

A Systems Feedback Control Loop Representation of the Resource Management Process

Daniel Hayes

Department of Fisheries and Wildlife
Michigan State University

Introduction

- We rely on control systems every day
 - Thermostat
 - Car cruise control
 - Airplane autopilot
 - Manufactured good
- Simple control rules have been applied in some fishery applications, but the potential of control system concepts has not been realized

Goal

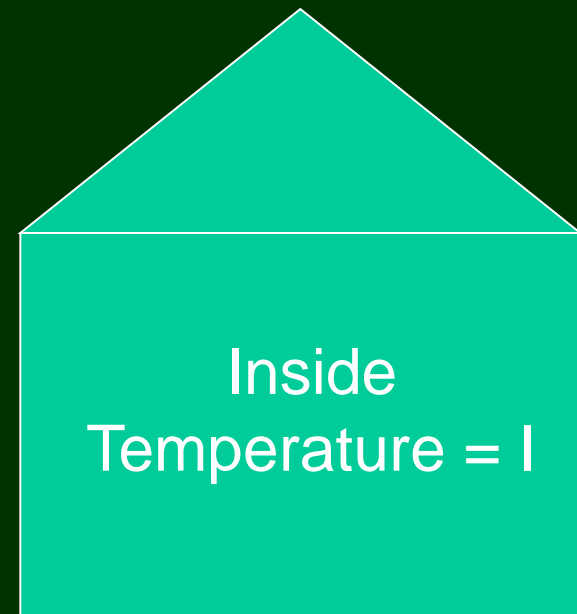
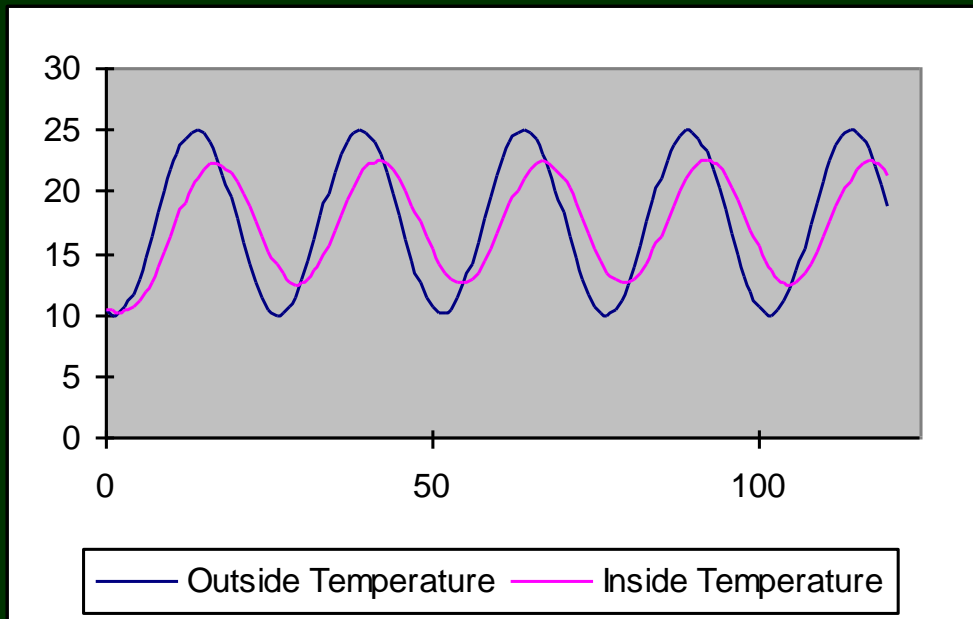
- Draw a parallel between engineering control systems and natural resource management systems
- Provide an example of the insight that this parallel provides

House Thermostat/Heating System

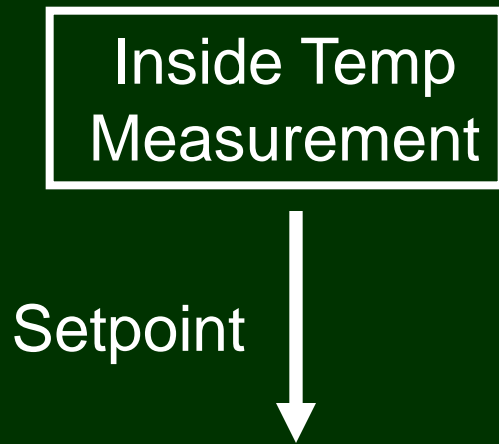
$$dI/dt = C (I - O)$$

where C is related to insulation and thermal inertia of house

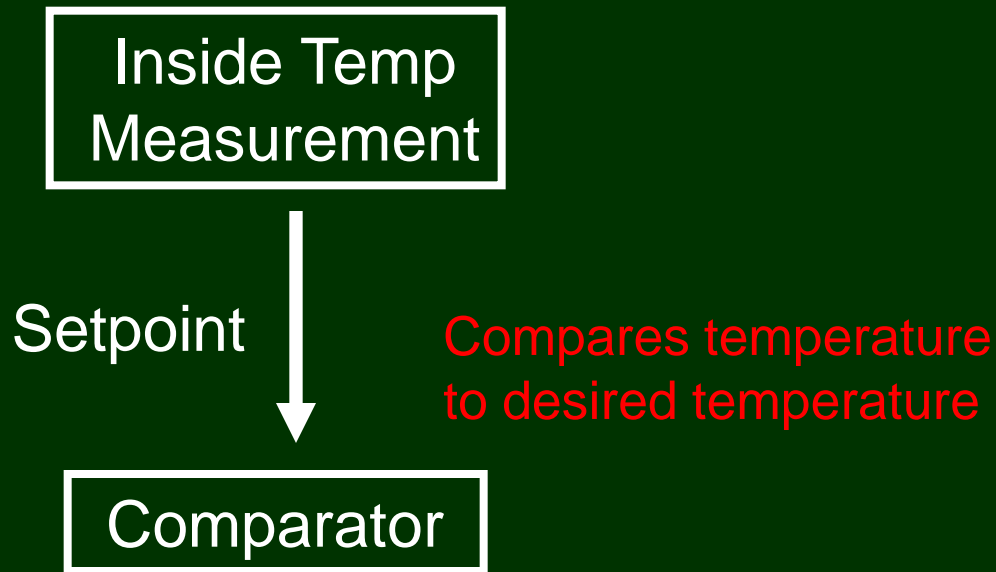
Outside Temperature = O



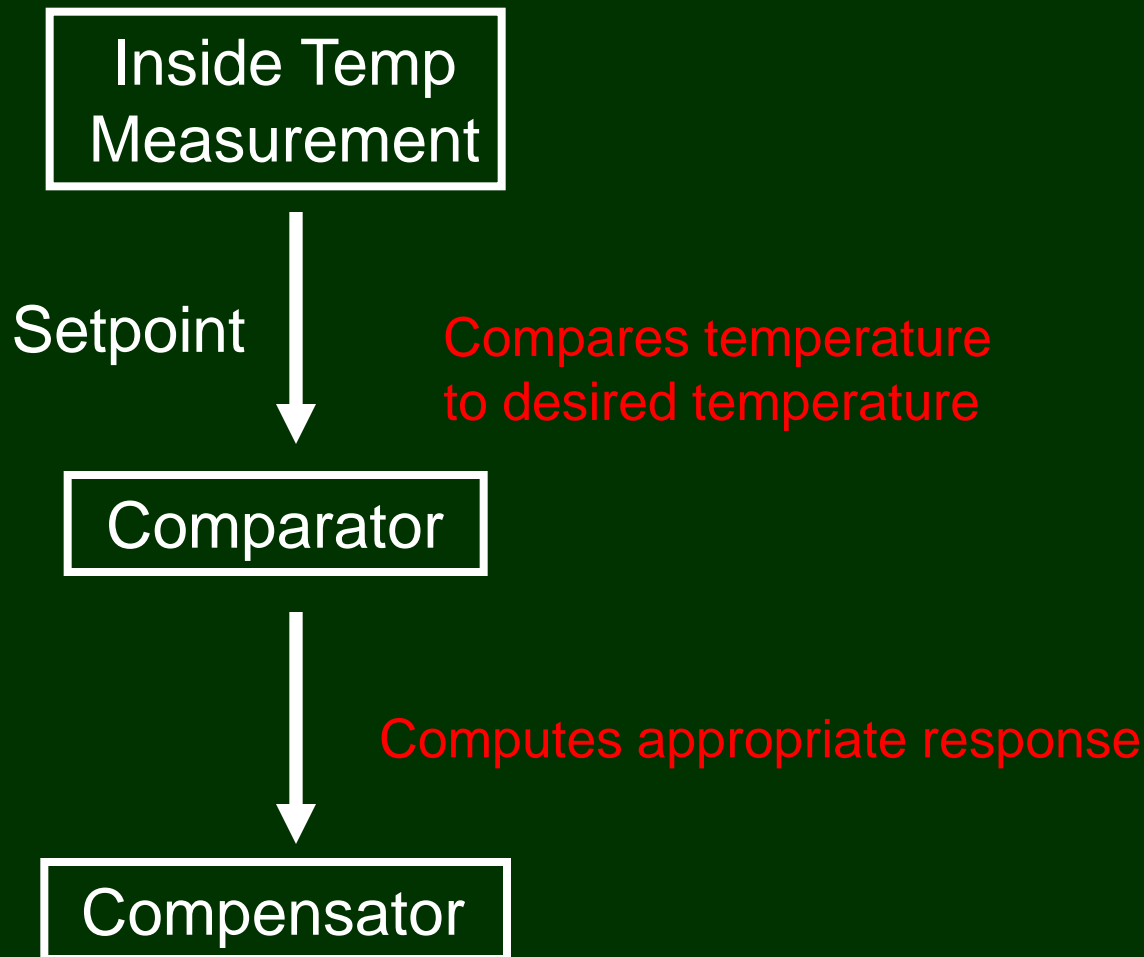
Control System



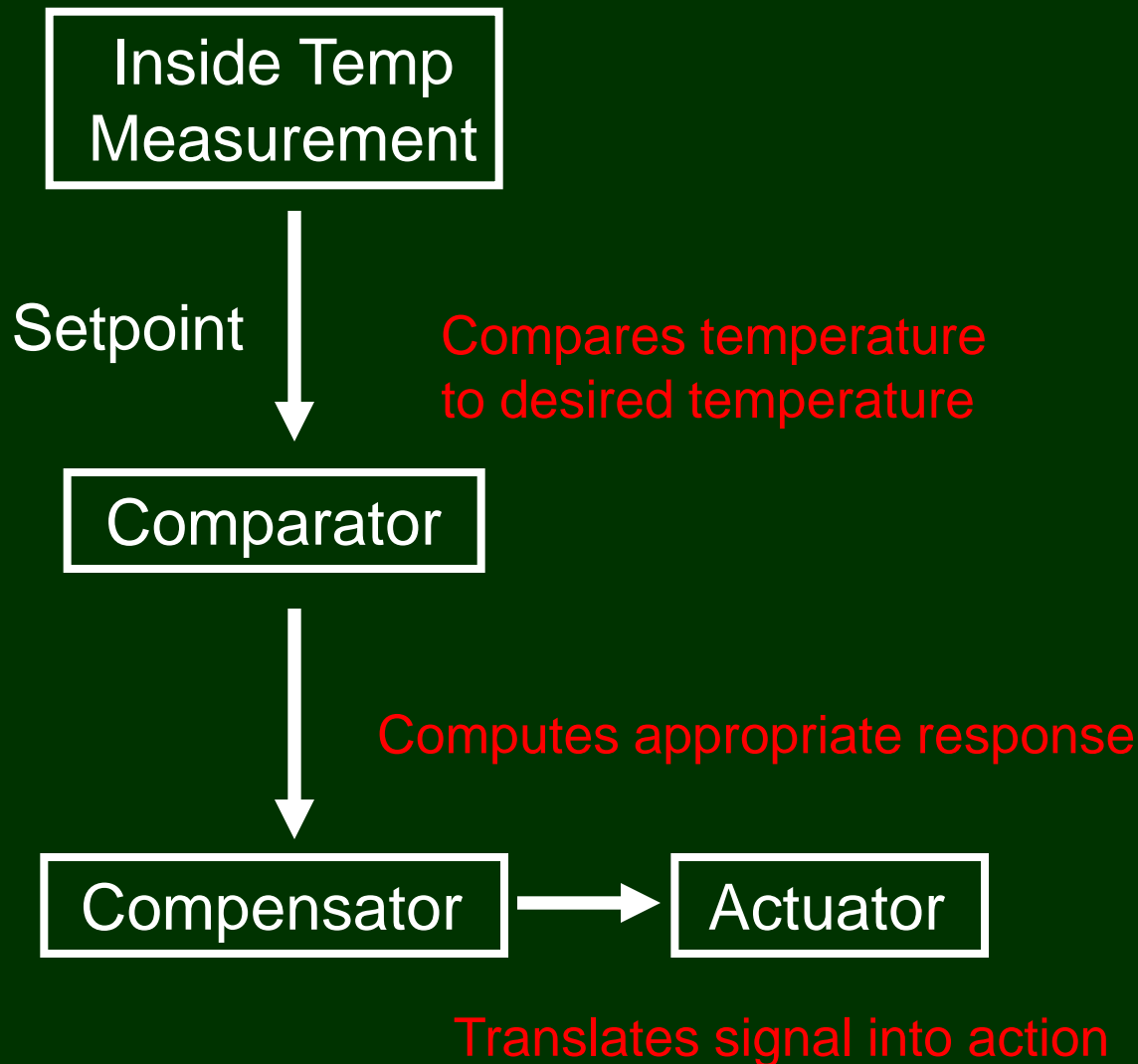
Control System



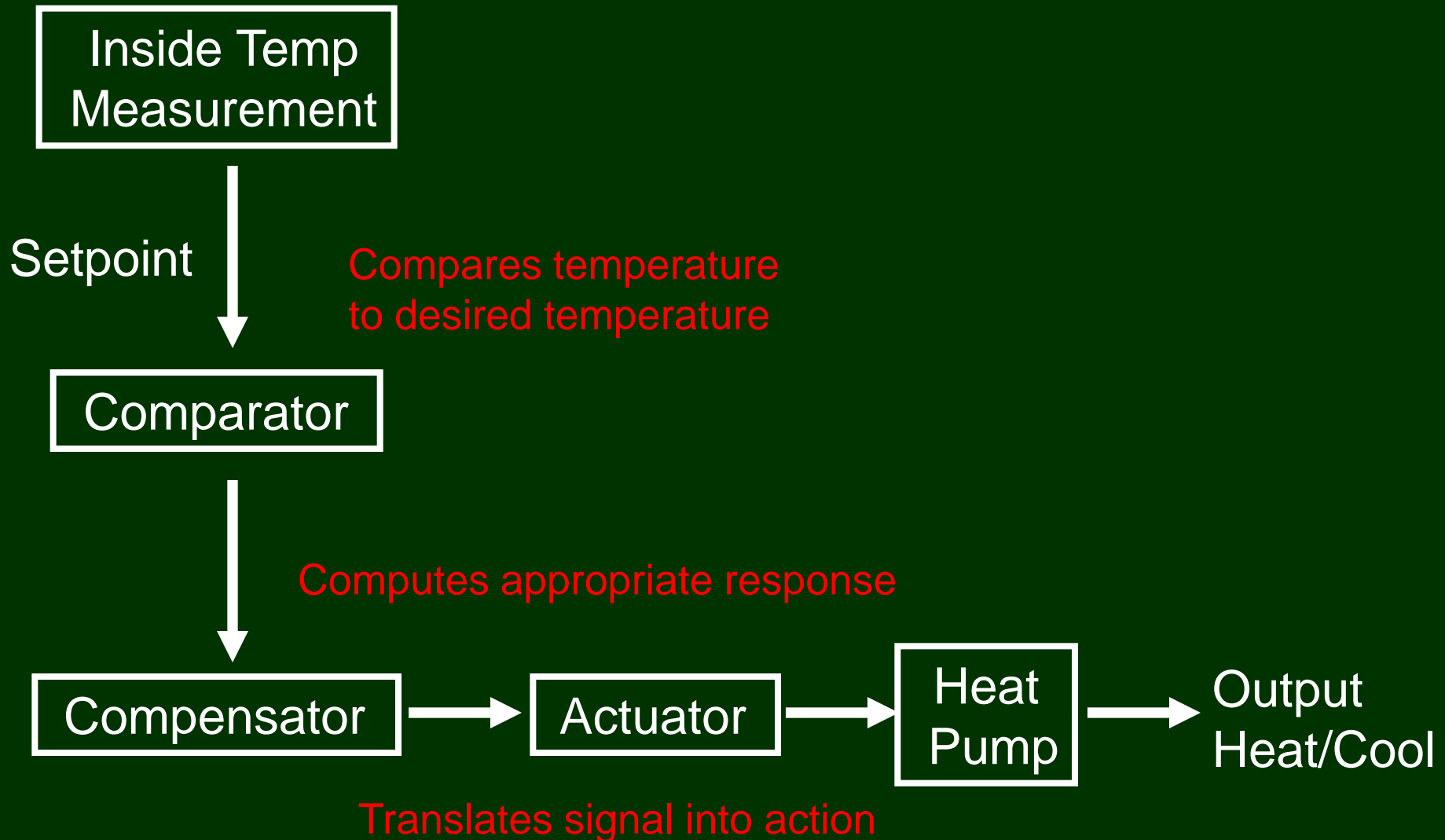
Control System



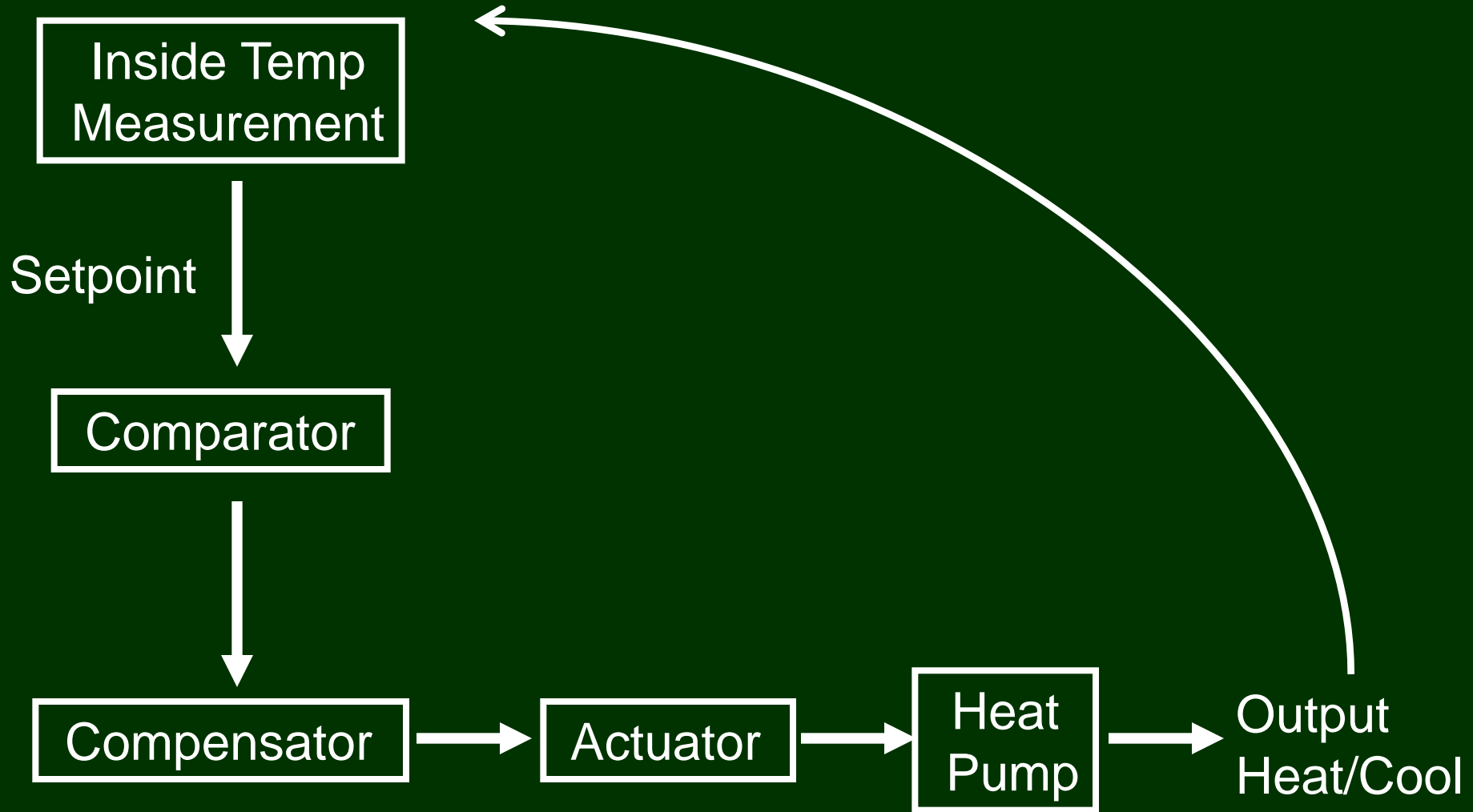
Control System



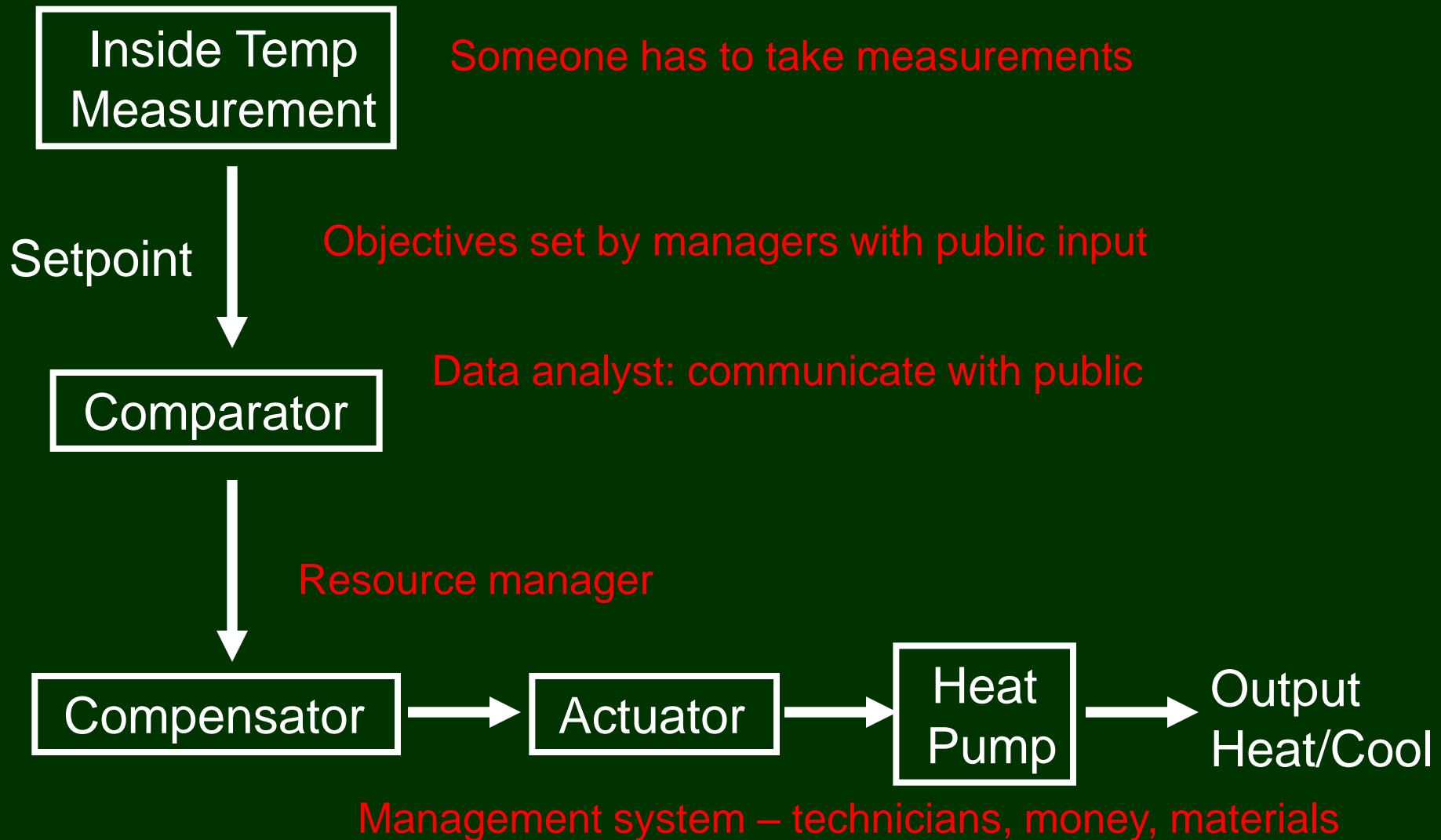
Control System



Control System

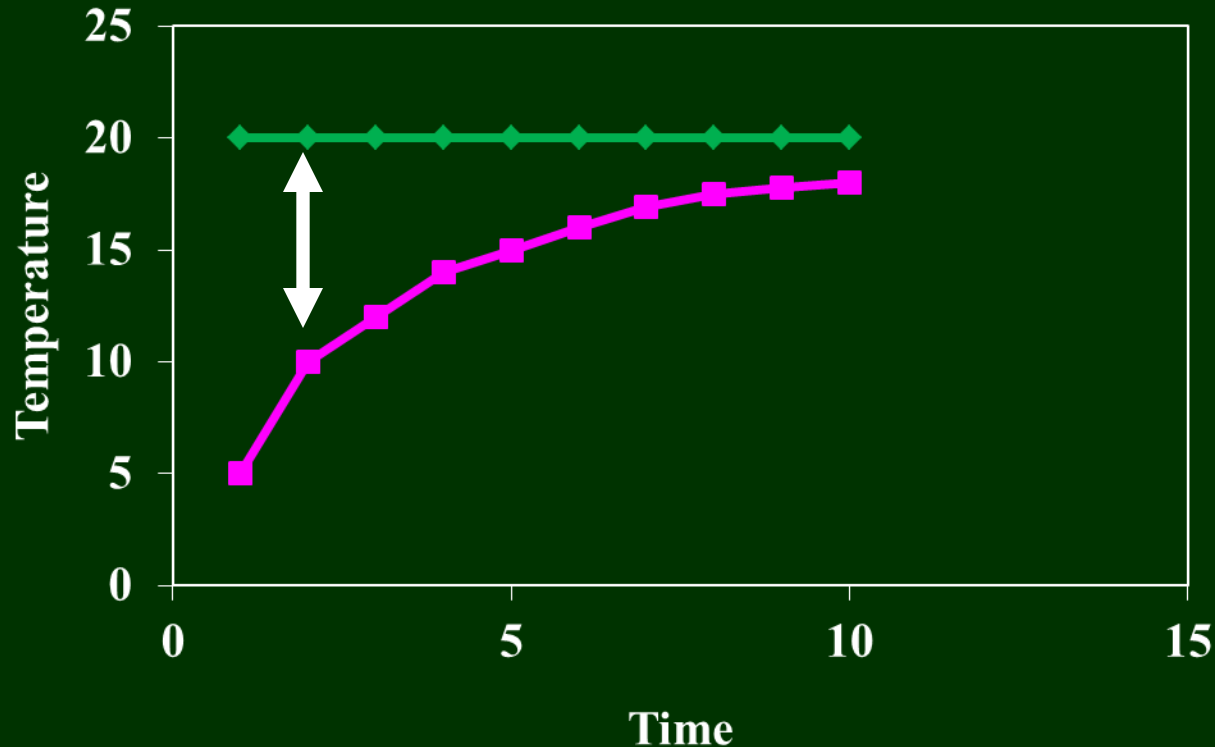


Control System



Focusing on Compensator

What Should We Do?

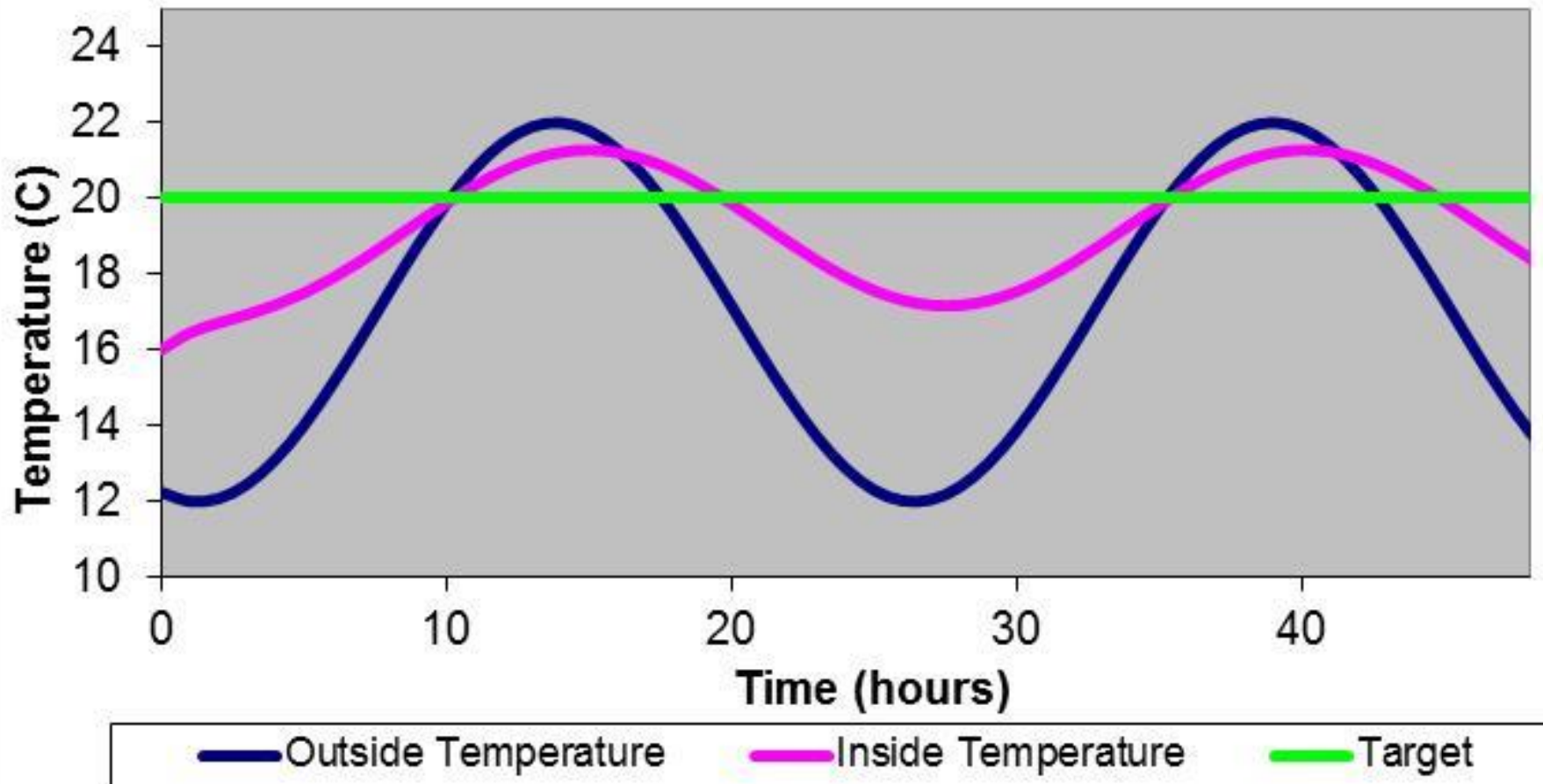


Proportional Control exerts control related to difference between target and observed temperature

$$C = a + b(S - I)$$

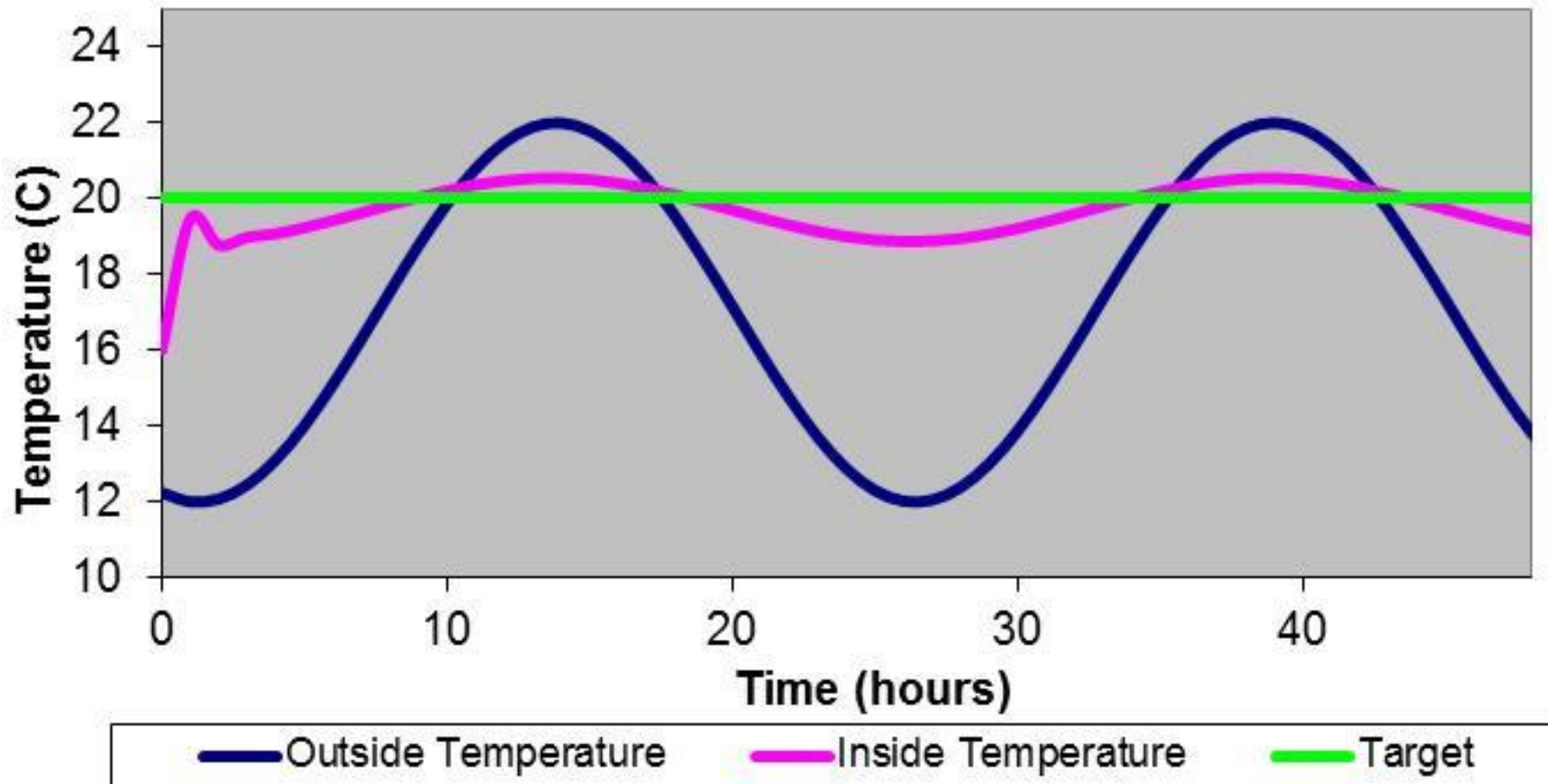
Focusing on Compensator

What Should We Do?



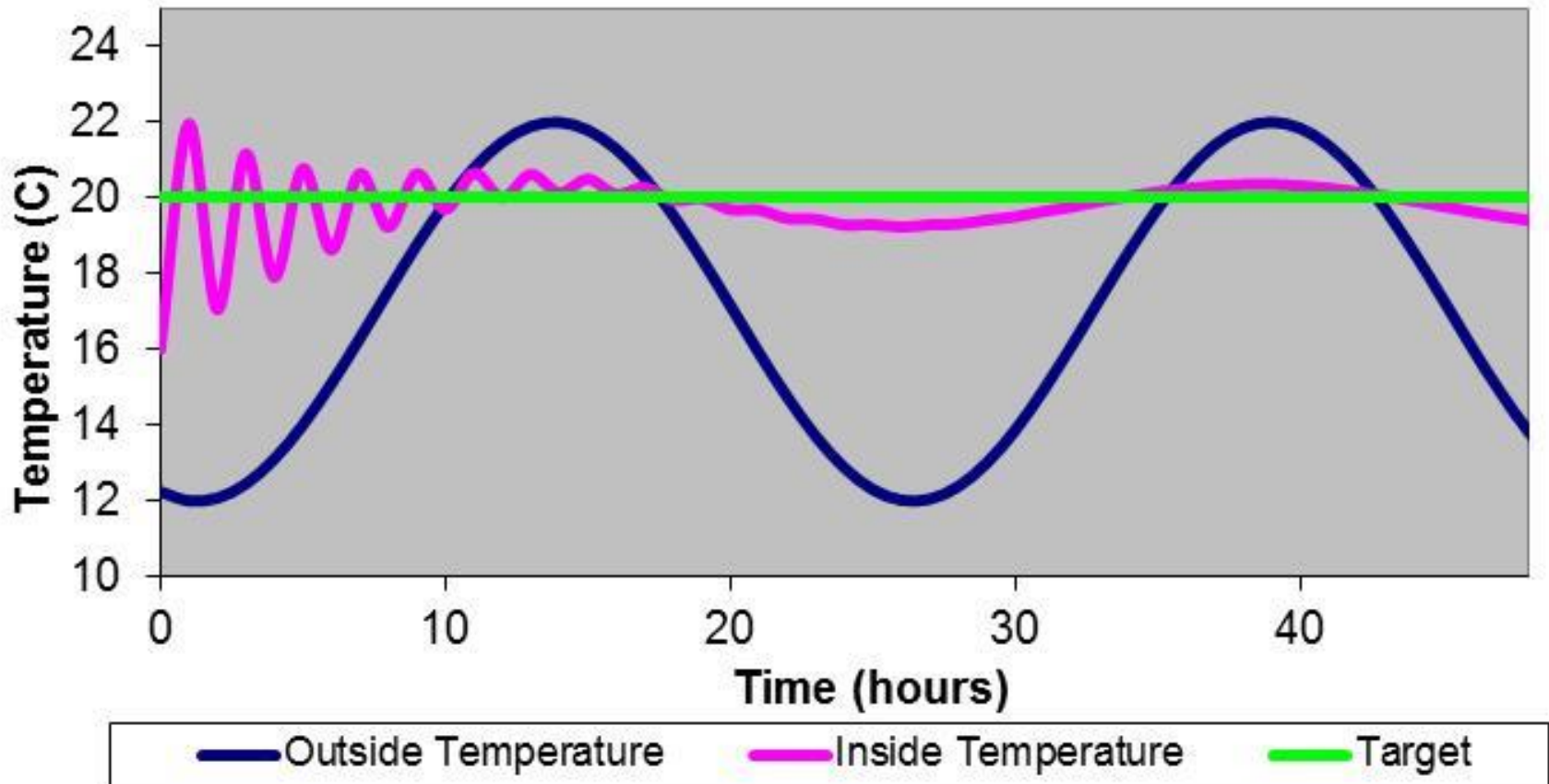
Focusing on Compensator

What Should We Do?



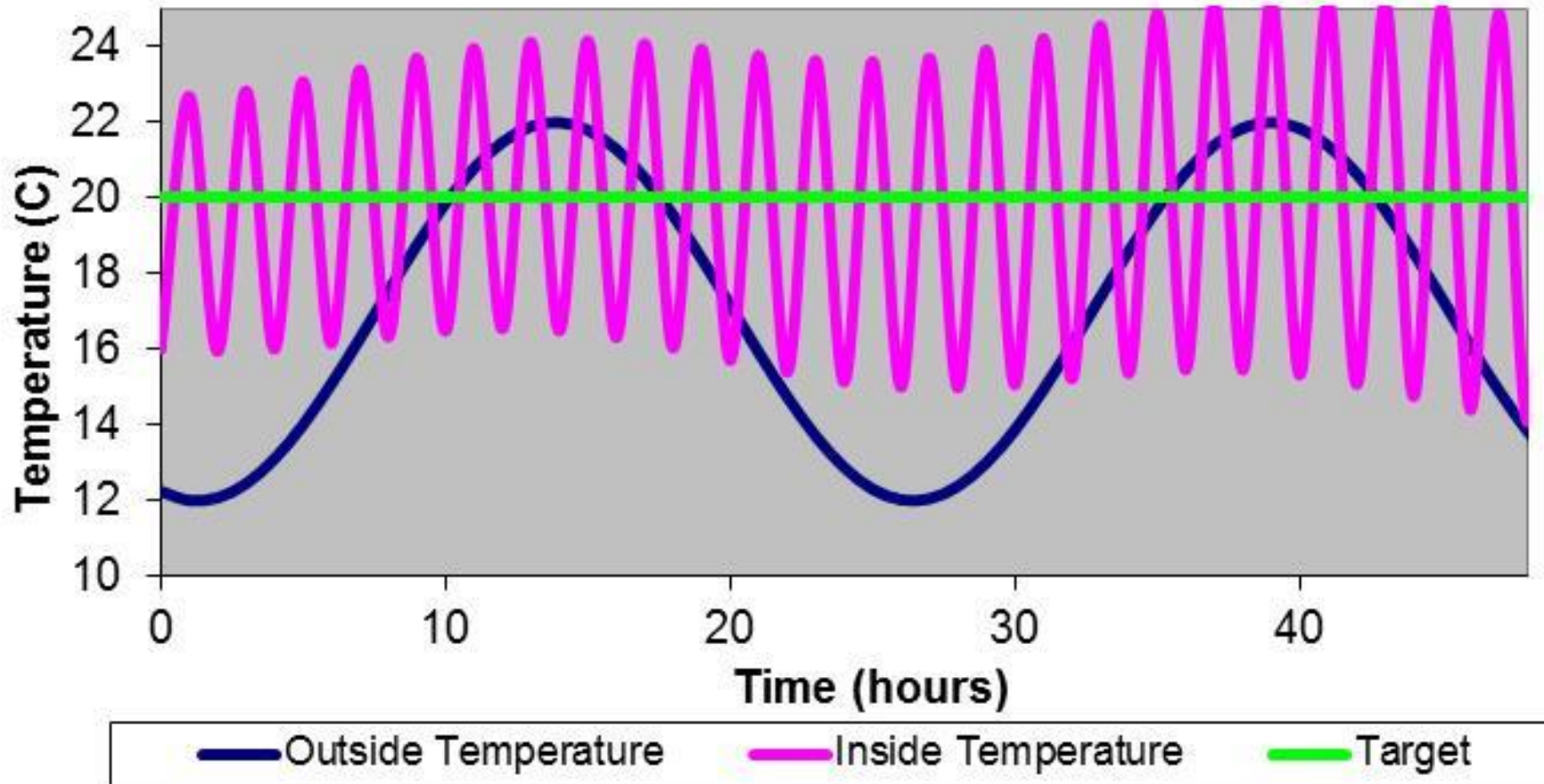
Focusing on Compensator

What Should We Do?



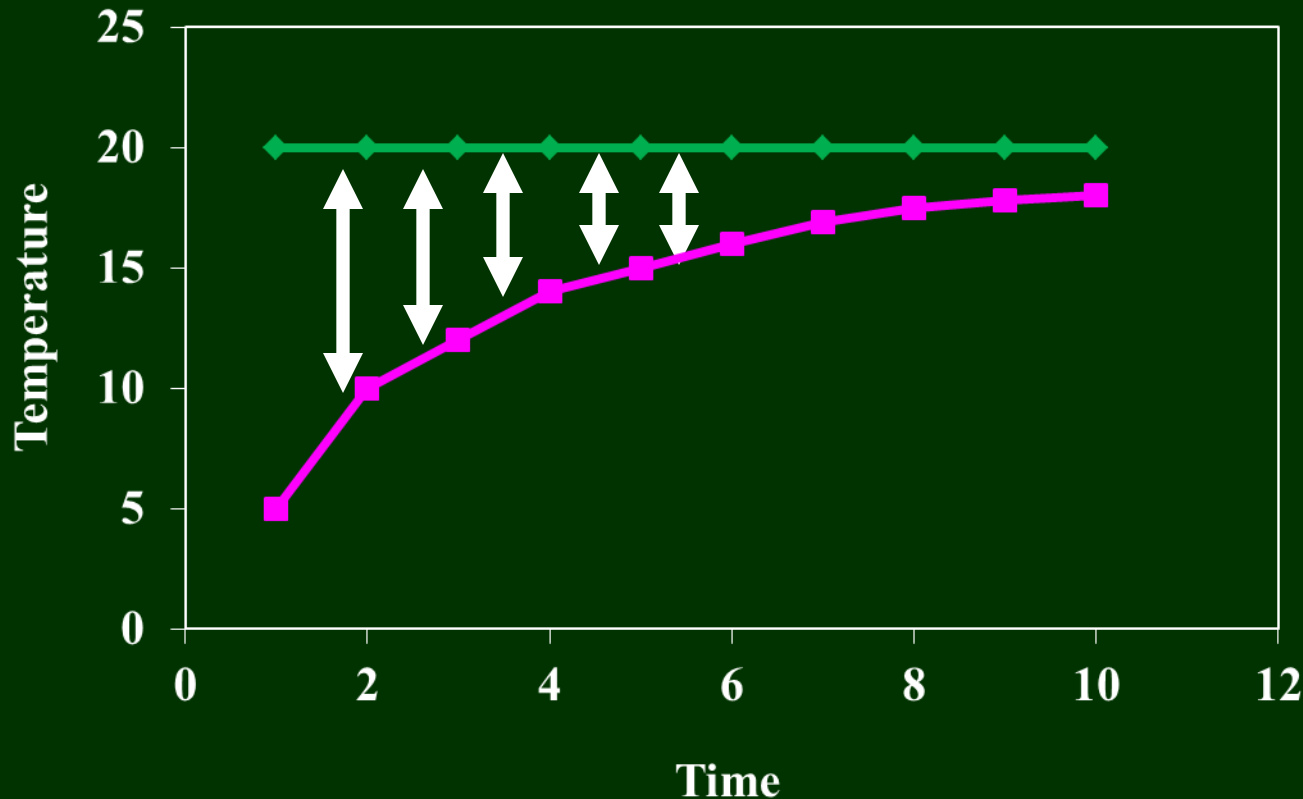
Focusing on Compensator

What Should We Do?



Focusing on Compensator

What Should We Do?

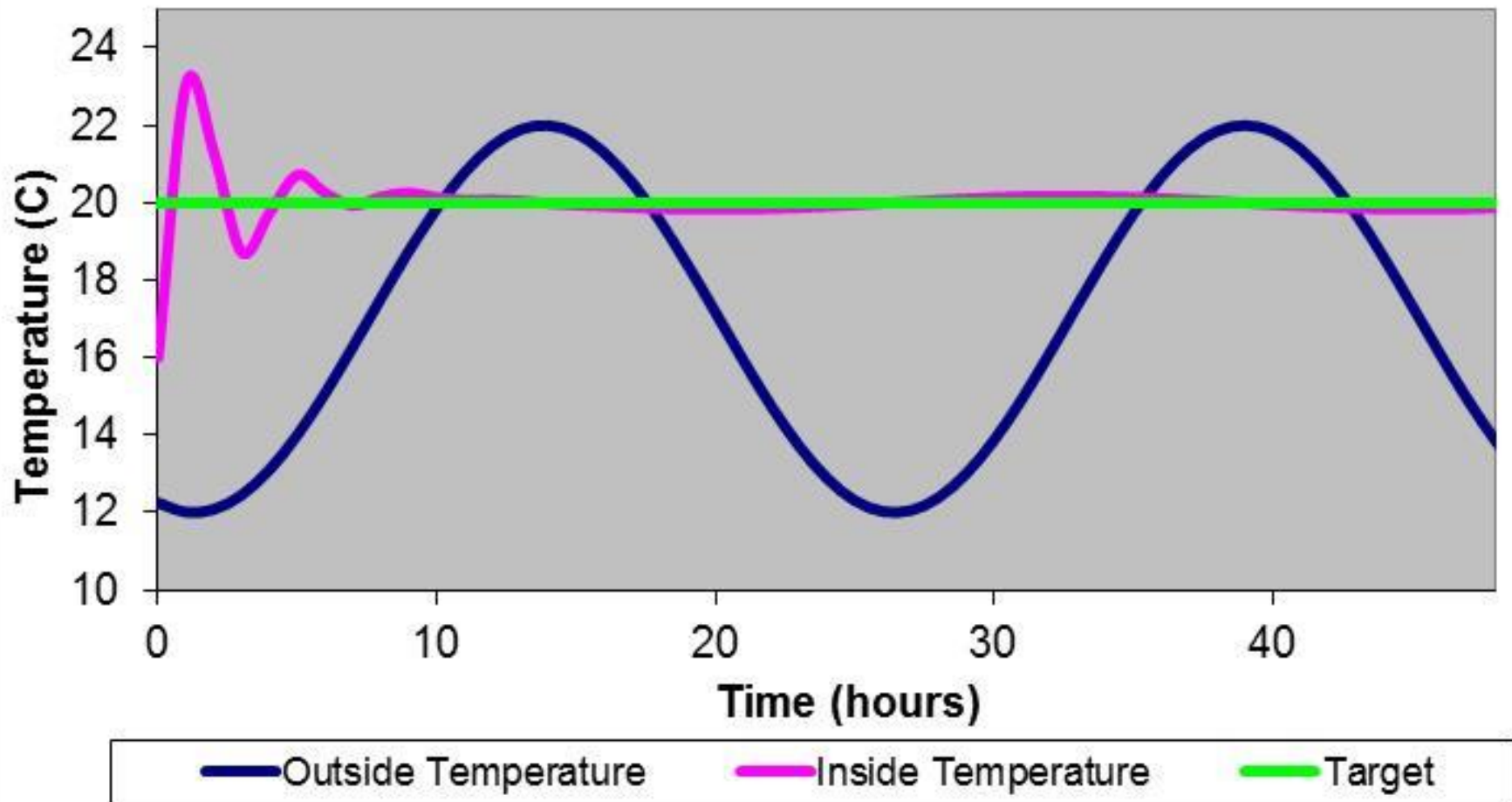


Integral Control exerts control related to **ACCUMULATED** difference between target and observed temperature

$$C = a + b(S-I) + c\sum(S-I)$$

Focusing on Compensator

What Should We Do?



Lessons

- The parallel structure between a control system and management systems helps clarify roles of different people involved in the management system
- Applying a control system concept reveals that our intuitive approach to control does not work! We need to think about accumulated error in addition to how far we are away from target currently