

ProcessDesignAgents

An Autonomous Multi-Agent System for Chemical Process Design

The Challenge

Traditional process design is slow, manual, and iterative. It requires coordinating multiple domain experts, leading to long development cycles and high costs.

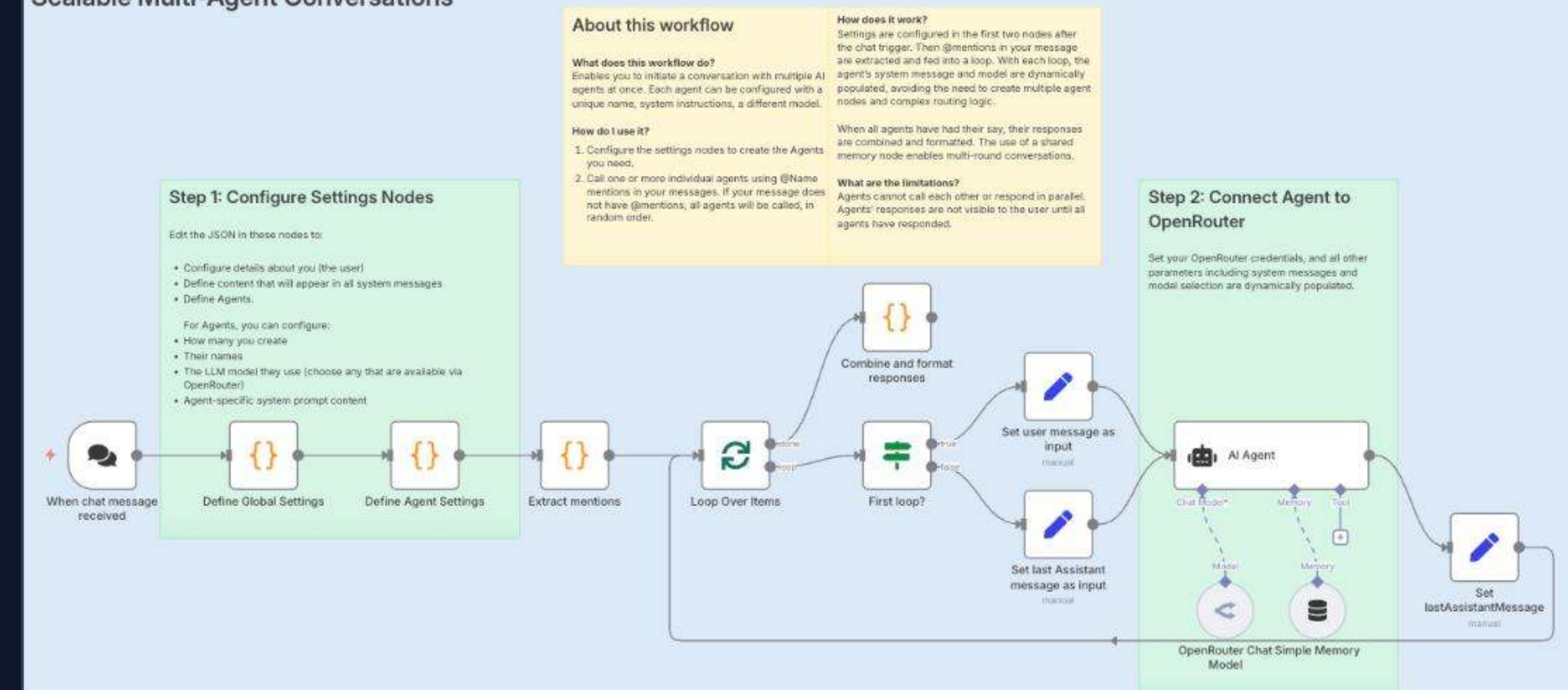
The Solution

An autonomous multi-agent system that streamlines and automates process design, from initial research to final equipment sizing and report generation.

High-Level Architecture

- ✓ Built on a graph-based framework (LangGraph) for robust state management.
- ✓ A central **Project Manager** agent orchestrates the workflow.
- ✓ Specialized agents work in parallel and sequence to perform complex tasks.
- ✓ The system manages state and propagates information, ensuring all agents have the necessary context.

Scalable Multi-Agent Conversations



Meet the Core Agent Teams



Researchers

Perform innovative and conservative research on process concepts, components, and technologies.



Analysts

Define the design basis, analyze process requirements, and conduct safety and risk analysis (HAZOP).



Designers

Create the flowsheet, estimate stream properties, and perform detailed equipment sizing.

Deep Dive: The Designer Agent

The Designer is not one agent, but a sub-graph of specialists:



Flowsheet Design Agent: Generates the Process Flow Diagram (PFD) concept.



Stream Property Agent: Estimates thermodynamic and transport properties for all streams.



Equipment Sizing Agent: Calculates detailed specifications for all unit operations.



Catalog Agent: Compiles all streams and equipment into a master catalog.

Core Feature: Engineering Sizing Tools

Preliminary Sizing

Uses robust, rule-of-thumb heuristics for rapid initial sizing of major equipment, allowing for quick feasibility studies and cost estimation.

Advanced Sizing

Integrates advanced models and calculations for detailed, high-fidelity equipment specifications suitable for a formal design package.

Example Sizing Capabilities



Heat Exchangers

Detailed sizing for shell-and-tube exchangers based on heat duty and fluid properties.



Distillation Columns

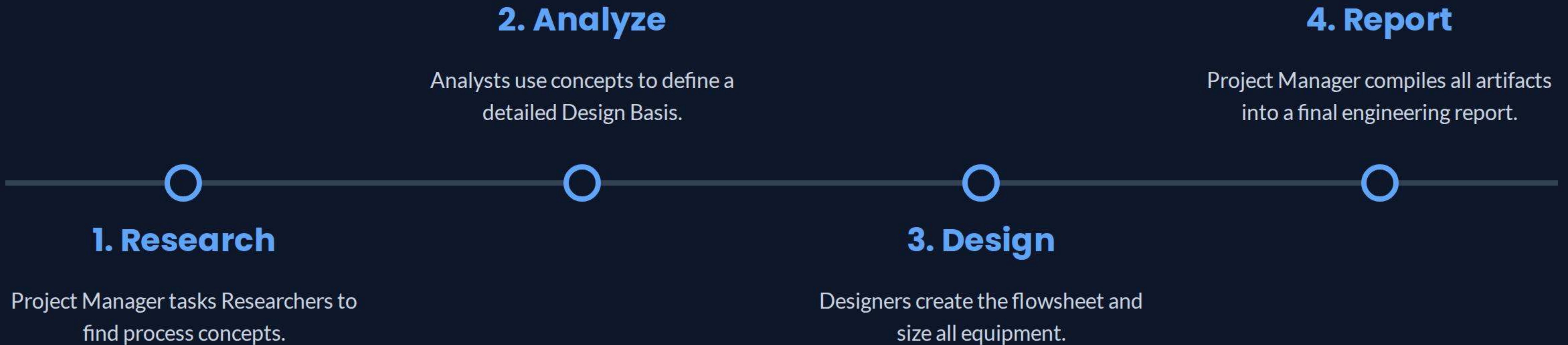
Calculates column diameter, height, and tray specifications based on separation needs.



Compressors

Sizes centrifugal compressors, calculating power requirements and shaft head.

The Workflow in Action



Example Output: Modular_CC

Project: Modular Carbon Capture

The agent team successfully generated a complete preliminary design for a modular carbon capture unit.

This included a full equipment list, stream tables, and safety analysis, compiled into a formal report.



TEMPLATE.NET

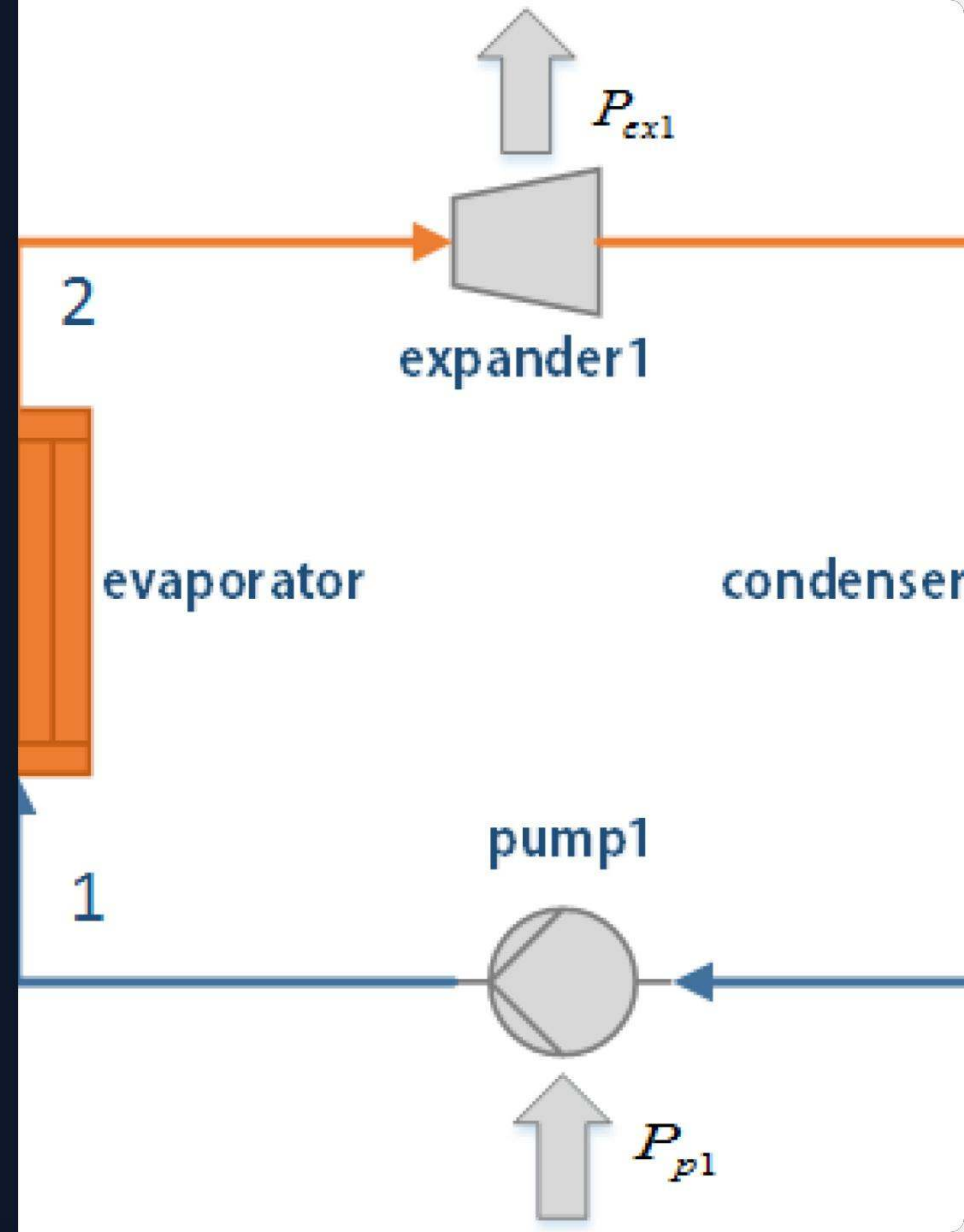
TECHNICAL REPORT

Example Output: EnergySavingORC

Project: Energy Saving ORC

An end-to-end design for an Organic Rankine Cycle (ORC) to recover waste heat.

The system autonomously selected the working fluid, designed the cycle, and sized the turbines and heat exchangers.



Value for Engineering Management

10x

Faster Scoping

Accelerate R&D and Scoping

Rapidly evaluate the feasibility of new process designs. Automate tedious calculations, freeing up senior engineers for high-value strategic work and review. Enforce design standards and safety checks automatically.

Questions?

Thank you.

Image Sources



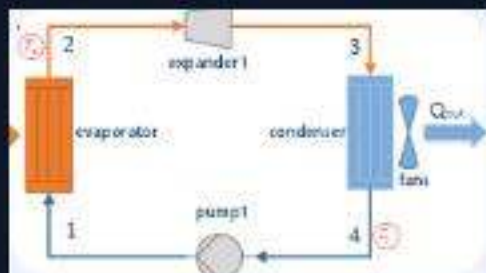
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