

Continuity Model for Energy System Sustainability

Dr. Susan Krumdieck

Department of Mechanical Engineering

Tony Burton

Energy Systems Engineer, PhD Student



Overview

Conclusions From:

- **Logic** The Industrial Revolution is over
- **Theory** Sustainability is achieved by design
- **Model** Energy & Environment Constraints

Logic

The Current Path

Population Growth
Resource Consumption
Environmental Degradation
Energy Supply

Is Unstable



Logic

There are no new resources to keep the present system from collapsing

There are no new technologies that can provide unconstrained land, water, energy, or materials

Therefore, we must develop a **new system** that can function for the good of the people without requiring more resources than are available

Logical Conclusion:

Sustainable Infrastructures will be

**Conceived,
Modeled,
Designed and
Built**

Within the Constraints of Continuity

Balance of Energy

Balance of Materials

Balance with Biological Cycles



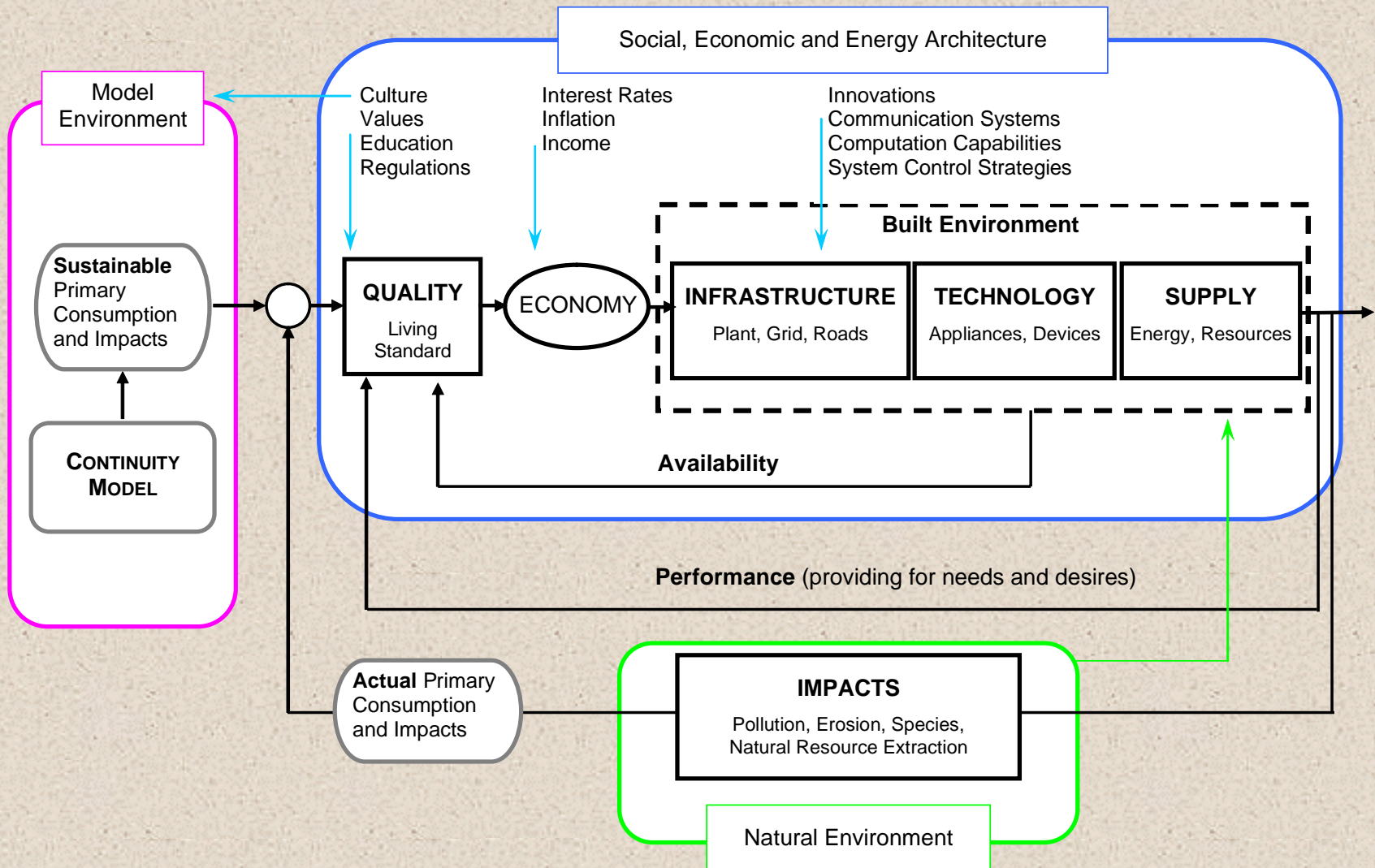
An New Approach is Needed

**We need an approach that allows
us to work on
Highly Constrained and
Highly Complex Systems**

Systems Approach



Theory



Conclusions from Theory

- A sustainable system must be stable
- A sustainable reference state must be determined
- The reference state must be incorporated in the decision processes at all levels
- The reference state must be designed for CONTINUITY

Continuity Modeling

A scenic sunset over the ocean. The sun is low on the horizon, casting a bright orange and yellow glow across the sky and reflecting on the water. In the foreground, there are dark, rocky islands or reefs extending into the sea. The overall atmosphere is calm and serene.

- Developed for each service subsystem
- In a specific region
- With given resource availability and environment constraints

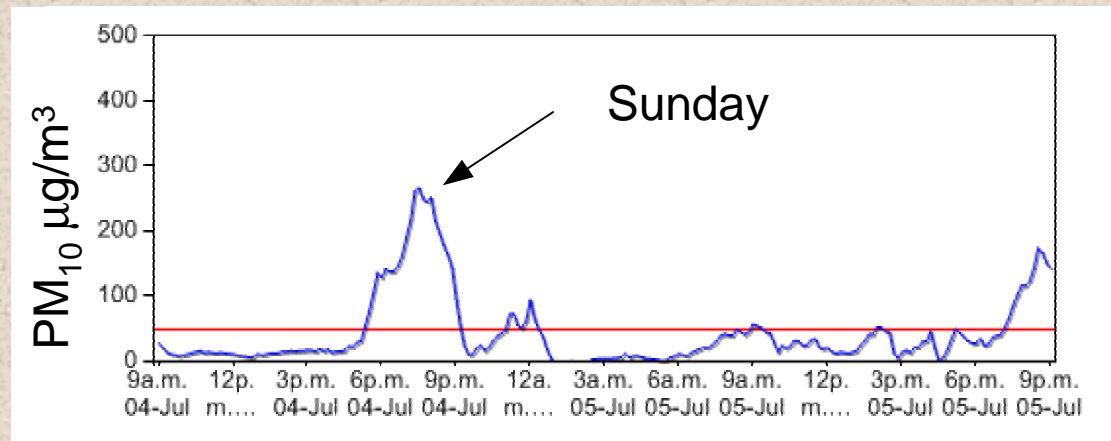
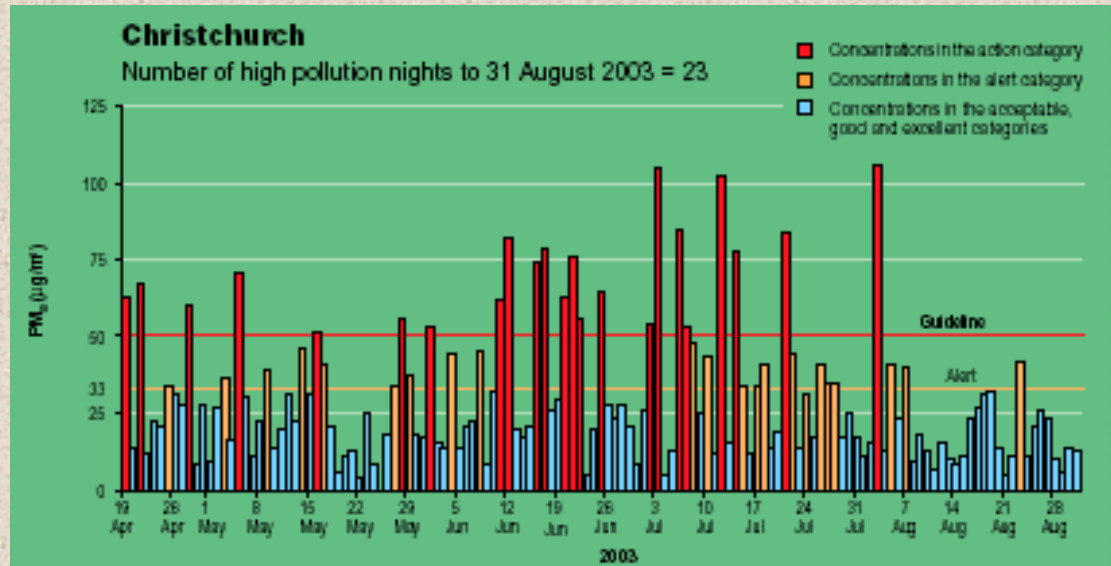
Example



1935 Sunlight League
begins campaign for
clean air

1960 Clean Air Society
takes up issue of
Christchurch's poor
air quality

1975 Christchurch City
Council declares the
City a "Clean Air Zone".



Problem

- 20,000 homes with open fires
- 60,000 homes with solid fuel burners
- 50,000 homes with no wall insulation
- Winter electricity demand already at maximum grid capacity
- Temperature inversions
- High humidity

Continuity Model

- Warm homes for everyone (above 16°C)
- No indoor mould growth
- Clean Air Now
- Sustainable Energy Architecture
- Economic and Social Context

Continuity Model

- Ban second-hand smoke at all times,
NOW
- Support of waste wood pellet manufacture
- Low-cost financing of wood pellet stoves

