

Electric Energy Workforce **Demographics: An Essay**

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Presentation “Topics!!”

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- The “Big Picture” : Multiple Facets
- Current Status
- Fresh Look
- Future Challenges
- Conclusions

Reflections!!

Populations:

World: 7.01 Billion

China: 1.34 Billion

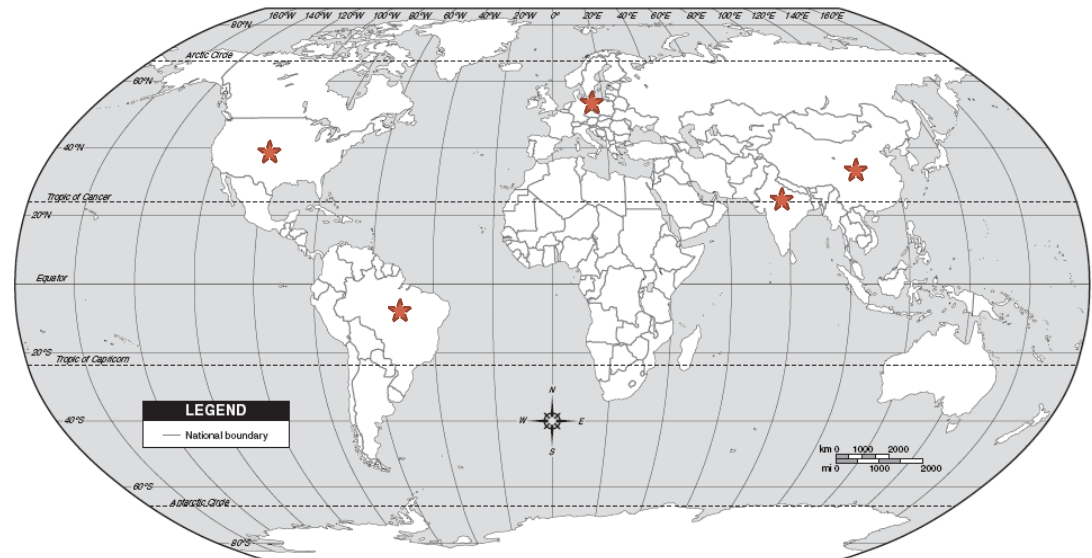
India: 1.17 Billion

USA: 312 Million

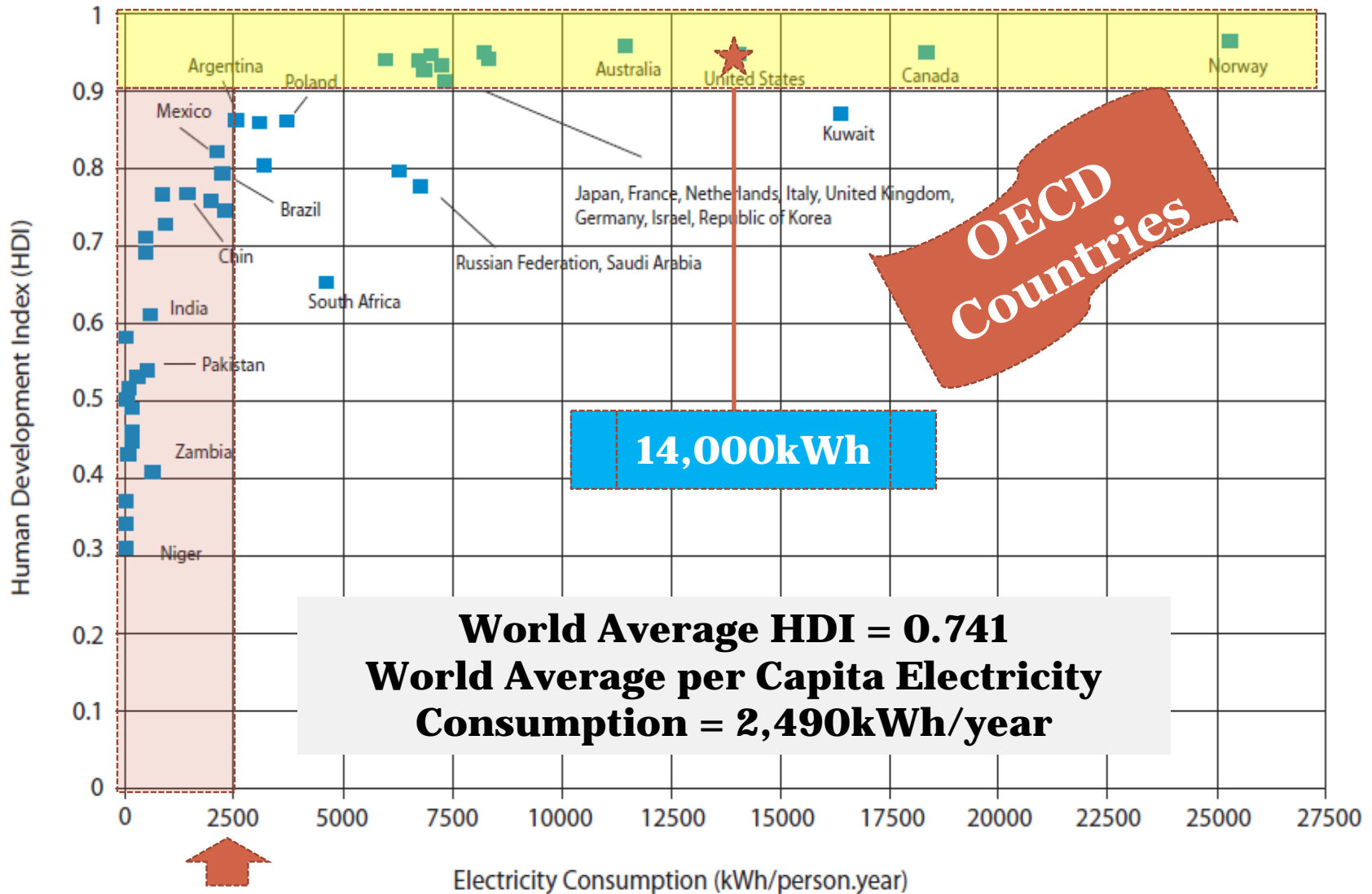
Brazil: 195 Million

Europe (EU-27):
500 Million

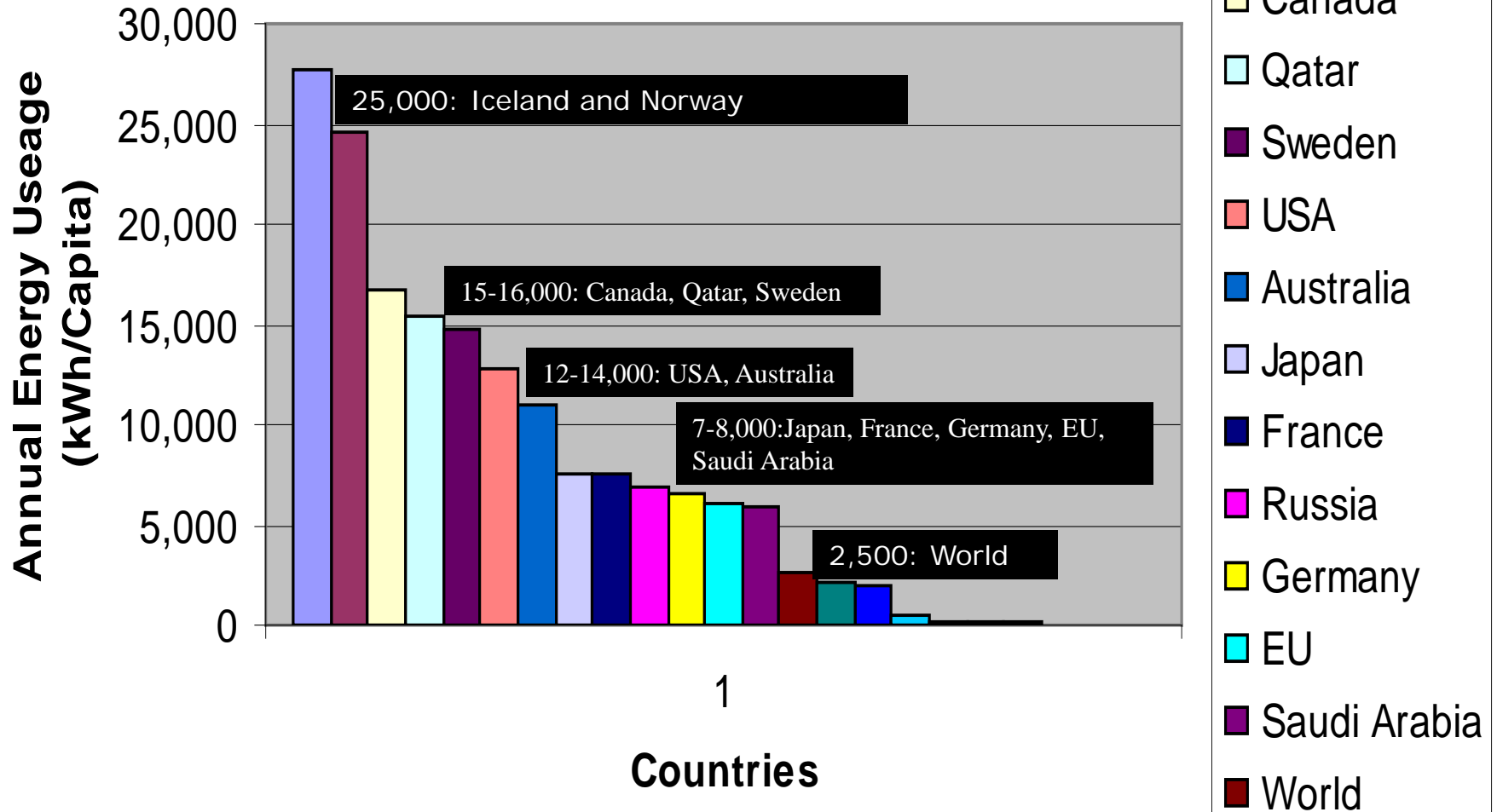
Electricity, World and Human Race



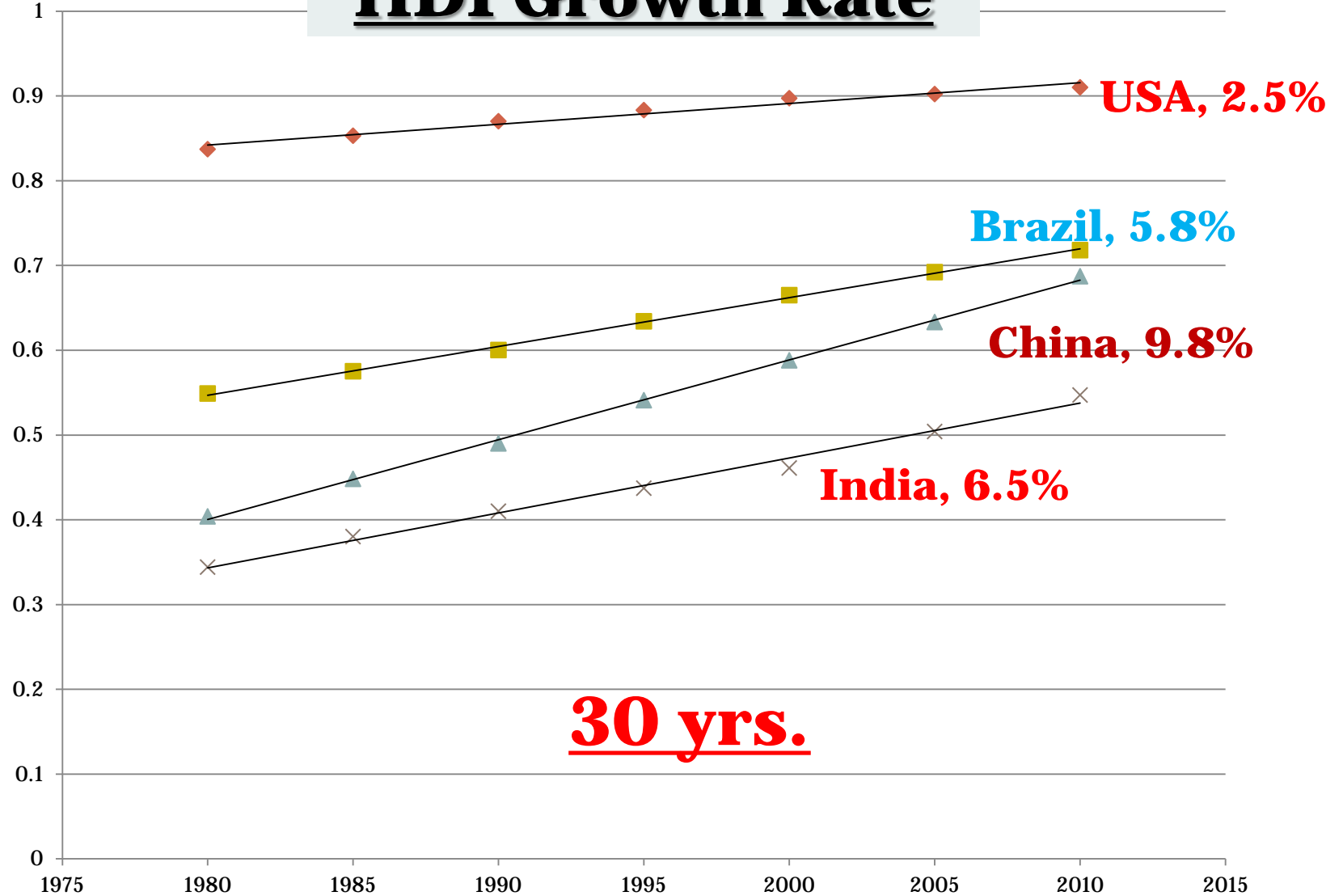
Electricity, Society and HDI



Electricity (Annual) Energy Usage [2007]



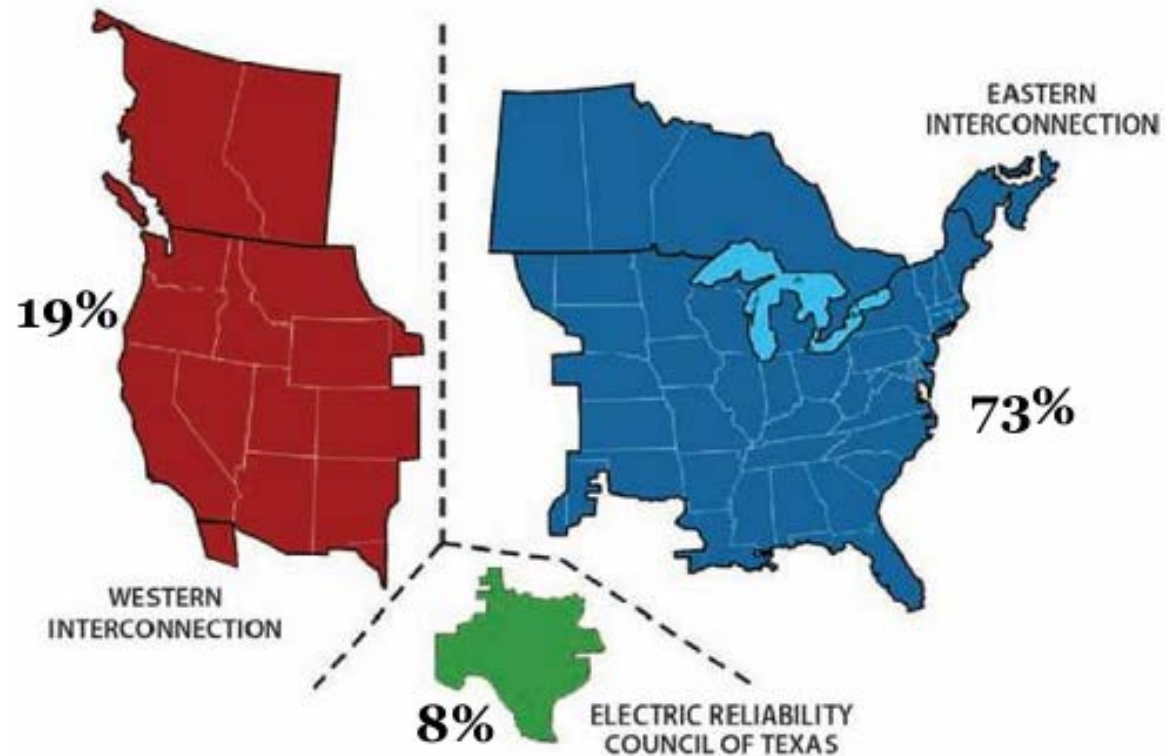
HDI Growth Rate



USA & Canada

**(%) Indicates
the Amount of
Electricity
Consumption**

107 Balancing Authorities

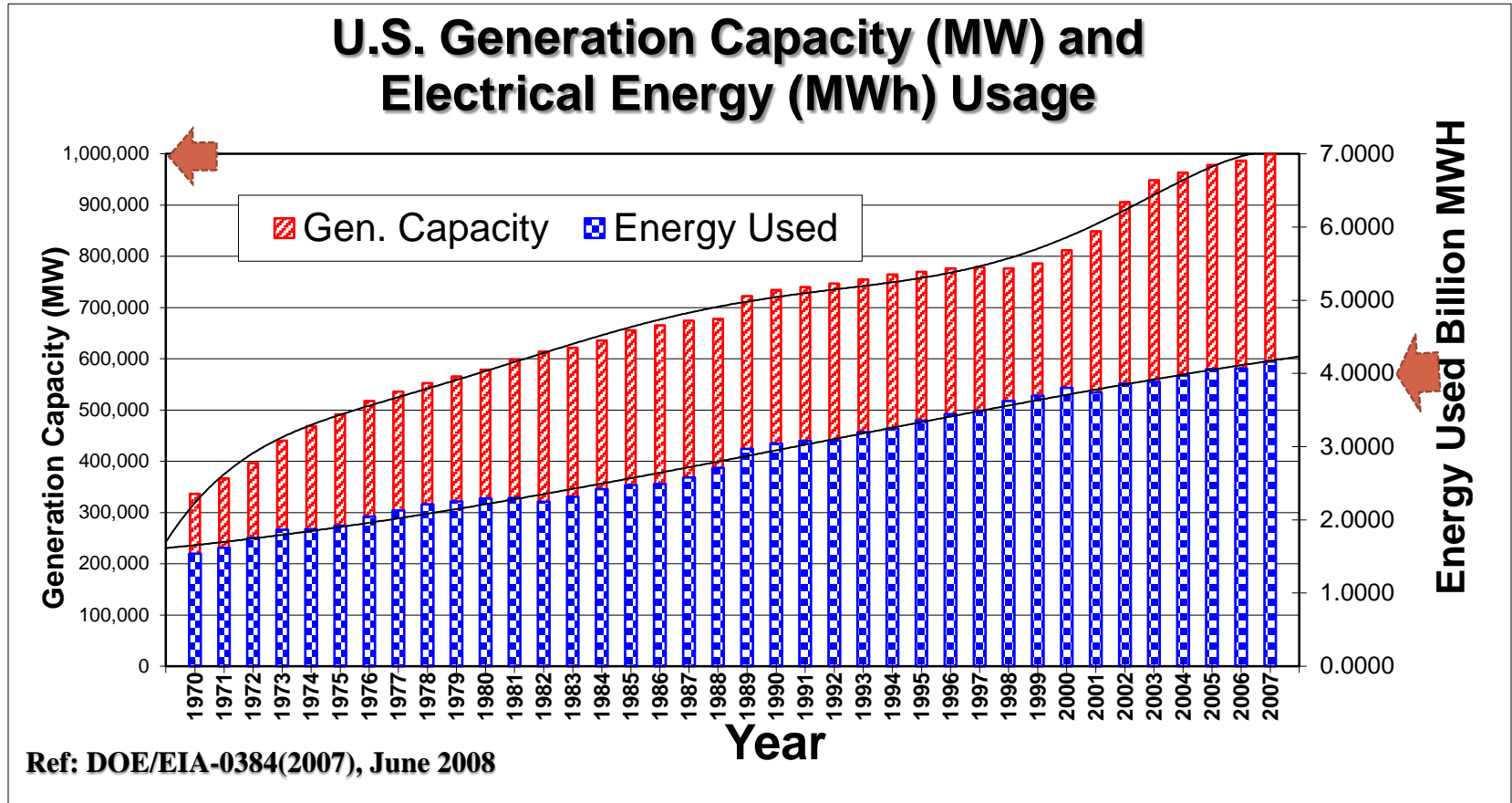


Interconnections of the North American Electric Grid

Source: The Future of the Electric Grid, MIT Study, 2011

Electricity Consumption & Capacity:

8



**[2010] US Energy Use = 3,900TWh, Total Generation Capacity = 1TW
(2008 – 2011) Slightly Negative (0.5%) Growth**

USA

Did You Know?

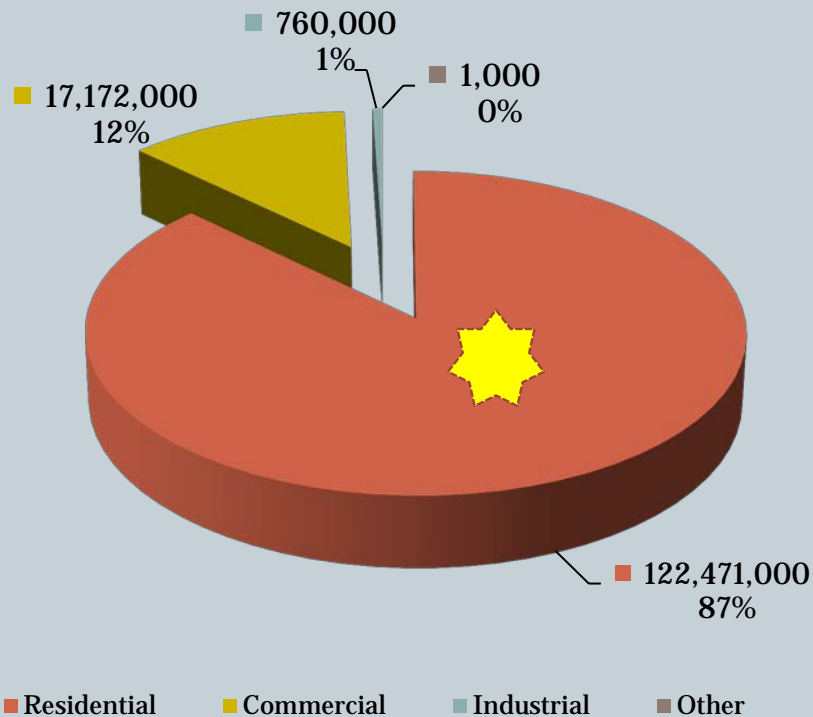
- **Electricity Uses about 40% of Primary Energy (\approx 40 Quads)**
- **Overall Efficiency of Electricity Production \approx 32%**
- **3,200 Electric Utilities in USA (IOUs, Government-Owned, Coop., Municipalities and REAs)**
- **700 Generate Electric Power**
- **143.4million Customers - % of Electricity Users:**
 - **Residential (125million) - 37%,**
 - **Commercial (17.6million) - 36% and**
 - **Industrial (0.8million) - 27%**

Source: The Future of the Electric Grid, MIT Study, 2011

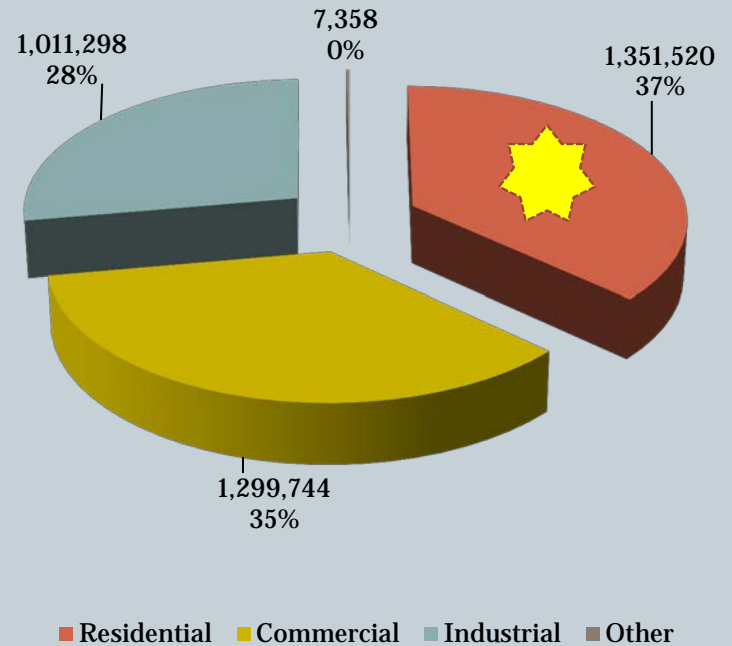
Customers and Energy Consumption

10

Customers

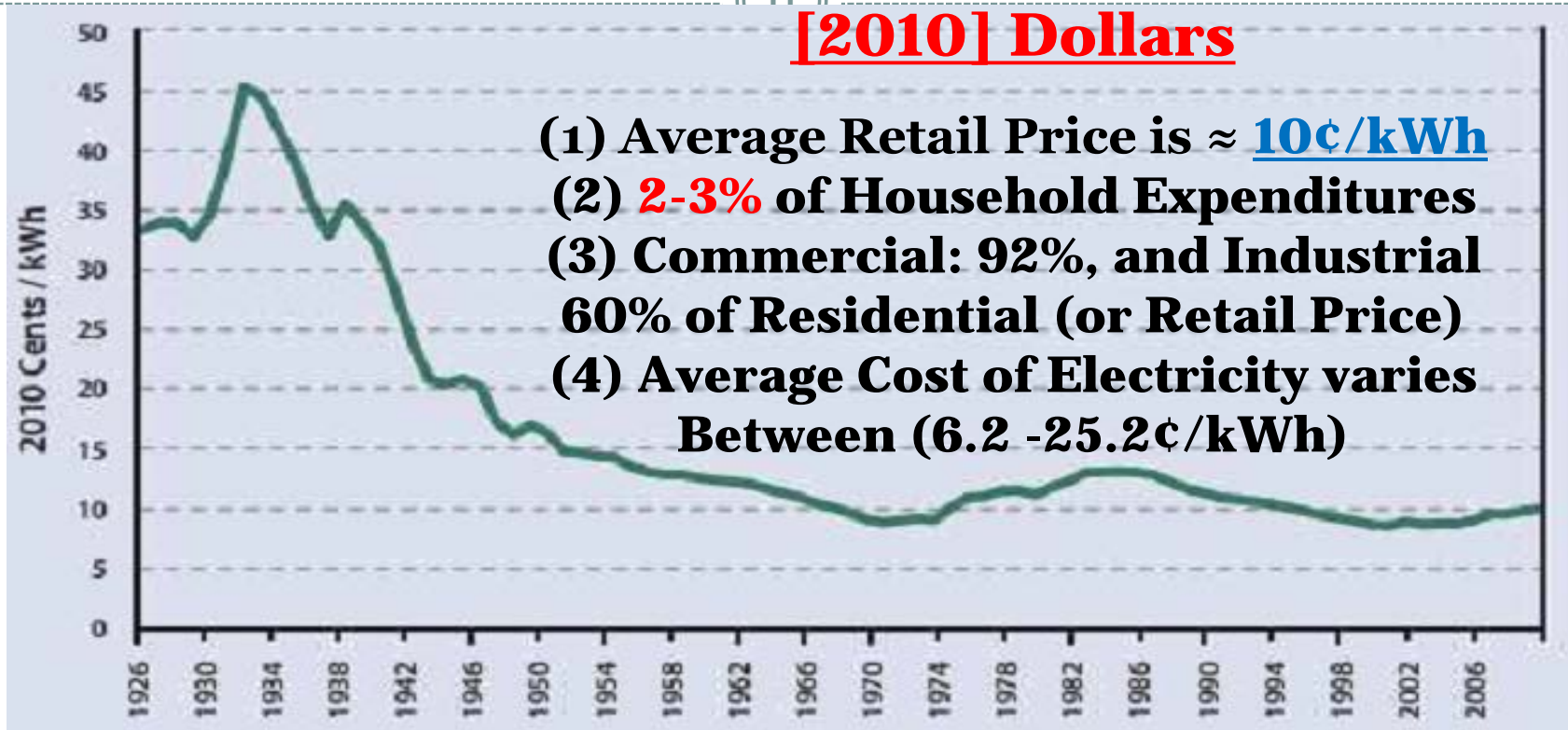


Electricity Sold (GWh)



Cost of Electricity:

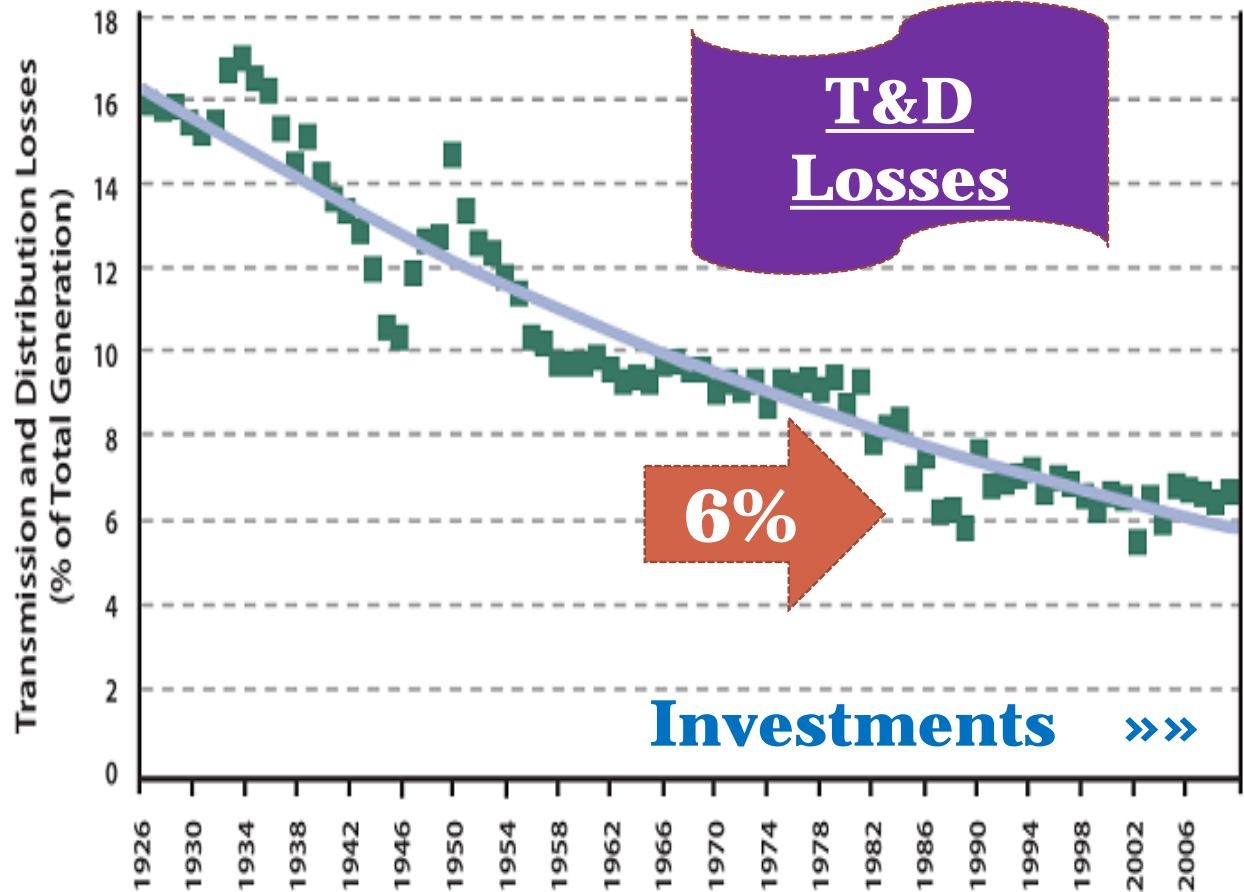
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Source: The Future of the Electric Grid, MIT Study, 2011

USA

Did You Know?

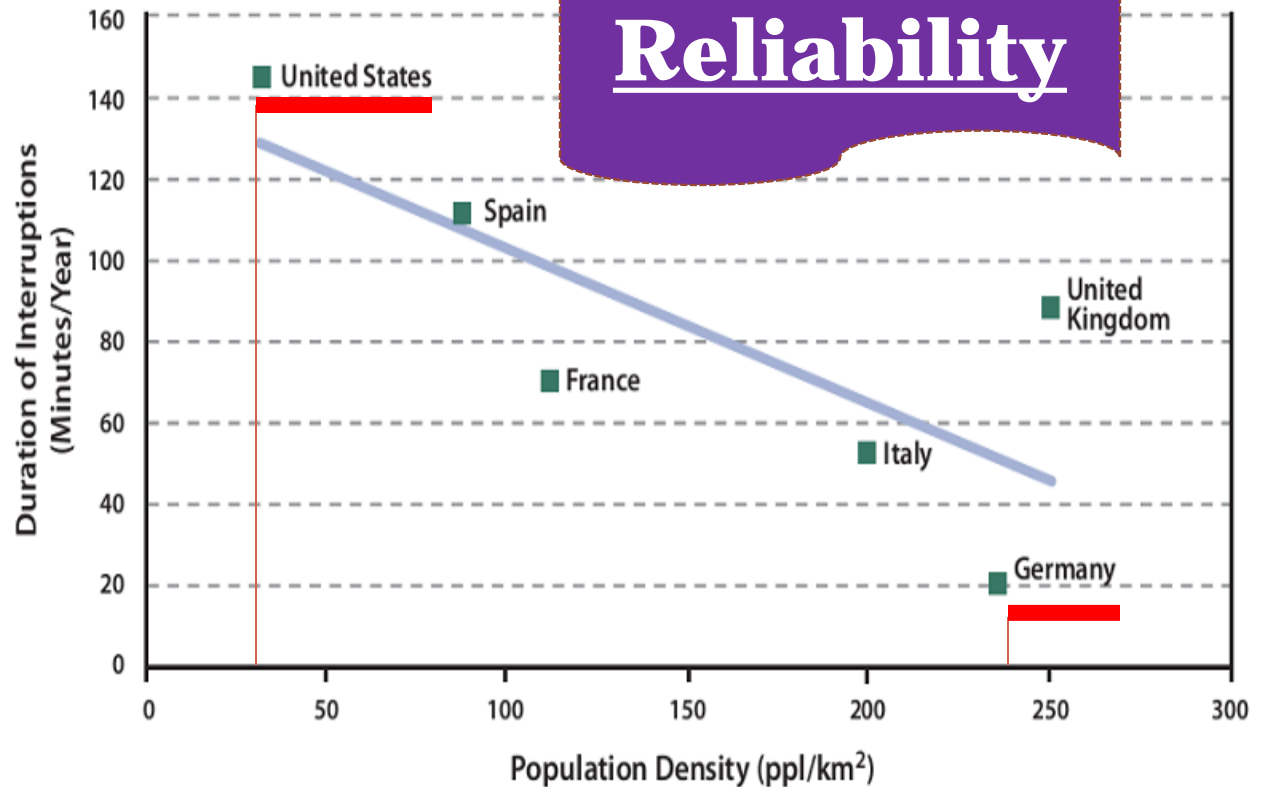


US Transmission and Distribution Losses, 1926-2009

Source: The Future of the Electric Grid, MIT Study, 2011

USA

Did You Know?



Average Duration of Interruptions for Selected Countries [2006]

Source: The Future of the Electric Grid, MIT Study, 2011

USA
G & T
REA's

**Did
You
Know?**

- ❖ **Most Loss Occurs in the Distribution System.**
- ❖ **80% of Interruptions are Due to Problems in the Distribution System.**

USA

G & T

REA's

Did You Know?

- **G & T (Owned by Distribution Co-ops.) Accounts for 5% of Total Utility Generation and **10%** of Utility Sales to Consumers**
- **Co-ops Own 673MW of Renewable Energy Generation and have Purchased Contracts for 2.93GW, for a Combined Total of 3.6GW of Non-Hydro Renewable Capacity.**
- **Roughly 10GW of Preference Power Contracts with Federal Hydroelectric Authority**

USA

G & T

REA's

**Did
You
Know?**

❖ Issues for the Next Few Decades:

- ❖ **Renewable Energy Integration**
- ❖ **Automated Fault Detection, Isolation and Restoration (**Reliability Indices**)**
- ❖ **Advanced Metering Infrastructures (AMI) (**Peak Shaving and Energy Efficiency**)**
- ❖ **Integration of New Communications Infrastructures, Sensor Technologies, and Advanced IT Applications (**Peak Shaving and Energy Efficiency**)**

USA

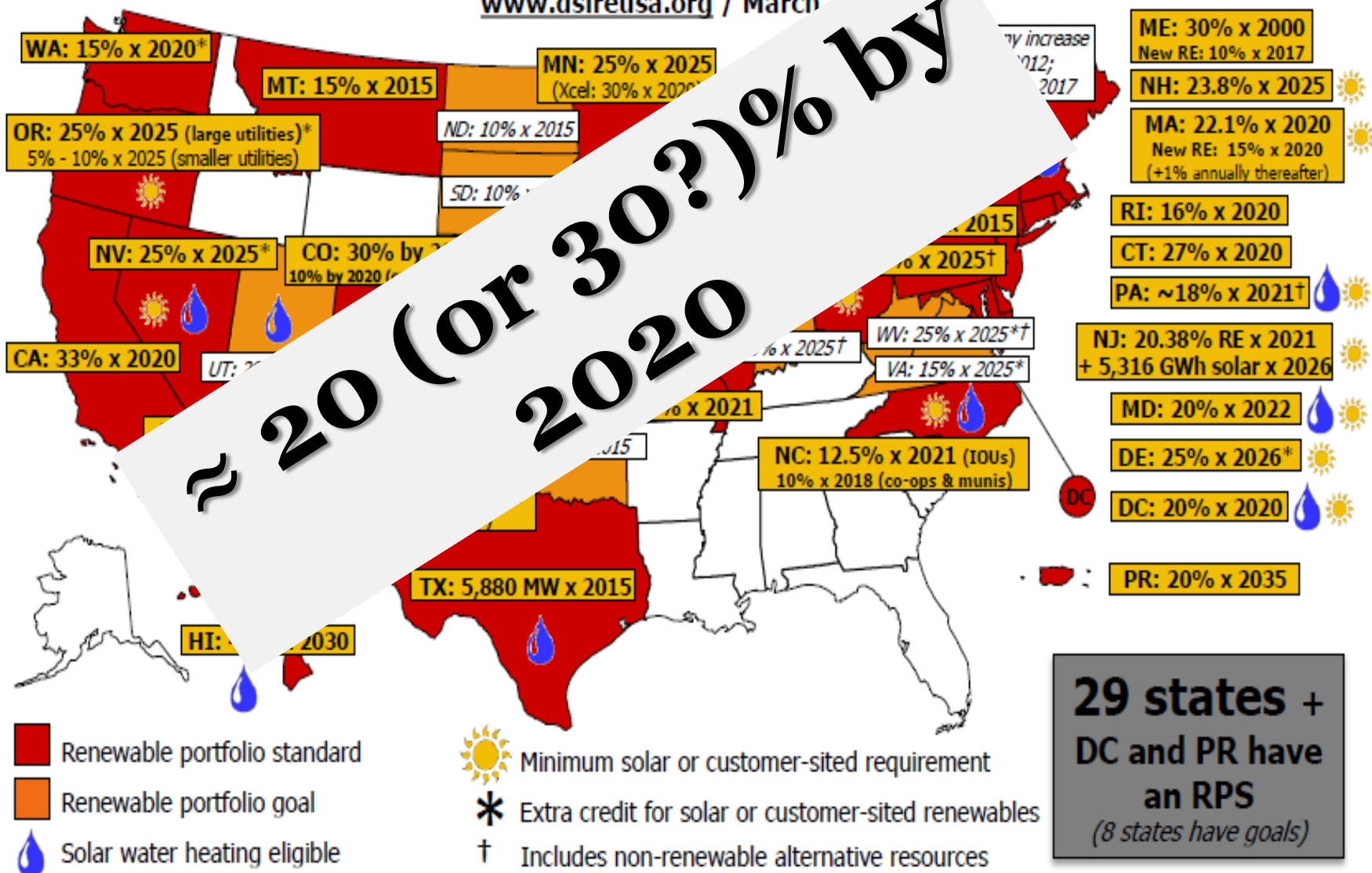
**Paradigm
Shift, New
Era and
Current
Environment**

Recent Acts and Regulations

- **[1978] PURPAct**
- **[1992] EPAct - IPPs**
- **[2005] EPAct**
- **RPS Portfolio**
- **[2007] EISAct**
- **[2009] ARRAAct**
- **[2012] JOB Act**

RPS Policies

www.dsireusa.org / March 2012



USA

**Paradigm
Shift, New
Era and
Current
Environment**

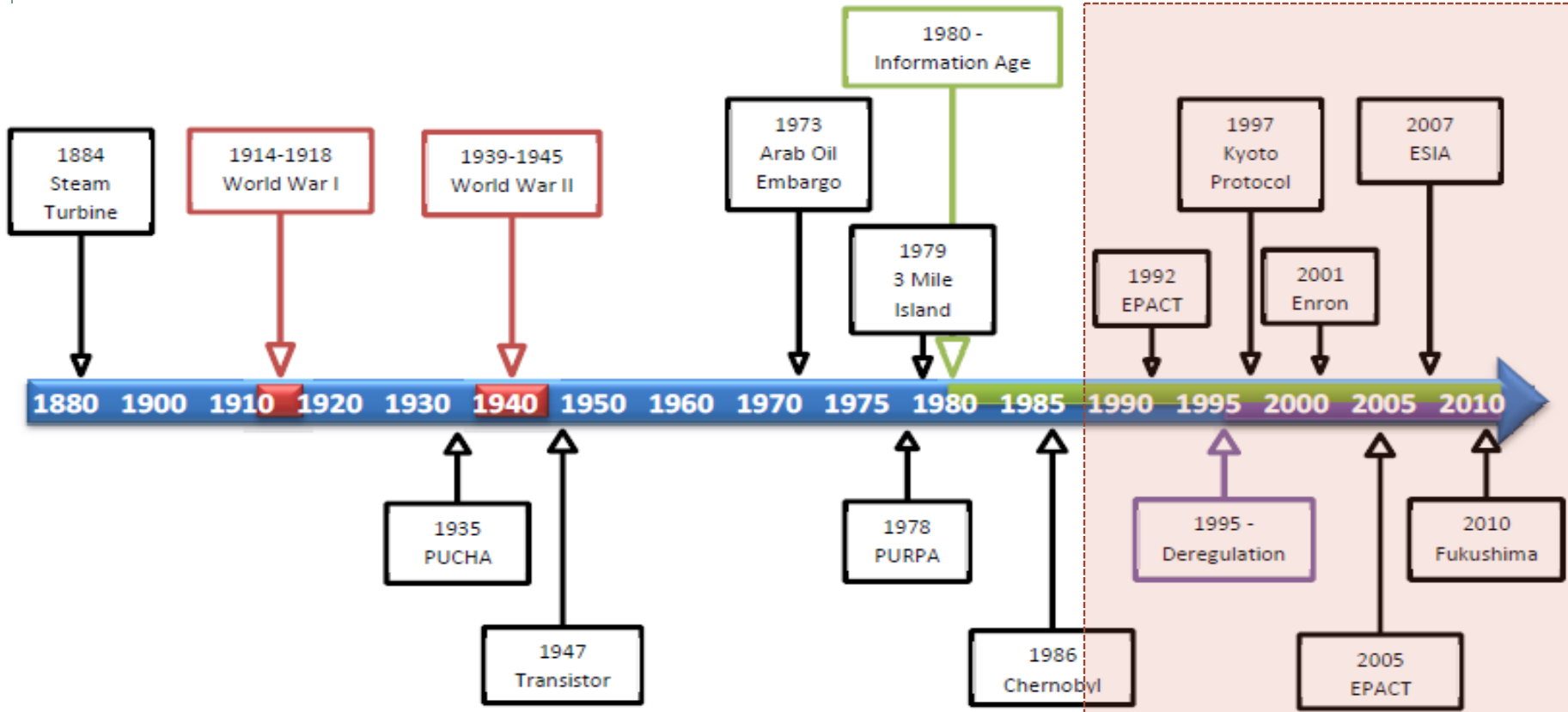
NERC, Restructuring and Deregulation:

- **FERC Orders 888
[1996], 2000 [1999]**
- **FERC Order 1000
[2011]**
- **NERC Compliance**

“PUC”

≈ 200yrs.

≈ 25yrs.



Snapshot: Time Line

Aging Workforce

Skilled!!

Key References

“Gaps in the Energy Workforce Pipeline 2009 CEWD Survey Results,” <http://www.cewd.org/>

W.K. Reder. “The Technical Talent Challenge, And Implications of Our Maturing Workforce,” *IEEE PES Magazine*. pp. 33-39, Jan. 2006.

“NSF Workshop on the Future Power Engineering Workforce,” November 2007.

“Preparing the US Foundation for Future Electric Energy Systems: A Strong Power and Energy Engineering Workforce,” *IEEE PES Society*, April 2009.

“Task Force on America’s Future Energy Jobs,” *National Commission on Energy Policy*.
<http://bipartisanpolicy.org/>

“Worker Shortage Threatens Utility,” *IBEW Journal*. pp. 12, April 2005.
<http://www.ibew.org/articles/>

Next Two Decades:



**Aging
Workforce**

Next Two (2) Decades:

- ❖ **Real Slow Growth**
- ❖ **Expansion of Transmission System**
- ❖ **Adoption of and Compliance with Regulatory Policies**
- ❖ **Technology for Reliability & Energy Efficiency (PMUs, AMI, FACTS)**
- ❖ **Grid Modernization**
- ❖ **Plug-in-Hybrid Vehicles & “RPS”**
- ❖ **Smart[er] Grid Initiatives**
- ❖ **Data Sharing and IT Applications**

Job Market

Aging Workforce

Too Much Need !!

❖ Electricity Producers & Distributors

- Utilities; ISO and RTO
- Government Utilities (BPA, TVA, USBR, WAPA, etc.)
- Coops (Generation and Transmission); REA's
- Municipalities
-



- ❖ **Industry**
- ❖ **Management**
- ❖ **The List Goes On!!**

Next Two Decades:



Aging Workforce



Trained Workforce

**New Knowledge,
Training, Transition,
Long-Term Planning,
Knowledgeable and
Trained Faculty
Members at All Level**

○ Advancements in Sensing,
Communication, Control and Power
Electronics (Smarter Grid)

○ Cyber

○ Inter

**Increased Cost
Degraded Reliability**

New

Workforce Issues and Future Challenges for the Energy, Power and Electricity Industry

CEWD Study:

- **[2015] 40-50% Across Wide Range of Power Industry Technical Job Categories (Line-Workers, Engineers, System Operators and Dispatcher, Electricians and Technicians)**
- **New Skills and Knowledge**
- **Declined Power Engineering Programs at All Level**
- **Lack of R & D Funding**



Aging Workforce and New Unskilled Workforce for the 21st Century

P.K. Sen's
Wild
Estimate

- Number of “Decent” **Power System** and **Power Electronics Engineering (BS) Graduates (Quality!)**

- **10** x 60 = 600 +
- **20** x 15 = 300
- + 600 = 1500

- Estimate of **2yrs. Colleges and AS** = 1500 (!!!)

2yrs. Colleges and AS Degrees

Power / Power Faculty Members:

3 = 70

Professors = 30

Assistant Professors = 50

Instructors/Lecturers (Teaching Faculty) =

50

- **Part-Time** Faculty Members = 60

Current Happening

Workforce Issues and Future Challenges for the Energy, Power and Electricity Industry

- **Within Next Five Years, 40% Power Engineering Faculty Members are Eligible to Retire and 25% are Expected to Retire**
- **DoE: 100M\$ to 52 Workforce Training and Development Efforts**
- **2yrs. Community Colleges (AS Degree)**
- **More Companies Investing in Retraining Existing Workforce, Training Future Workforce**

Potential Replacements 2009–2015

JOB CATEGORY	PERCENTAGE OF POTENTIAL ATTRITION & RETIREMENT	ESTIMATED NUMBER OF REPLACEMENTS
Technicians	50.7	27,800
Non-Nuclear Plant Operators	49.2	12,300
Pipefitters/ Pipelayers	46.1	8,900
Lineworkers	42.1	30,800
Engineers	51.1	16,400

Source: CEWD Study, 2009

Conclusions and Parting Thoughts

- ❖ **Evaluate the Needs of the 21st Century Electric Power and Energy Industry**
- ❖ **Re-evaluate How we Prepare Our Future Engineers and Technical Personnel at All Level**
- ❖ **Be Forward Looking Rather than Following the Trend!!**

Conclusions and Parting Thoughts

- ❖ **Understand the Academic Environment at ALL Level–**
 - ❖ **Basic Course, Training and Curriculum Development and Needs**
 - ❖ **Shortage of “Qualified” Faculty Members, and (Non-Existent) Laboratory Facilities**
 - ❖ **Undergraduate vs. Graduate Programs**
 - ❖ **Long-Distance Learning**
 - ❖ **2-yrs. Community College, 4-yrs. BS in EE and EET Program**

Conclusions and Parting Thoughts

- ❖ **Understand the Academic Environment –**
 - ❖ **Internship, Co-op Education and Part-Time Job Opportunities**
 - ❖ **Training Opportunities for Young Faculty Members with Practically No Industrial Applications Knowledge**
 - ❖ **Active Role, Direct Industry Involvement in Academic Issues – Curriculum Development, Hiring Faculty Members, Alumni Influence!!**
 - ❖ **Future Research and Development Opportunities**

Thanks

**Questions
??
and/or
Comments
!!**

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