

EMERGING ALTERNATIVE TECHNOLOGIES AND ELECTRICAL SAFETY CODES AND STANDARDS



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**Alternative Energy Technologies and
Electrical Safety Standards Symposium**

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EMERGING ALTERNATIVE TECHNOLOGIES AND ELECTRICAL SAFETY CODES AND STANDARDS

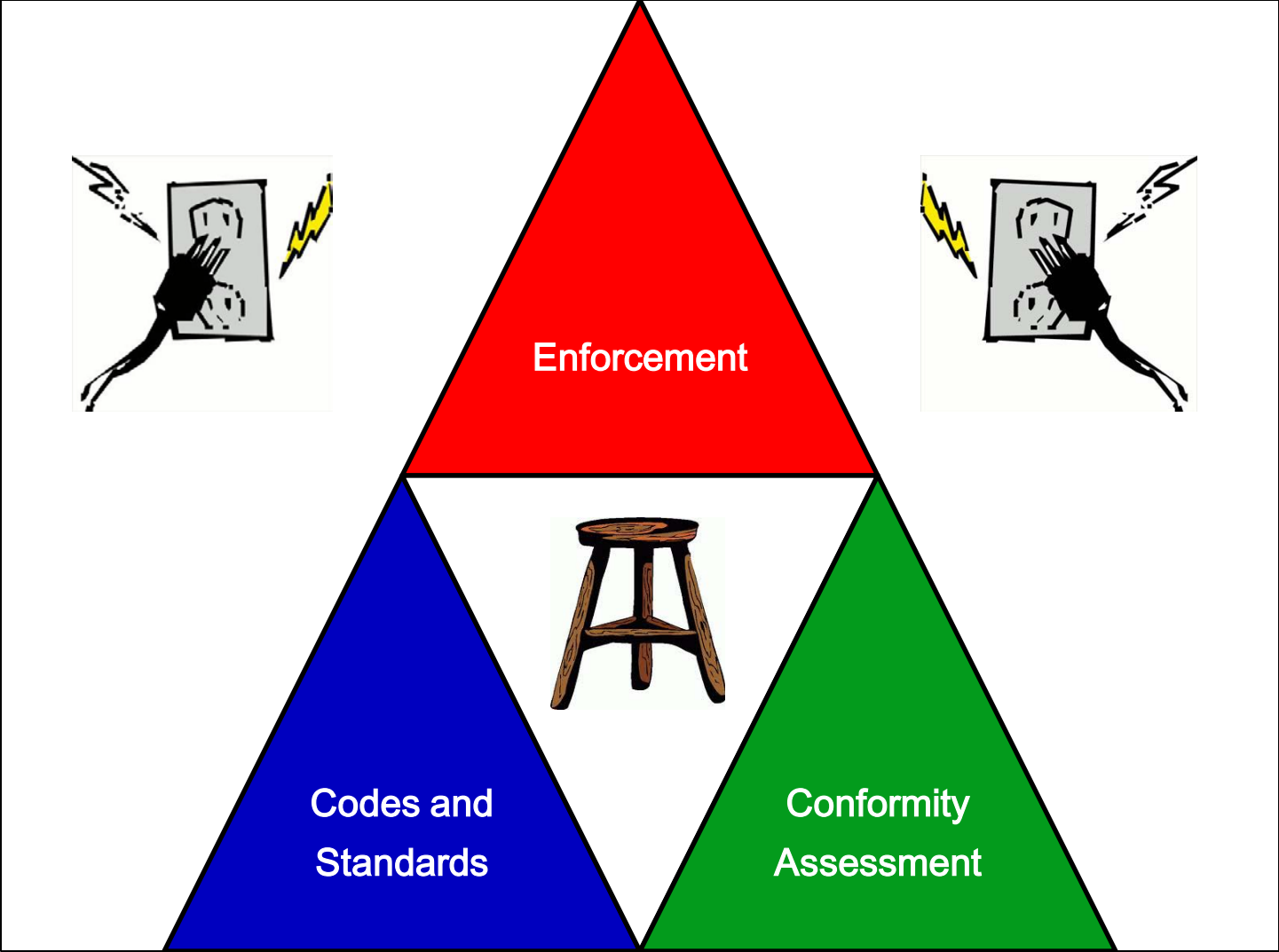
PRESENTATION TOPICS

1) The Safety Infrastructure

2) Today's Challenges

3) Tomorrow's Horizon

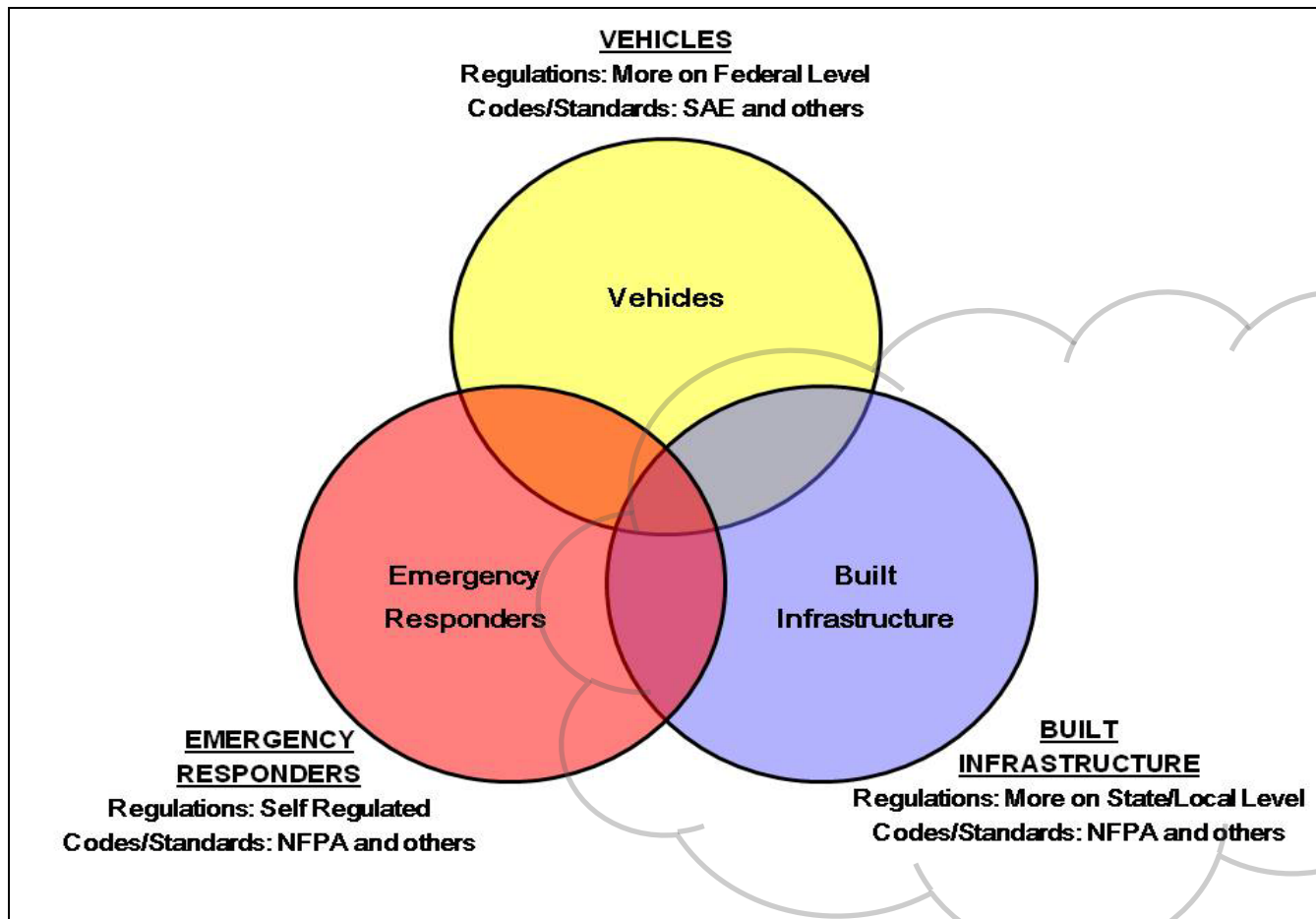
OVERVIEW OF THE SAFETY INFRASTRUCTURE



Electrical Safety Infrastructure Overview

OVERVIEW OF THE SAFETY INFRASTRUCTURE

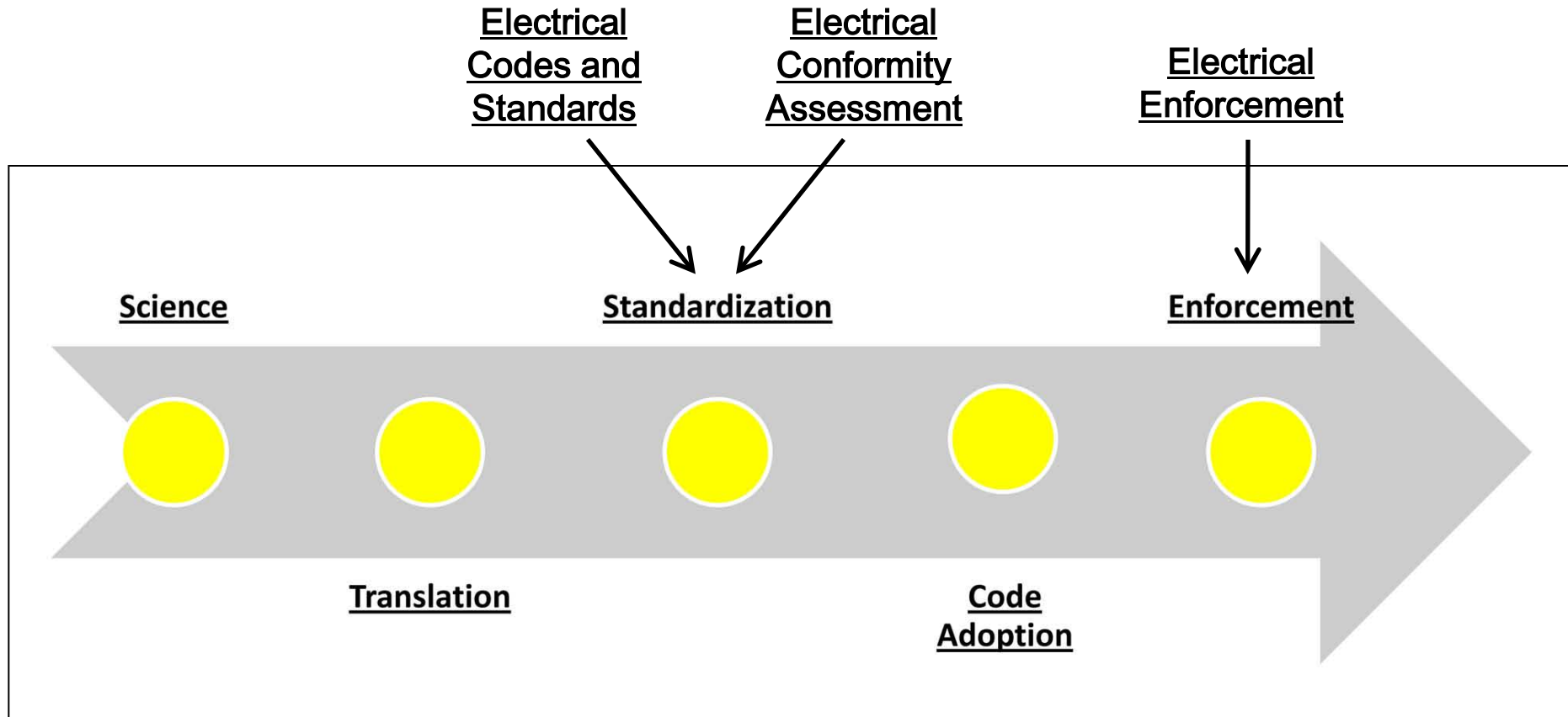
The safety infrastructure is topic dependent... for example...



**Basic Realms of Focus on Electric Vehicle
Related Codes and Standards (from 2010 EV Summit)**

OVERVIEW OF THE SAFETY INFRASTRUCTURE

For societal issues, how do we go from science to practice?



Safety Infrastructure Spectrum
(from science to full implementation)

SAFETY INFRASTRUCTURE: CODES & STANDARDS

What is a standard? What is a code?

- **ISO (International Organization for Standardization)**
 - “Document, established by consensus and approved by a recognized body, that provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context”
- **ANSI (American National Standards Institute)**
 - Refer to all standardizing documents as “standards”
 - Generally defined via “ANS” (American National Standard) designation



SAFETY INFRASTRUCTURE: CODES & STANDARDS

What is a standard? What is a code?

- **Standardization Essentials (Brenner & Spivak)**
 - A uniform set of measures, agreements, conditions, or specifications between parties.
 - Parties may be buyer-seller, manufacturer- user, government-industry, government-governed, and so on...
 - Commerce & trade are built on foundation of rational standards.
- **SES (Standards Engineering Society)**
 - Standards are an agreed upon way of doing something.
 - Codes are a collection of standards on the same topic.



SAFETY INFRASTRUCTURE: CODES & STANDARDS

What is a standard? What is a code?

Difference between Codes & Standards

- Standards:
 - Address specific technical issues.
 - Tend to be more common, and have fewer pages.
- Codes:
 - Have significant impact on society.
 - Address broad topics, & reference standards on details.
 - Are less common, and are very comprehensive.

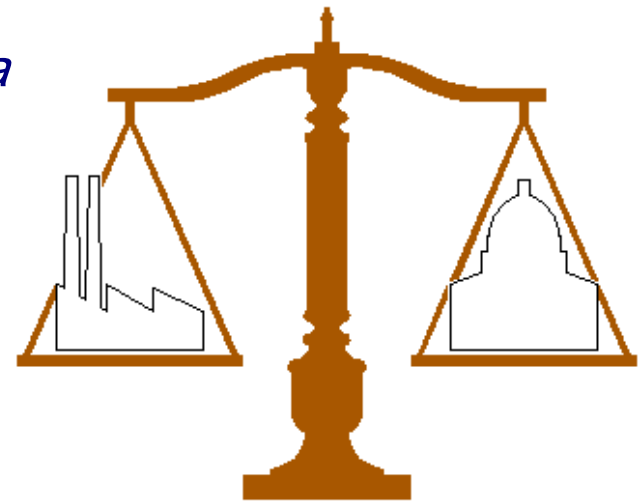


SAFETY INFRASTRUCTURE: CODES & STANDARDS

What is a standard? What is a code?

What is a “Model Code?”

- **Example Dictionary Definitions:**
 - Code: A systematic collection of regulations and rules of procedure and conduct.
 - Model: An example for imitation or comparison.
- **Practical Definition:**
 - *Reflection of the will of society on a particular technical subject.*
 - *Balances the risk that society is willing to tolerate versus available resources.*

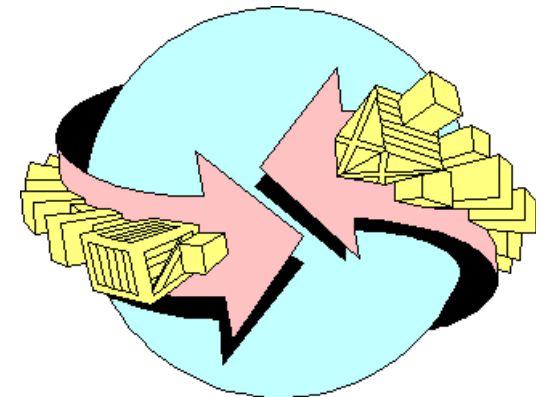


SAFETY INFRASTRUCTURE: CODES & STANDARDS

What is a standard? What is a code?

Types of Standards

- **Product oriented documents**
 - Focus on marketplace coordination
 - Example: standard on connector thread size
- **Safety oriented documents**
 - Focus on establishing minimum acceptable levels, for topics such as public safety, health, and protection of the environment.
 - Example: electrical code
- **Combination documents**
 - addressing products and safety
 - Example: electrical equipment test standard



SAFETY INFRASTRUCTURE: CODES & STANDARDS

The big picture and electrical codes and standards...

		Total # of		Total # of	
Developer / Organization		Standards	Percent	Organizations	Percent
Private Sector	Codes & Standards developing organizations	17,000	18%	40	6%
	Trade association	16,000	17%	130	19%
	Scientific and professional societies	14,000	15%	300	43%
	Developers of informal standards	3,000	3%	150	21%
	Private Total	49,000	53%	620	89%
Federal Govt	Department of Defense	34,000	37%	4	1%
	General Services Administration	2,000	2%	1	1%
	Other	8,000	8%	75	10%
	Federal Government Total	44,000	47%	80	11%
Overall Total		93,000	100%	700	100%

Codes and Standards Documents and Developing Organizations in the United States

SAFETY INFRASTRUCTURE: CONFORMITY ASSESSMENT

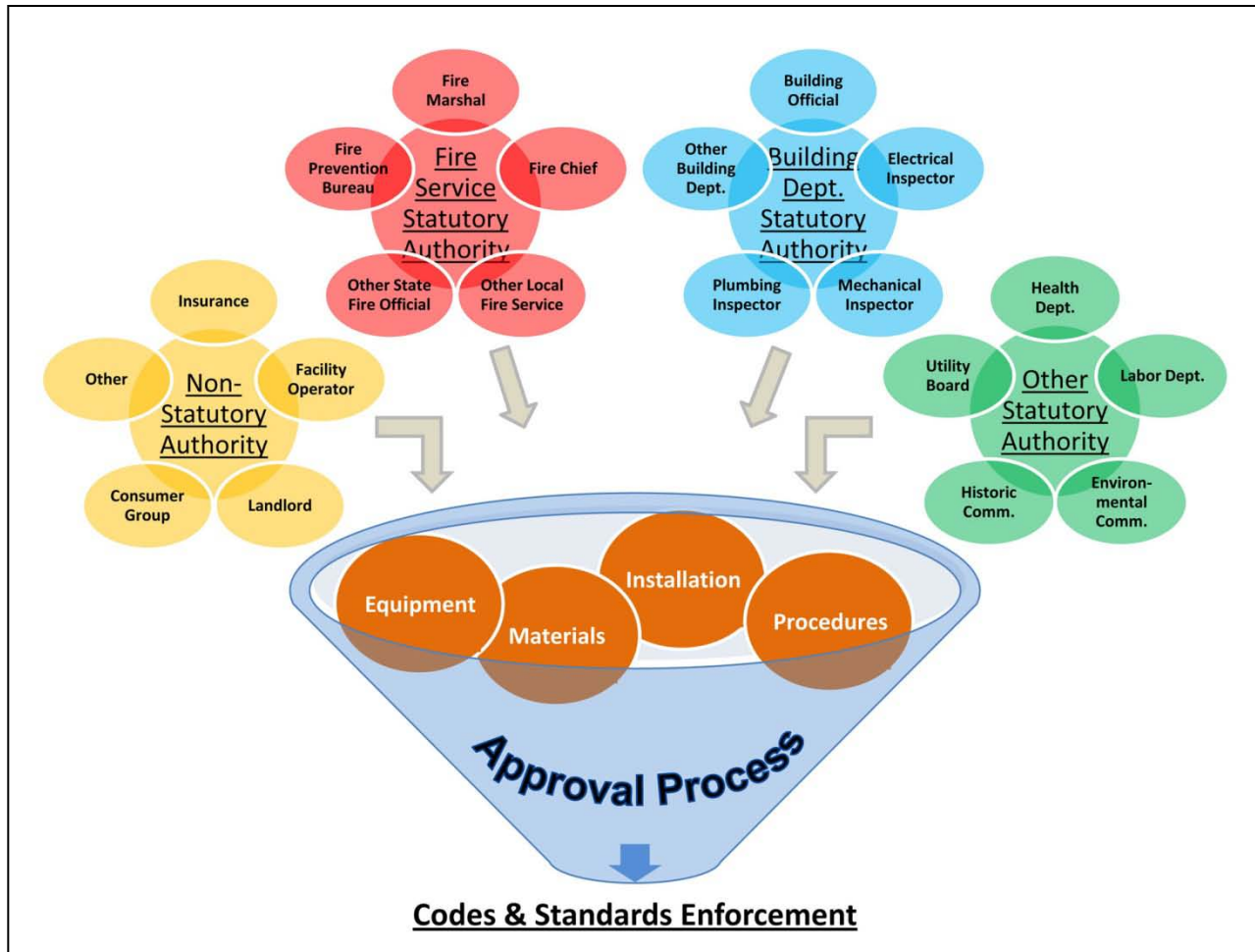
Providing the basis for electrical conformity assessment...

Canadian Standards Association (CSA) (also known as CSA International)
Communication Certification Laboratory, Inc. (CCL)
Curtis-Straus LLC (CSL)
FM Approvals LLC (FM) (formerly Factory Mutual Research Corporation)
Intertek Testing Services NA, Inc. (ITSNA) (formerly ETL)
MET Laboratories, Inc. (MET)
NSF International (NSF)
National Technical Systems, Inc. (NTS)
SGS U.S. Testing Company, Inc. (SGSUS) (formerly UST-CA)
Southwest Research Institute (SWRI)
TUV America, Inc. (TUVAM)
TUV Product Services GmbH (TUVPSG)
TUV Rheinland of North America, Inc. (TUV)
Underwriters Laboratories Inc. (UL)
Wyle Laboratories, Inc. (WL)

**Organizations Recognized as Nationally
Recognized Testing Laboratories (NRTLs) by U.S. OSHA**

SAFETY INFRASTRUCTURE: ENFORCEMENT

Authorities Having Jurisdiction (AHJs)



Overview of Individuals, Organizations
and Groups that Function as AHJs

SAFETY INFRASTRUCTURE: ENFORCEMENT

What ultimately determines which code or standard applies?

Property Owner

- Federal
- State
- Sovereign Nations
- Port Authorities
- Other

Geographical Location

- Special Districts
- State, County, City, Town, Village
- Other

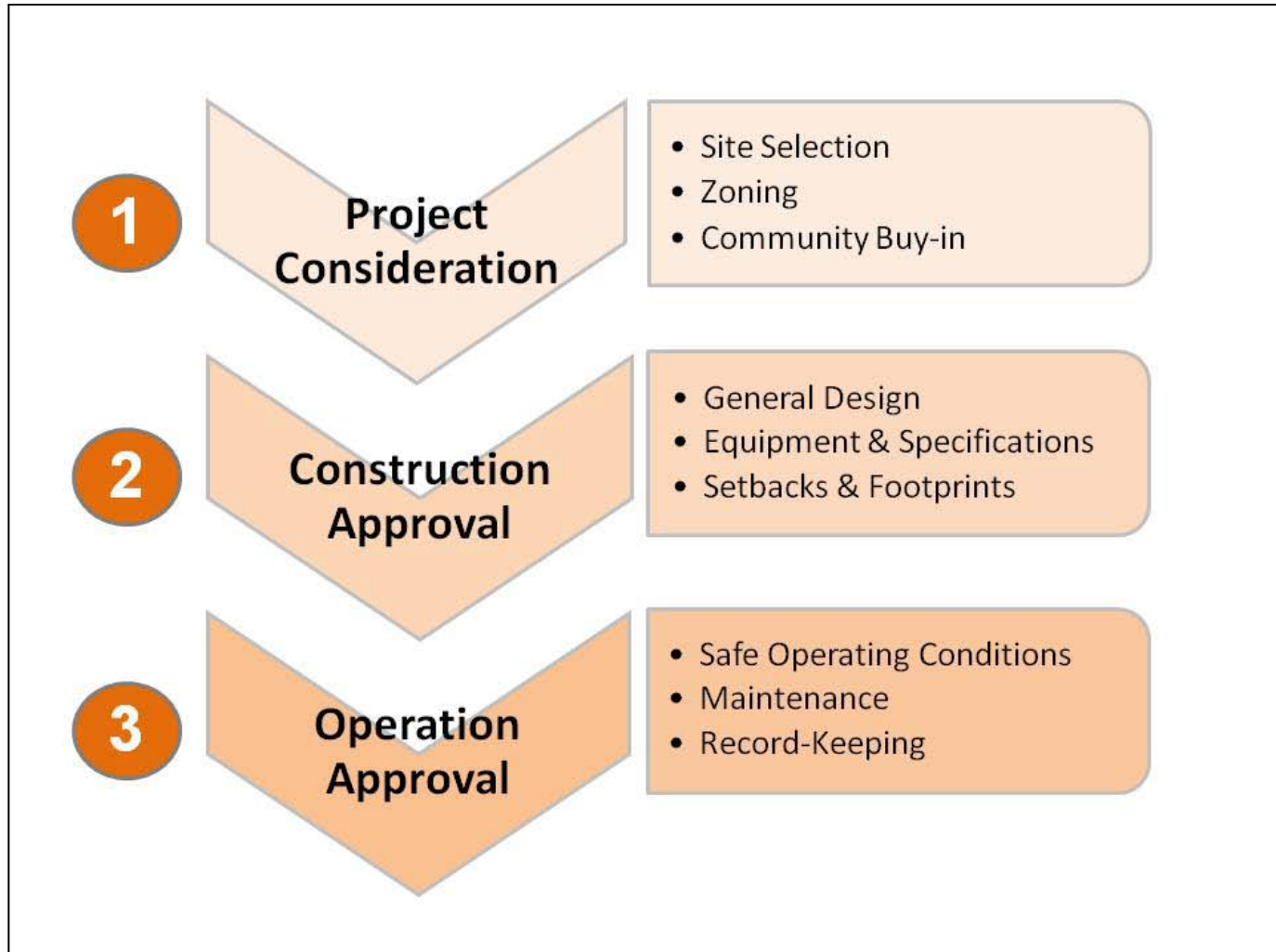
Type of Occupancy

- Mercantile or Industrial
- Residential
- Other

Influencing Factors in Determining Jurisdictional Authority

SAFETY INFRASTRUCTURE: ENFORCEMENT

The big picture perspective on permitting...



Fundamental Steps of the Permitting Process

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TODAY'S CHALLENGES: ALTERNATIVE ENERGY

Defining "Alternative Energy" ...

- Energy derived from sources that do not use up natural resources or harm the environment.

(Princeton's WordNet)

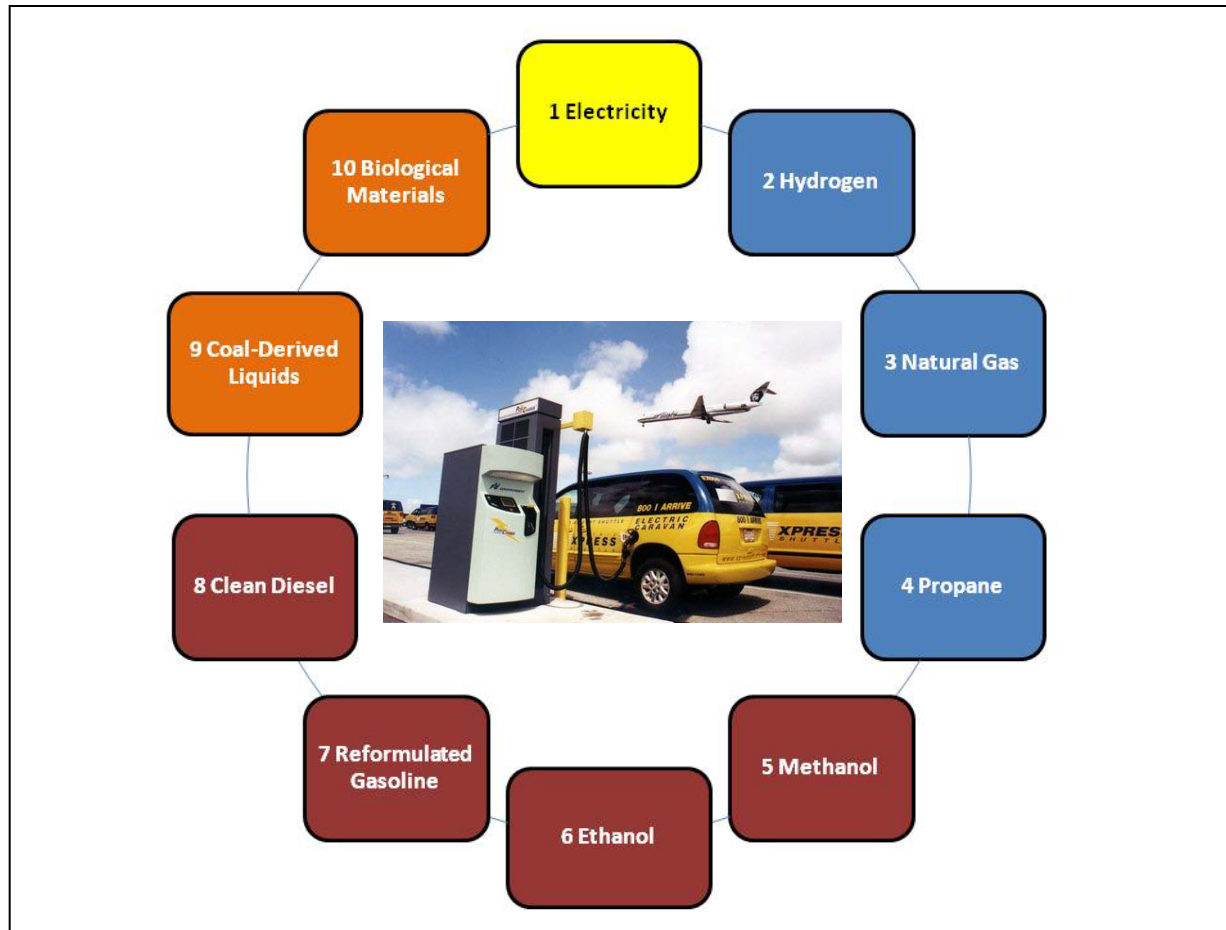
- Energy sources that have no undesired consequences (such as fossil fuels or nuclear energy), are renewable, and considered to be "free" energy sources. *(www.altenergy.org)*

- Have lower comparable carbon emissions than conventional energy sources.
- Generally considered to include:
Biomass, Wind, Solar, Geothermal, and Hydroelectric.



TODAY'S CHALLENGES: ALTERNATIVE ENERGY

Defining "Alternative Energy" ...



Types of Alternative Fuels Used in Motor Vehicles

(based on U.S. Environmental Protection Agency classifications from Clean Air Act Amendment of 1990 and Energy Policy Act of 1992)

TODAY'S CHALLENGES: NEC AND ALTERNATIVE ENERGY

How the National Electrical Code has addressed “alternative energy” through the years...

- 1897 Edition (First Edition)

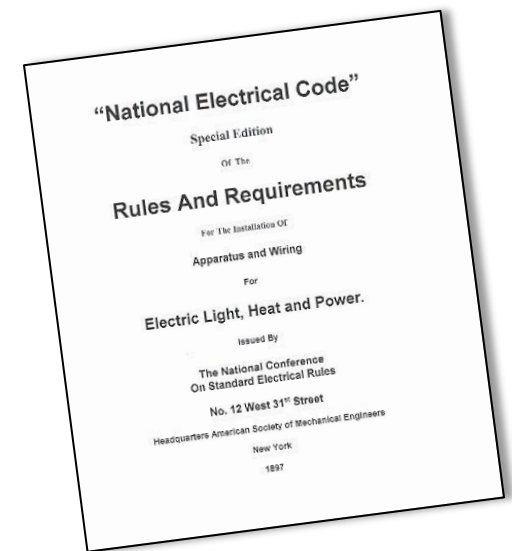
- Article 445 – Generators
- Article 480 – Batteries
- Article 700 – Emergency Systems

- 1971 Edition

- Article 517 – Health Care Facilities

- 1981 Edition

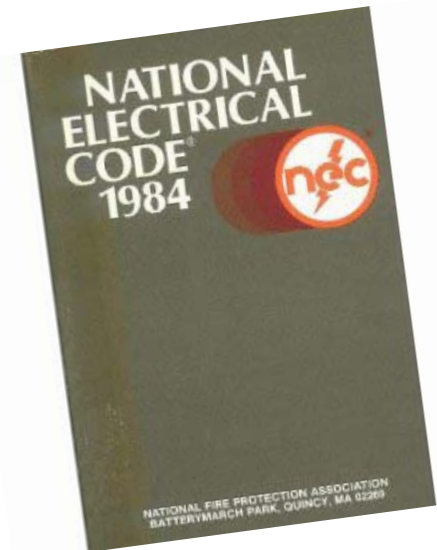
- Article 685 – Interconnected Electrical Systems
- Article 701 – Legally Required Standby Systems
- Article 702 – Optional Standby Systems



TODAY'S CHALLENGES: NEC AND ALTERNATIVE ENERGY

How the National Electrical Code has addressed “alternative energy” through the years...

- 1984 Edition
 - Article 690 – Solar Photovoltaic Systems
- 1987 Edition
 - Article 705 – Interconnected Power Production Sources
- 1993 Edition
 - Article 455 – Phase Converters



TODAY'S CHALLENGES: NEC AND ALTERNATIVE ENERGY

How the National Electrical Code has addressed “alternative energy” through the years...

- 1996 Edition
 - Article 625 – Electric Vehicle Charging Systems
- 2002 Edition
 - Article 692 – Fuel Cell Systems
- 2008 Edition
 - Article 626 – Electrified Truck Parking
 - Article 708 – Critical Operations Power Systems
- 2011 Edition
 - Article 694 – Small Wind Electric Systems



TODAY'S CHALLENGES: NEC AND ALTERNATIVE ENERGY

How the National Electrical Code has addressed “alternative energy” through the years...

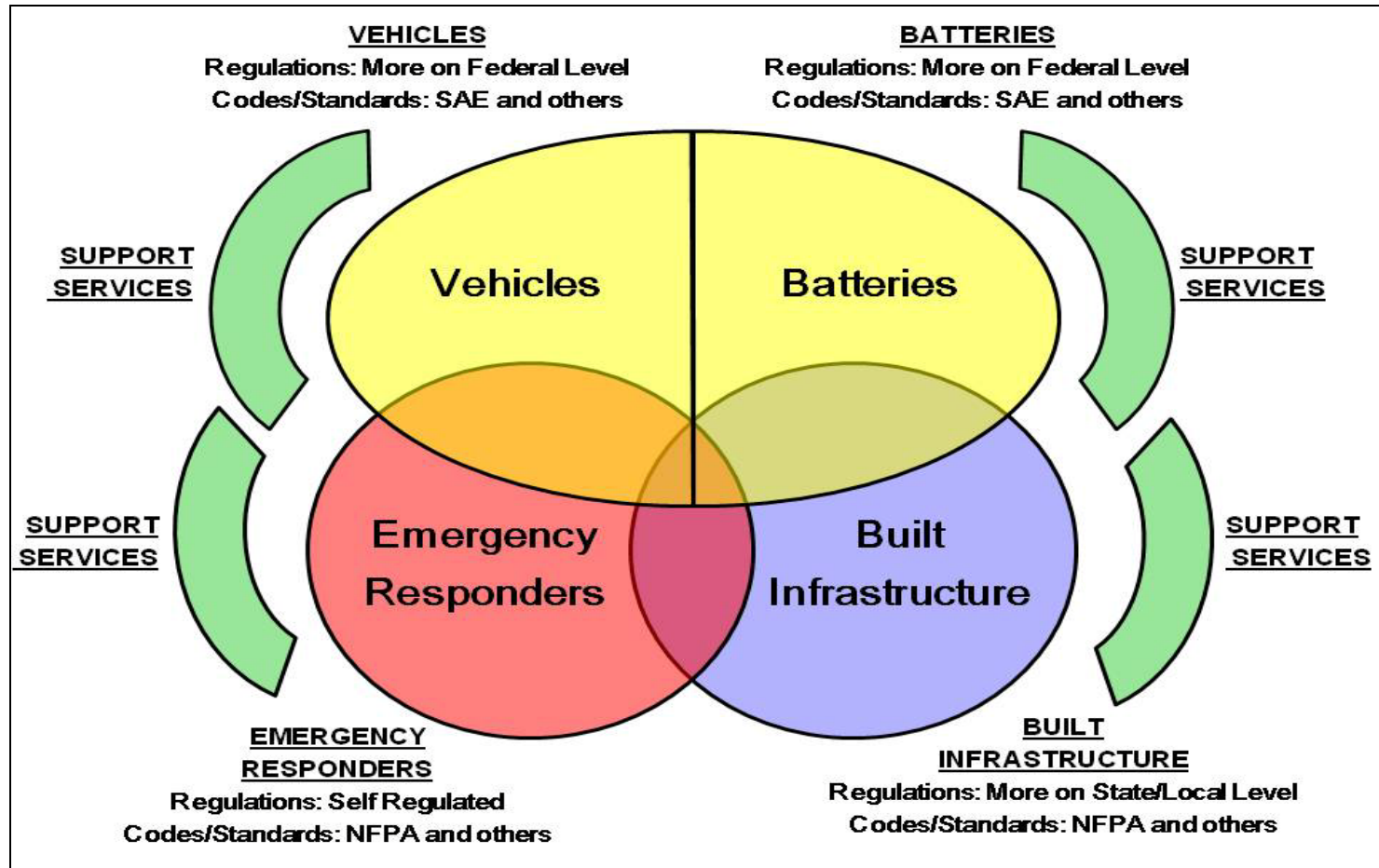
- 2014 Edition Plans

- CMP 4 Task Group on PV Systems
- CMP 12 Task Group on Electric Vehicles
- TCC Task Group on Smart Grid Technology
- TCC Task Group on DC Power



TODAY'S CHALLENGES: STAKEHOLDER DIVERSITY

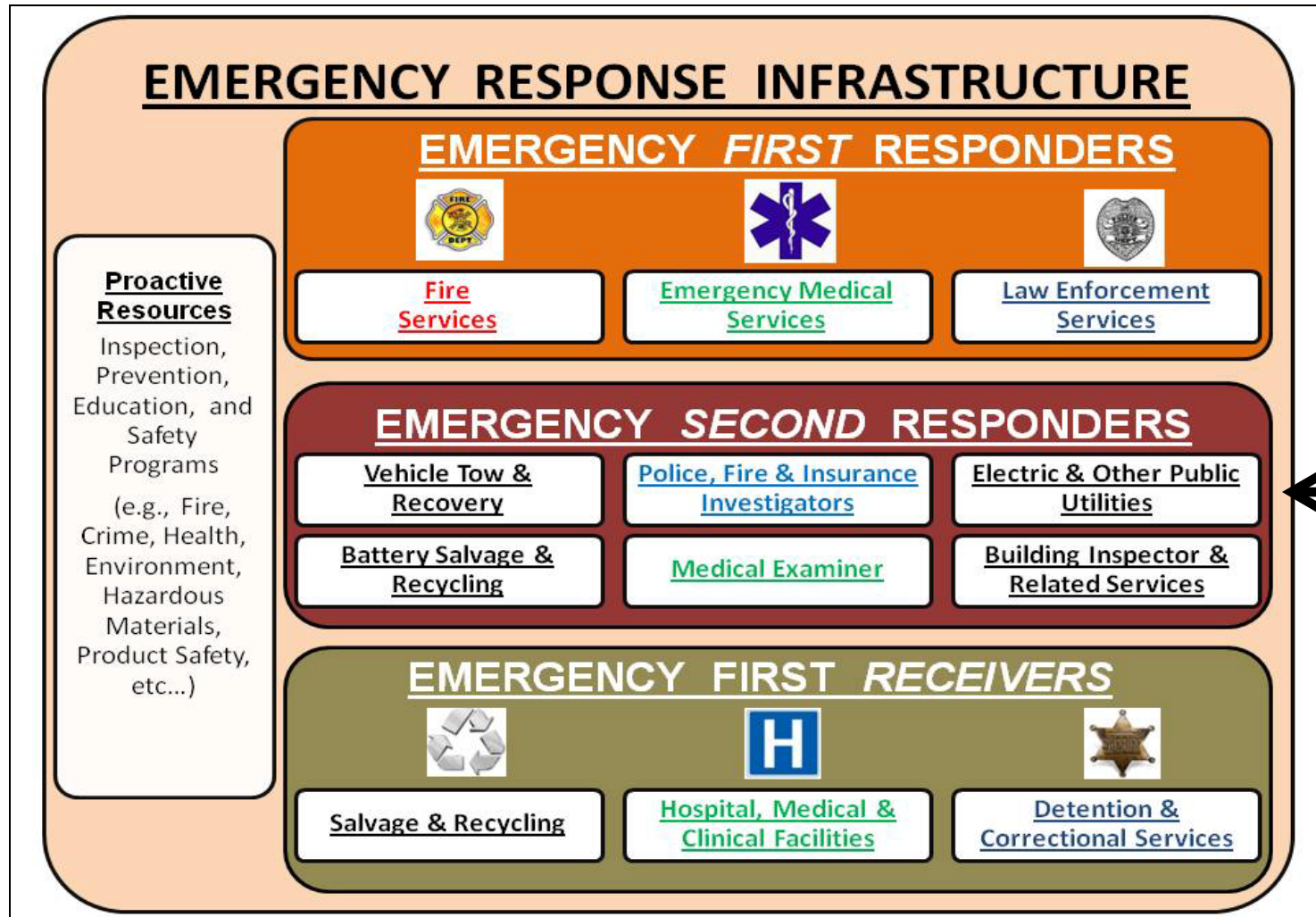
EVs: a complex technical topic involving diverse stakeholders...



Basic Realms of Focus on Electric Vehicle
Related Codes and Standards (from 2011 EV Summit)

TODAY'S CHALLENGES: STAKEHOLDER DIVERSITY

Multiple roles of each stakeholder, such as...



Example of Emergency Responder Infrastructure

TODAY'S CHALLENGES: TECHNICAL REQUIREMENTS

Multiple technical requirements are needed for each application...

Application	Type	Subject	Developer / Document
Stationary Fuel Cell Emergency Power Supply	Design & Installation	Siting and Set-Backs	ICC-IFC & IFGC, NFPA 1, 52, 54 & 853
		Fire Safety Equipment	ANSI FC1, ICC-IFGC & IMC, NFPA 1, 54, 55, 853
		Compressed Hydrogen Gas Storage	ICC-IFC & IMC, NFPA 1, 54, 55 & 853
		Electrical Equipment	ANSI FC1, ICC-IFGC & IMC, NFPA 1, 54, 55, 70, 70E, 853
		Fuel Lines	ANSI FC1, NFPA 55 & 853
		Balance of Plant Components	ANSI FC1, ICC-IFGC & IMC, NFPA 1, 54, 55, 853
	Operation & Maintenance	Vehicle Access	ICC-IFC, NFPA 1 & 55
		Hydrogen Delivery & Unloading	CGA P1, ICC-IFC, NFPA 1 & 55
		Fire Safety & Emergency Planning	NFPA 55 & 853
		Personnel Issues & Training	CGA P1, ICC-IFC, NFPA 1 & 55
		Signage	ANSI FC1, ICC-IFC, NFPA 1, 55 & 853
		Periodic Inspections	ANSI FC1, ICC-IFC & IFGC, NFPA 1 & 54

**Example of Typical Codes and Standards
Required for a Stationary Fuel Cell Power Supply**

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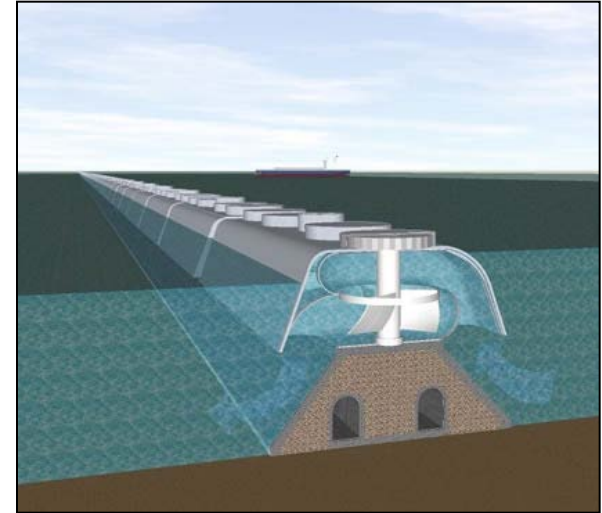
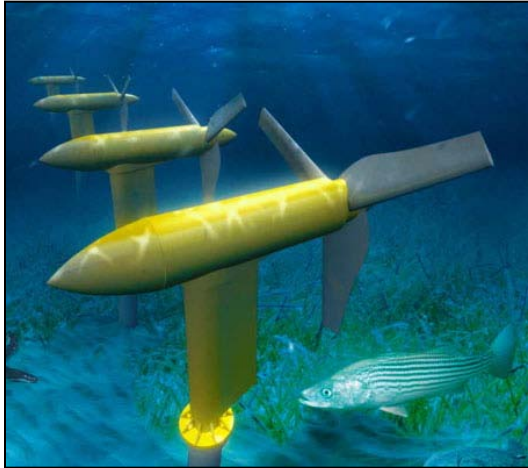
TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Geothermal Power

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Hydroelectric and Tidal Power

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

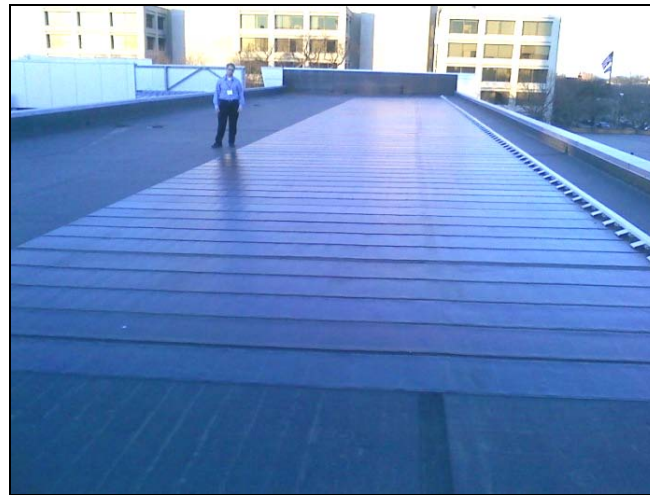
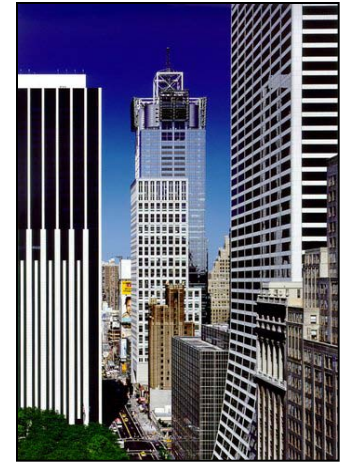
TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Wind Power

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Photovoltaic Applications

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Photovoltaic Applications

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY

The screenshot displays the 'San Francisco Solar Map' website. The header includes the site title, a subtitle 'A MAP OF SOLAR ACTIVITY AROUND THE CITY', and logos for SF Environment and CH2MHILL. The main content area features a map of San Francisco with numerous colored markers representing solar installations. A sidebar on the right contains a legend for 'Markers' (Municipal, Residential, Commercial, Schools/libraries, Non-profits, Monitoring stations, Environmental Justice Program, Case Study, Solar Hot Water) and a section titled 'What Can Solar Do For You?' with an address input field and a 'get my info' button. Below that is 'SF Solar News' with several bullet points and 'SF Solar Facts' with a table of statistics.

Metric	Value
PV systems installed	1622
Total capacity	8.5 MW
Energy produced	11,254 MWh

2012 Goal: 16,000 systems, 100 MW capacity, 100,000 MWh energy produced.

Website for Local Solar Power Systems

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

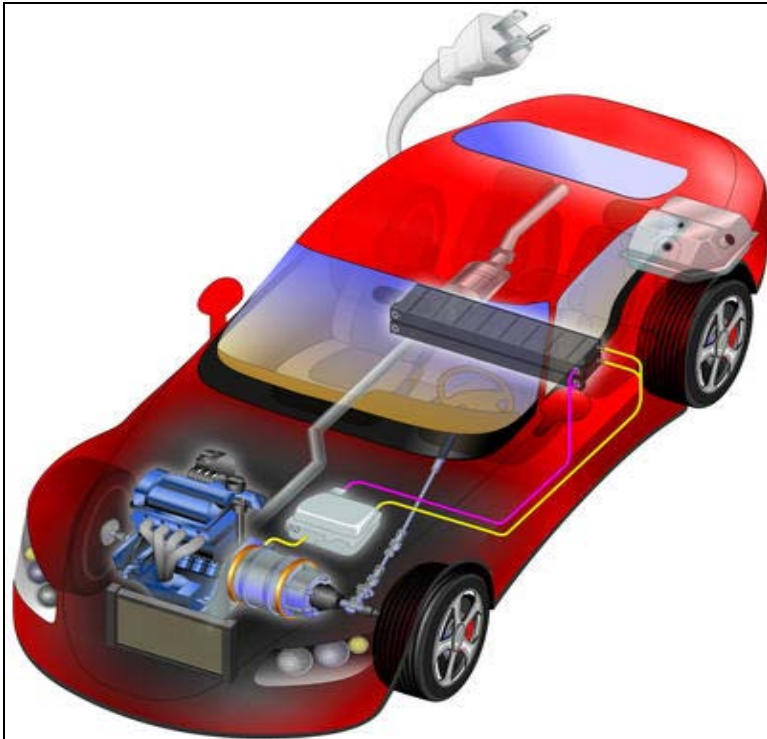
TOMORROW'S HORIZON: ALTERNATIVE ENERGY



EV Fleet Charging Station

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Electric Vehicles and Charging Stations

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



Battery Installation (for a Photovoltaic Solar Power System)
(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: ALTERNATIVE ENERGY



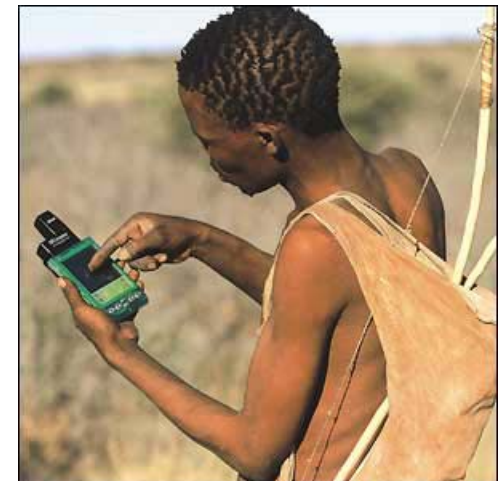
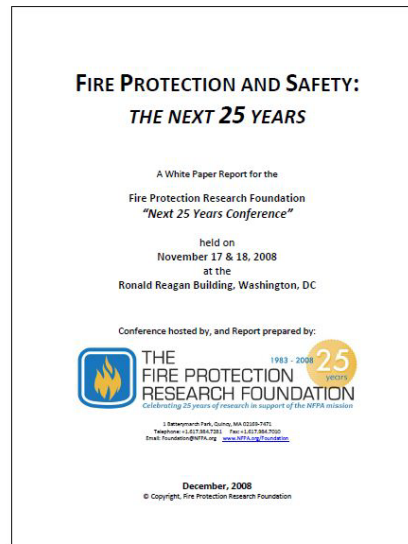
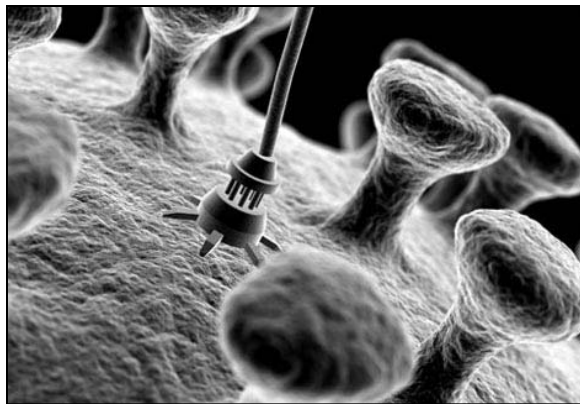
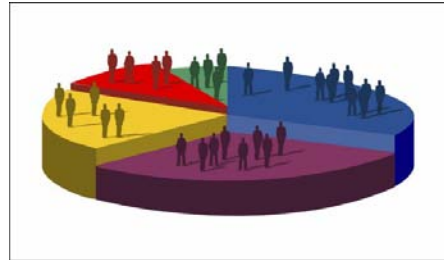
Stationary Fuel Cells for Power Generation

(Issues: Distributed Energy Resources, Power Isolation/Shutdown, Jurisdictional Scope, etc...)

TOMORROW'S HORIZON: WHAT'S NEXT ??

FPRF Report on "The "Next 25 Years", Dec 2008

www.nfpa.org/foundation



Consider: 1) Societal; 2) Technological; 3) Environmental

Contact Information:

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Amanda Kimball, or Eric Peterson*

Fire Protection Research Foundation

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Phone: 617-770-3000 Email: epeterson@nfpa.org

FPRF Website: www.nfpa.org/foundation

