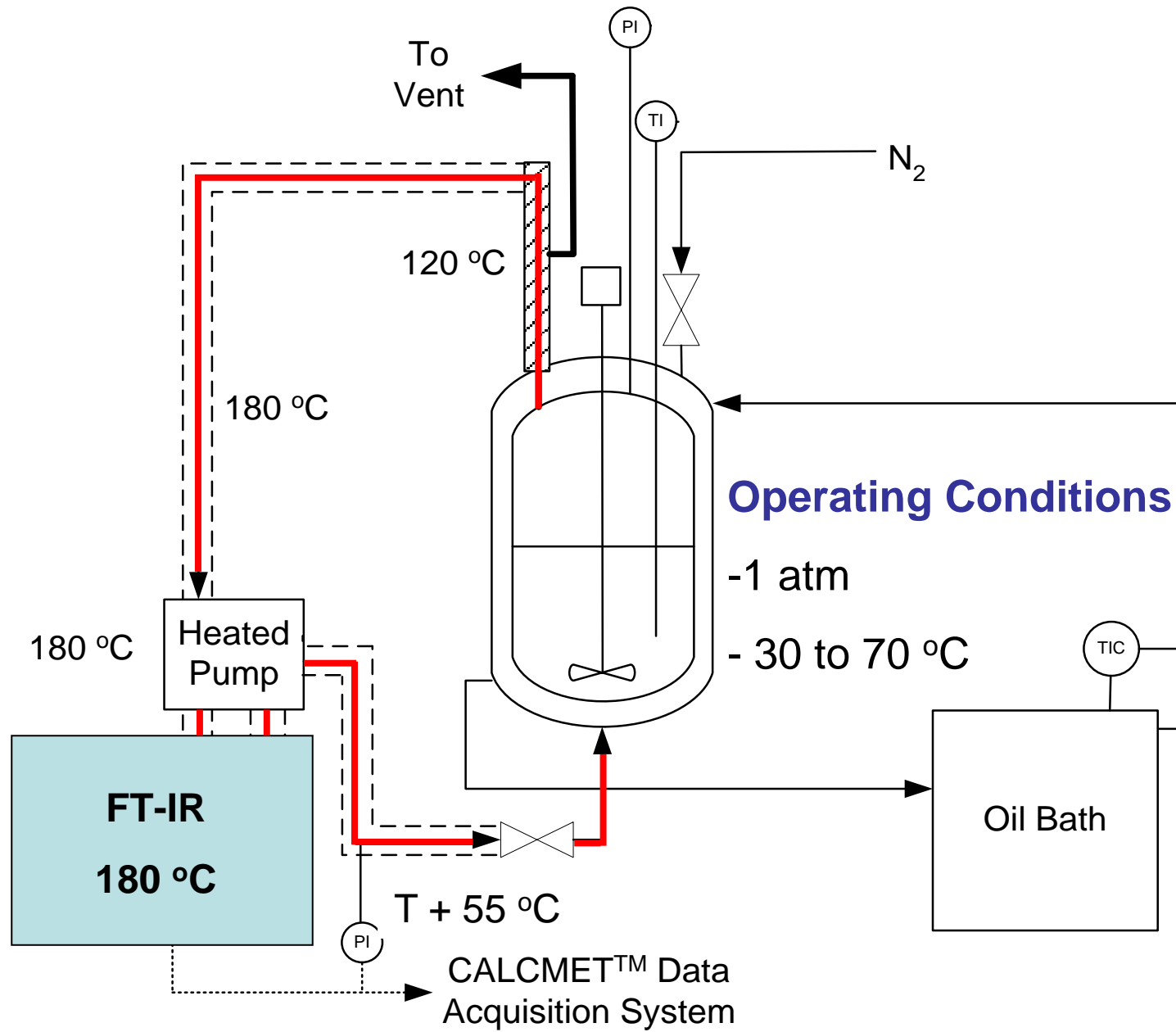
- Better Solvents – 2-methyl-piperazine et al.
 - Faster CO₂ Transfer
 - Greater Stability - Oxidation inhibitors
- Better Processes
 - Stripping by Multistage flash
 - Solvent Reclaiming
 - Nitrosamine Decomposition
- Better contacting
 - Packing to get G/L area

Experiments on Energy Use

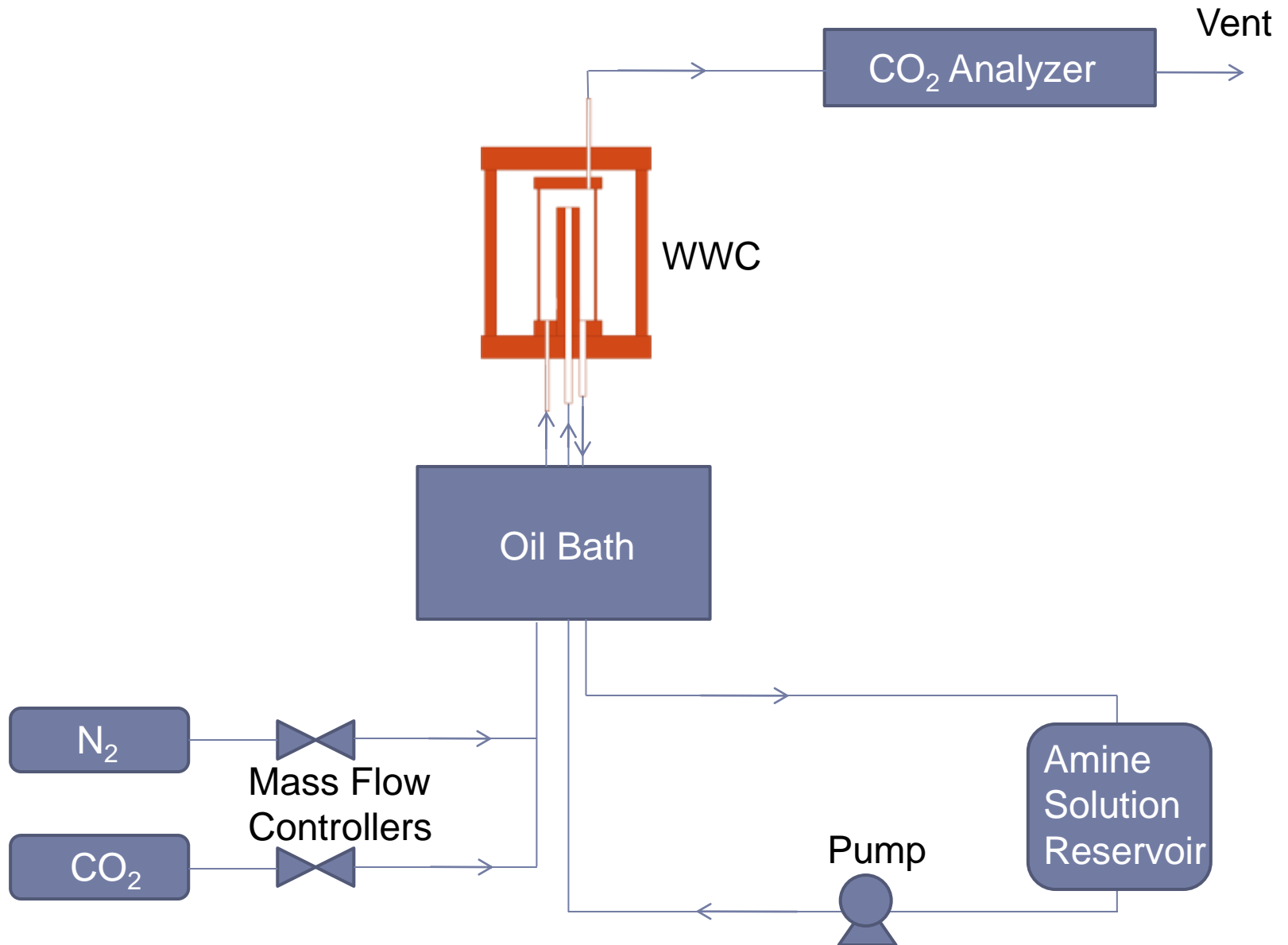
(2 students needed)

- Measure & Model Thermo with high amine & ions
 - Hot Gas FTIR - CO₂ & Amine Vapor pressure
 - NMR speciation
 - Heat Capacity
 - Hindered Amines, Blends, PZ derivatives
- Measure & Model Mass Transfer w Reaction
 - Wetted Wall Column
 - Hindered Amines, Blends, PZ derivatives
 - Structure/kinetics relationships

McVaR apparatus



Wetted Wall Column

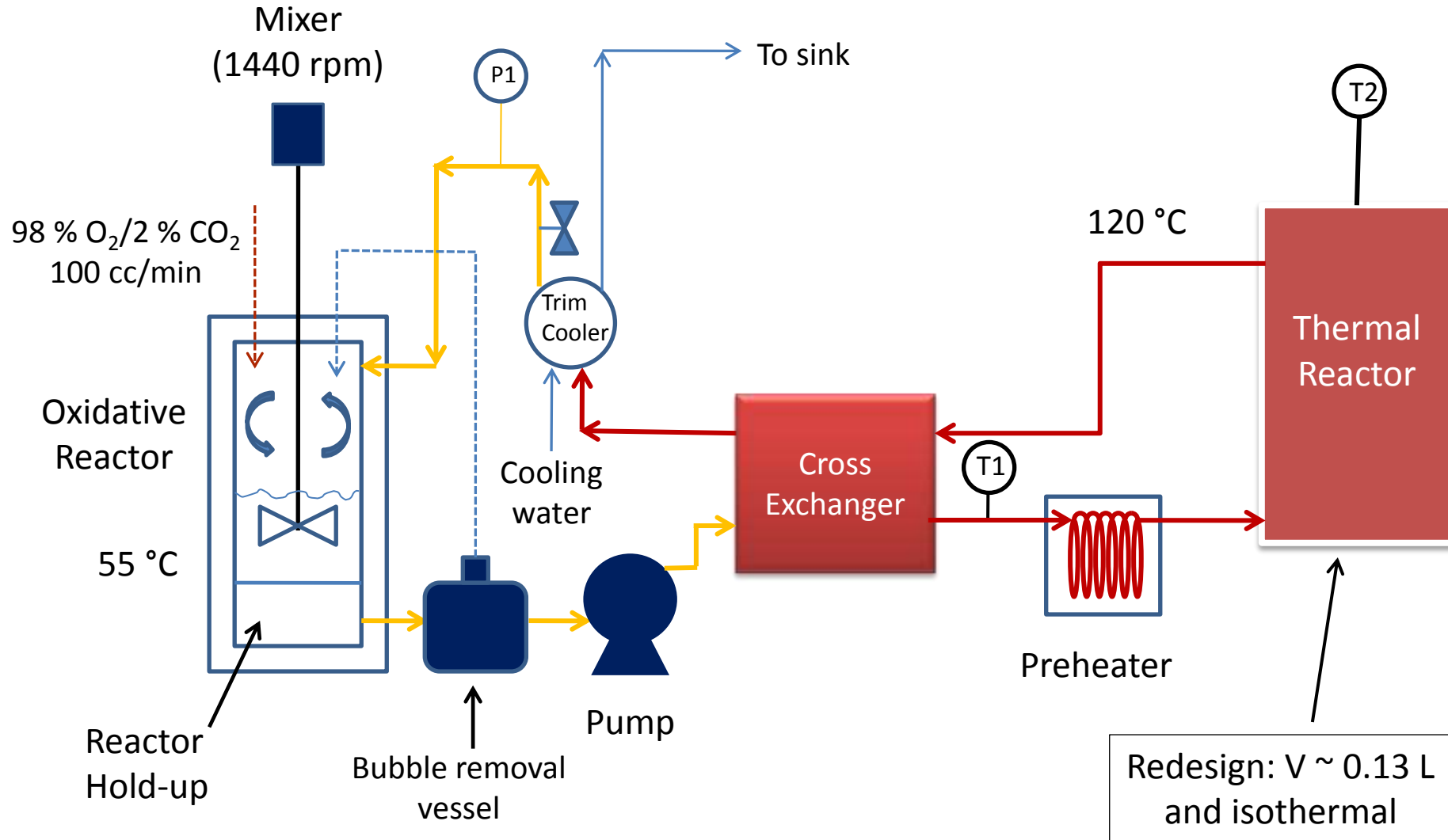


Experiments on Solvent Management

(4 students needed)

- Nitrosamine (carcinogen) from NO_2 & amine
 - NO_2 Absorption in various amines
 - Nitrite reaction & thermal degradation of nitrosamine
 - Decomposing Nitrosamines by catalysis, UV
 - Solvent Reclaiming
- Oxidation
 - Inhibitors and catalyst mechanisms
 - Effect of amine structure
- Thermal degradation
 - Effect of amine structure
 - Hindered amines

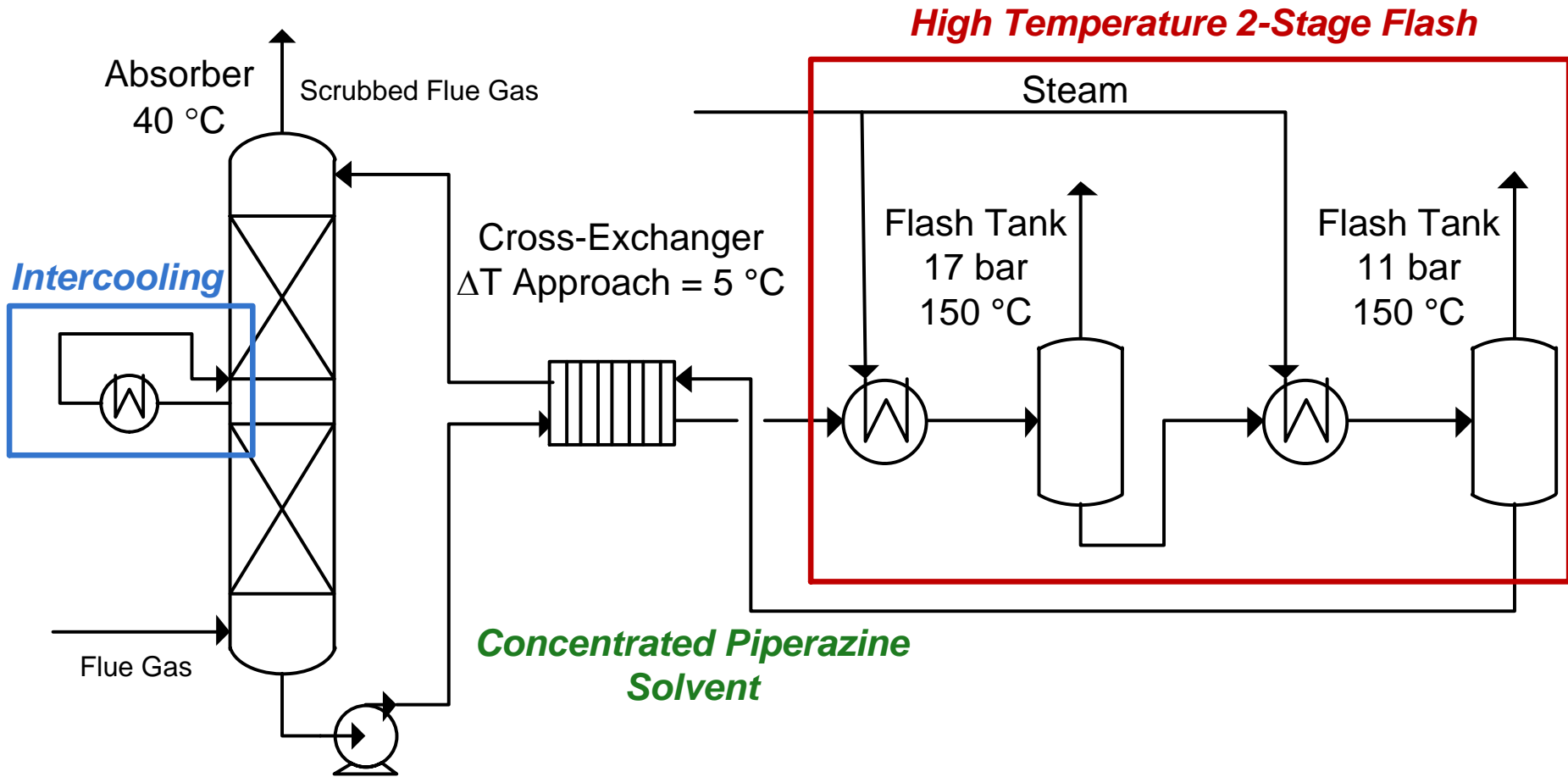
Integrated Solvent Degradation Apparatus



Modeling & Pilot Plant- 5 needed

- Solvent modeling for 2MPZ/PZ, etc
 - Thermo and rate models
 - Rate-based process model in AspenPlus
- Validate Models with Pilot Plant
 - With Dr. Eric Chen
 - Absorber Performance
 - Effects of back-mixing, G/L distribution
 - Intercooling, Hybrid internals, Packing Selection
 - Stripper Performance
 - Heat and CO₂ mass transfer in exchangers
 - Short time G/L separators

Pilot Plant



Modeling and Pilot Plant (cont)

- Test and Develop Available & Innovative Packing
 - With Dr. Frank Seibert
 - Characterize Structured Packing with sprays
 - Low deltaP structured packing
 - Random Packing
- Implement dynamic modeling
 - Multivariable process control
 - On/off operation

Available projects

- Experimental
 - Thermodynamics
 - Mass Transfer Rates
 - Nitrosamines
 - Thermal Degradation
 - Oxidative Degradation
 - Random Packing
- Modeling
 - New Solvent
 - Absorber
 - Stripper
 - Packing
 - Dynamic

Your Safety Committee, Talk to us

Monthly mtg, 1st Friday, 1 pm

Gary Rochelle, Chair, CPE 1.450, 1-7230, gtr@che.utexas.edu

Kevin Haynes, staff, Safety Manager

CPE 1.450B, 1-1354, Haynes@che.utexas.edu

Grad Student Representatives

Josh Katzenstein, jkatzens@gmail.com, CPE 3.428, 1-4789

Zach Frye, fryez724@gmail.com, CPE 5.452, 1-3742

John Ekerdt, faculty

Keith Friedman, Undergraduate labs

Jim Smitherman, staff

Training New Students & Faculty

- To get lab/office keys Grad students must take
 - **OH 101 – General Hazard Communication**
 - **OH 201 – General Laboratory Safety**
 - **OH 202 – Hazardous Waste Management**
 - **FF 205 – Fire extinguisher**
 - **EH&S training web site, register with EID**
<http://www.utexas.edu/safety/ehs/train/>
- To keep bldg access After 30 days lab students
 - **OH 102 - Site-Specific Hazard Communication**
Get form at EHS site
Site review by supervisor or designated person

Some Lab Safety Requirements

- Think. Do not take risks. Period!
- Wear Safety Glasses, lab coats, closed shoes
- Conduct monthly lab self inspections
- DO NOT Eat or drink in labs
- Report all incidents to Kevin and EHS
- Use approved procedures w hazardous exps
- Tag and dispose waste properly
- Never work alone
- Safely handle & store flammables & haz chems
- Keep your lab neat and organized
- Wear Safety glasses
- Think. Do not take risks. Period!