

Resource Recovery from the Circular Economy Perspective: *Recovering Construction and Demolition Waste*

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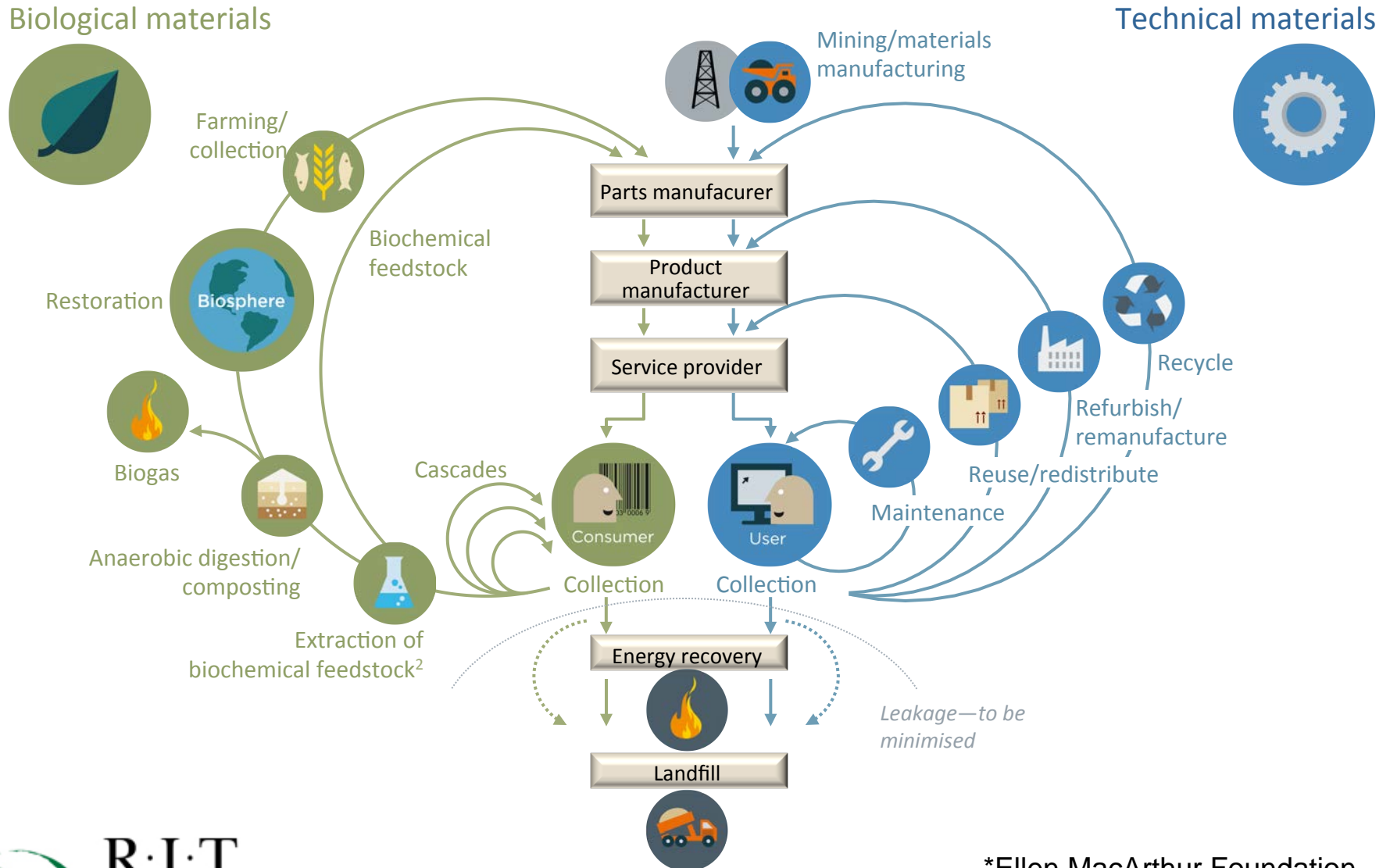
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The Circular Economy is a New System Approach*



*Ellen MacArthur Foundation

Reman Industry Sectors

Aerospace

Automotive

Consumer Products

Electrical Apparatus

Furniture

Heavy Duty/
Construction
Equipment

Imaging Products
& Consumables



IT Equipment

Locomotive Systems

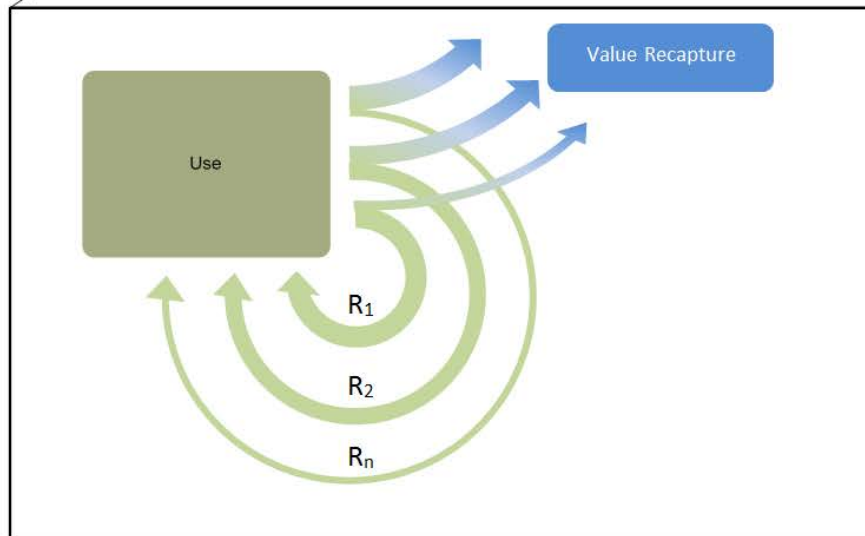
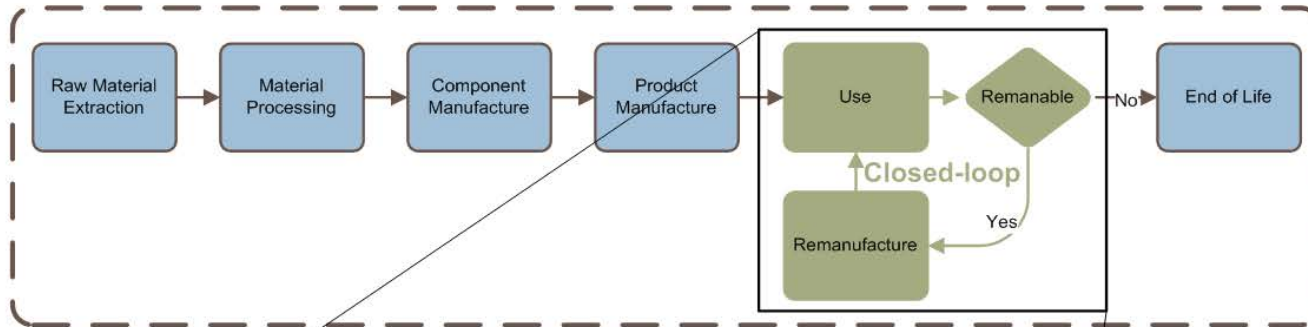
Machinery

Medical Equipment

Restaurant
Equipment

Tires

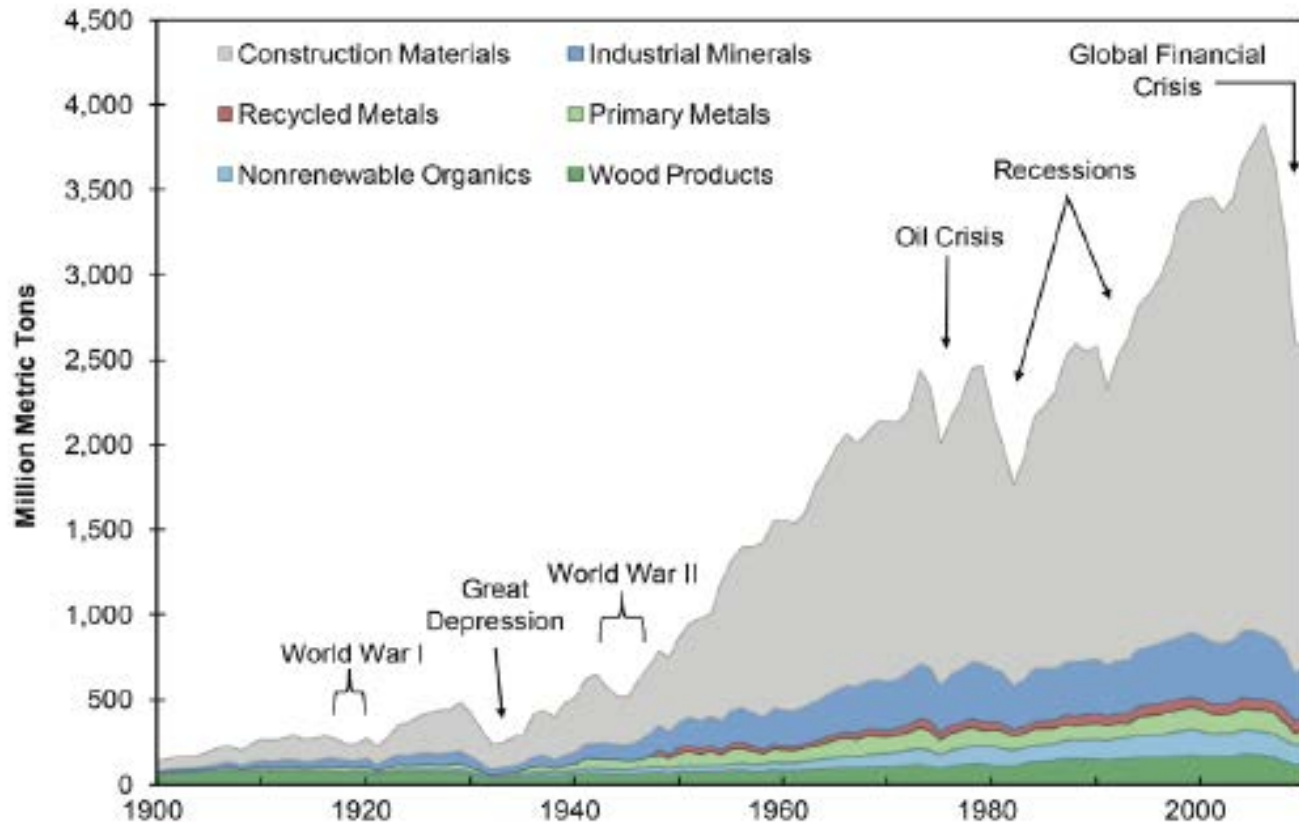
Multi-Life Cycle Material Flow



Recovering Construction and Demolition Waste

The U.S. Construction Industry and Material Consumption

U.S. Nonfuel Material Consumption, 1900-2010¹



(Source: G. Matos. 2012. Use of Raw Materials in the United States From 1900 Through 2010. U.S. Geological Survey (USGS))

Construction and Demolition Waste

325+ million tons of recoverable C&D materials are generated in the United States annually. C&D materials include aggregates such as:

- Concrete
- Asphalt & asphalt shingles
- Gypsum wallboard
- Wood
- Metals



Source: Construction & Demolition Recycling Association.

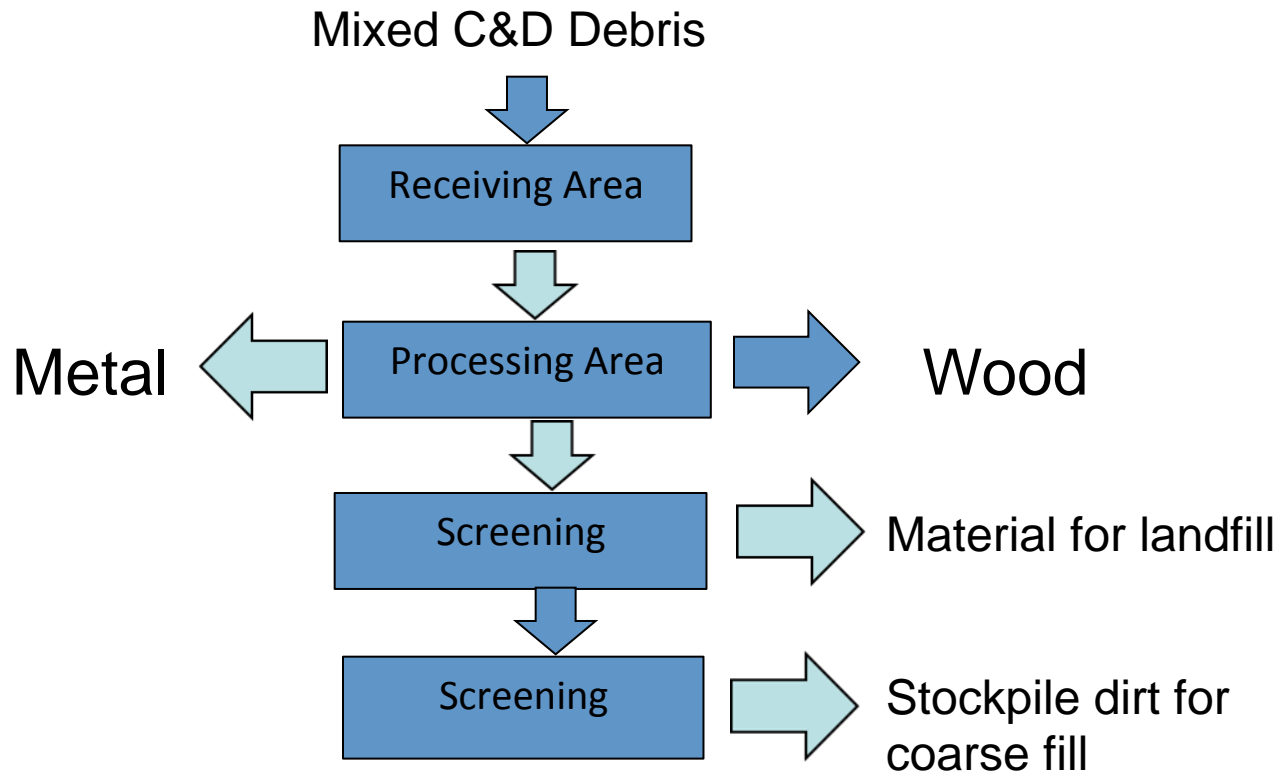
Construction and Demolition Waste

US Environmental Protection Agency estimates:

- 53% percent of all building-related C&D materials are result of demolition activities
- 38% of materials are produced by renovation activities
- 9% are the result of construction
- Only 40% were reused, recycled, or sent to waste-to-energy facilities
- Remaining 60% percent of materials were sent to C&D landfills

(Source: Recover Your Resources: Reduce, Reuse, and Recycle Construction and Demolition Materials at Land Revitalization Projects, US EPA. 2009.)

Typical General Materials Flow for C&D Waste Processing



George Tchobanoglous and Frank Kreith, McGraw-Hill. 2002)

Commonly Recovered C&D Materials

- Asphalt Paving
- Greenwaste (trees and brush, soil)
- Wood
- Gypsum Wallboard
- Metals
- Plastic packaging
- Glass
- Cardboard
- Carpet
- Concrete
- Steel
- Asphalt Shingles
- Roofing (non-asphalt/metal shingles)
- Brick
- Architectural Salvage

(Sources: *Construction & Demolition (C&D) Waste Diversion in California*, Dan Burgoyne, State of California, Department of General Services n.d.;

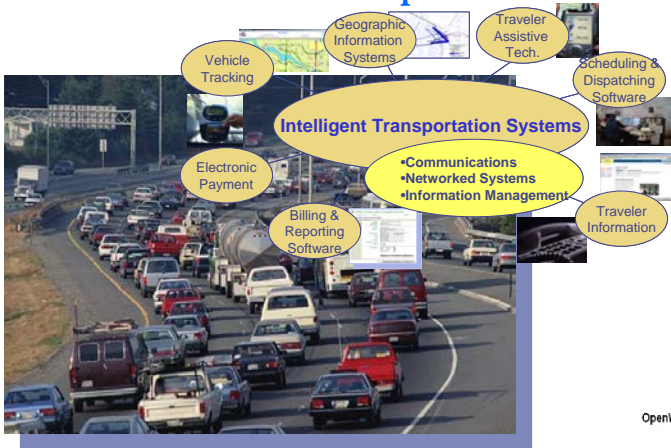
Recover Your Resources: Reduce, Reuse, and Recycle Construction and Demolition Materials at Land Revitalization Projects, US EPA. 2009.)

NEW TRENDS IN THE BUILT ENVIRONMENT

Smart Products and Systems

Instrumented – Interconnected - Intelligent

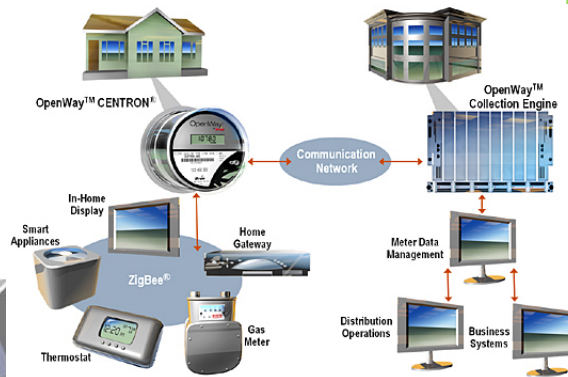
Smart Transport



Smart Cities



Smart Products



Smart Homes

The Smart House

Xcel Energy's Smart Grid Consortium is imagining a future that would allow you to communicate your energy choices to the power grid and automatically receive electricity based on your personal needs.

The potential benefits:

- Lower cost of power
- Cleaner power
- A more efficient and resilient grid
- Improved system reliability
- Increased conservation and energy efficiency

Plug-in Hybrid Electric Car

Xcel Energy is studying how plug-in electric vehicles can store energy, act as backup generators for homes and supplement the grid during peak hours.

Smart Meter

Real-time pricing signals create increased options for consumers.

Smart Appliances

Smart appliances contain on-board intelligence that "talks" to the grid, senses grid conditions and automatically turns devices on and off as needed.

Smart Thermostat

Customers can opt to use a smart thermostat, which can communicate with the grid and adjust device settings to help optimize load management. Other "smart devices" could control your air conditioner or pool pump.

High-Speed Connections

Advanced sensors distributed throughout the grid and a high-speed communications network tie the entire system together.

Customer Choice

Customers may be offered an opportunity to choose the type and amount of energy they'd like to receive with just the click of a mouse on their computer.

100 percent green power? A mix of sources? The cheapest priced source? In Smart Grid City, it could be up to you.

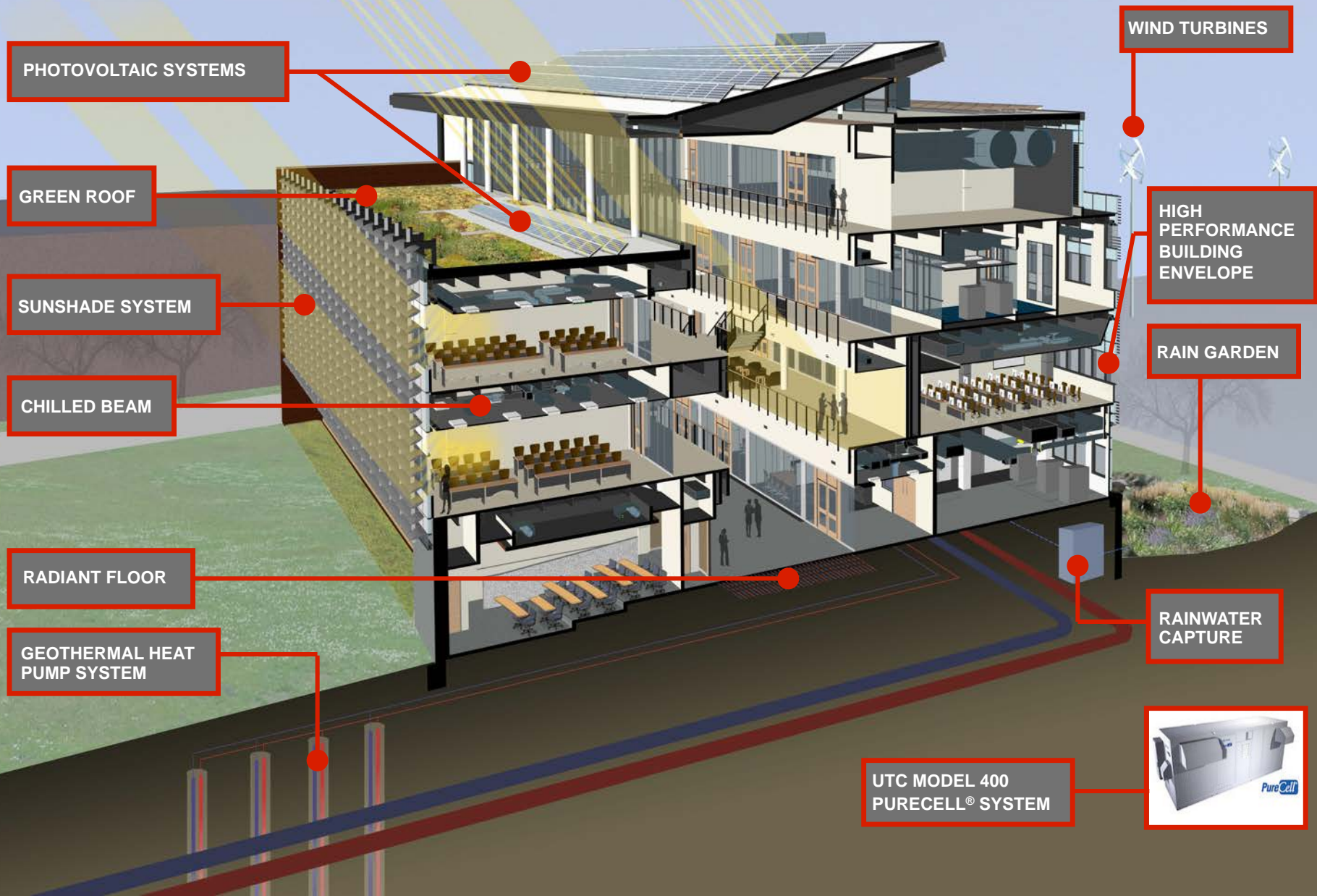
Smart Grid: Enhanced Performance, Efficiency, Reliability & Security

Advancing Grid Reliability and Efficiency through Information Technology

200+ homeowners, commercial and municipal customers and distributed generation tested smart technologies that automatically respond to price and frequency signals



BUILDING SYSTEMS



Thank You



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