Energy Sustainability and Smart Grids

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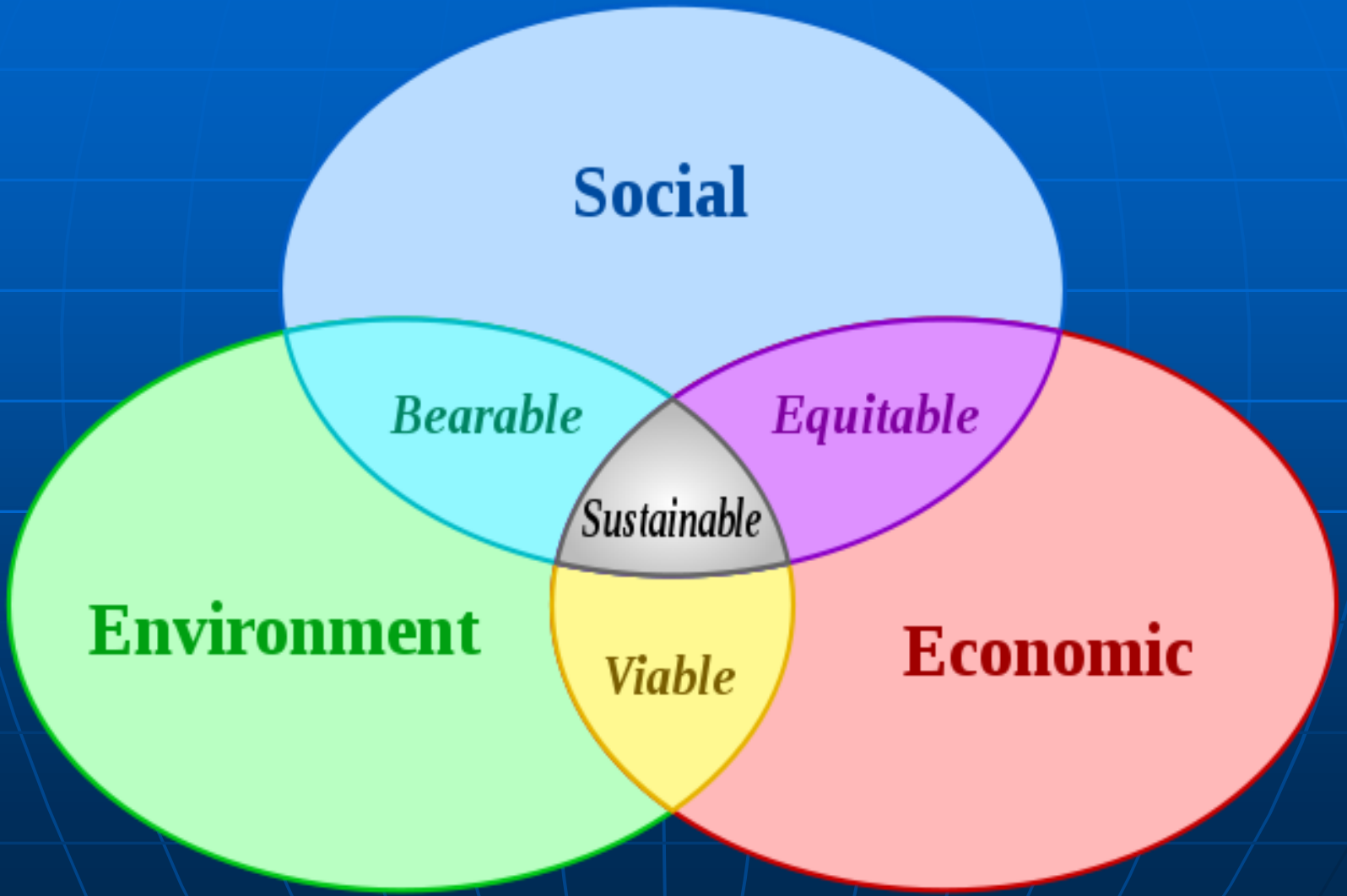
Motivation

- Sustainability
- Sustainable energy use
- Smart grids

SUSTAINABILITY

Sustainability



Multidisciplinary

International, open access journal

Importance

Vision

Engineering for a prosperous, safe and ***sustainable*** Canada

ENERGY SUSTAINABILITY

Energy Sustainability

Provision of energy services in a sustainable manner

- Sufficient for necessities
- Affordable
- Environmentally benign
- Acceptable

Energy Sustainability Requirements

1. Sustainable energy sources

Energy Sustainability Requirements

1. Sustainable energy sources
2. Appropriate energy carriers

Secondary Energy Carriers

- Work
- Electricity
- Thermal energy (heat/cold)
- Fossil fuels
- Secondary chemical fuels
  - Oil products (e.g., gasoline, diesel fuel, naptha)
  - Synthetic gaseous fuels (e.g., from coal gasification)
  - Coal products (e.g., coke)
  - Methanol
  - Ammonia
  - Hydrogen

Energy Sustainability Requirements

1. Sustainable energy sources
2. Appropriate energy carriers
3. Increased efficiency


Device efficiency
Matching supply and end use
System efficiency
Efficiency
Integration
Energy management
Design of systems using energy for efficiency

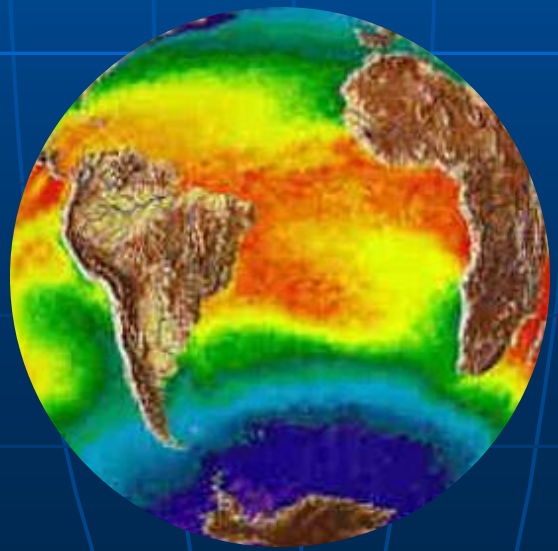
Exergy Analysis

- Energy quality
- Non-conserved
- Meaningful
  - Efficiencies
  - Losses
  - Improvement potential

Energy Sustainability Requirements

1. Sustainable energy sources
2. Appropriate energy carriers
3. Increased efficiency
4. Reduced environmental impact

LCA



CCS

Energy Sustainability Requirements

1. Sustainable energy sources
2. Appropriate energy carriers
3. Increased efficiency
4. Reduced environmental impact
5. Satisfy other facets of sustainability

Globalization

Policies

Urbanization

Ethics

Culture

Attitudes

Other Facets

Health

Laws

Lifestyle

Education

Living standards

SMART GRIDS AND ENERGY SUSTAINABILITY

Smart Grids and Sustainability I

Smart grids coordinate needs & capabilities of

- generators
- grid operator
- end users
- electricity market stakeholders

to operate all parts of the system

- maximizing efficiency
- minimising costs
- minimising environmental impacts
- maximising system reliability, resilience, stability

Smart Grids and Sustainability II

Smart grids are important for

- addressing current concerns with existing electricity systems, e.g., aging infrastructure
- addressing increasing peak demands
- enabling clean and/or low-carbon technologies, e.g., renewables, electric cars

Smart Grids and Sustainability III

Smart grids can help deployment of new electricity infrastructure in

- developing countries and emerging economies
- rural areas
- sparsely populated areas
- small “remote” systems not connected to centralized electricity infrastructure

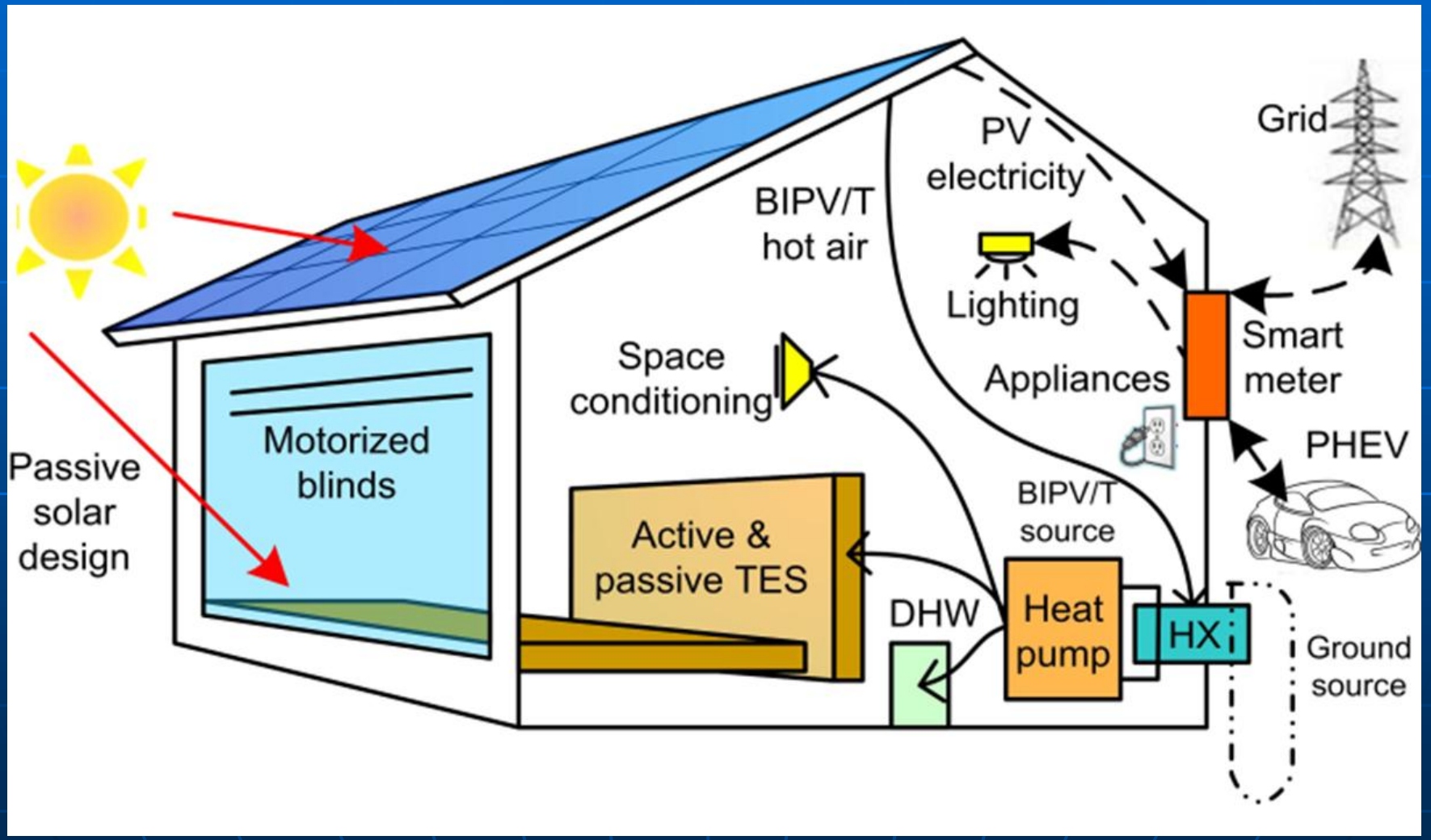
Sustainable Energy

"Smart Grid is the key to sustainable energy future"

International Energy Agency
Smart Grids Technology Roadmap
2011

EXAMPLES

Net-zero Energy Buildings



NSERC Smart Net-zero Energy Buildings Strategic Research Network

1. Integrated solar and HVAC systems for buildings
2. Active building envelope systems and passive solar technologies
3. Mid- to long-term thermal storage for buildings and communities
4. Smart building operating strategies
5. Technology transfer, design tools, and input to national policy

Sustainable Cities

Closing

Sustainability: Essential

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Energy sustainability: A critical quest

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Smart grids: Key part