Gas Technology Institute (GTI) & Broadband Over Power Lines (BPL) Roundtable

Governor Office Bldg. Ballroom
10:00 to 3:30, August 26, 2005

Gas Technology Institute (GTI)

- Funding of natural gas research and development (R&D) used to be mandated through interstate pipelines charges.
- GTI was a recipient of this funding.
- Charges to support gas R&D are no longer mandated at the federal level.
- What is GTI's focus now, how is it being funded and what should state regulatory agencies be considering related to state funding of natural gas R&D efforts?

Gas Technology Institute (GTI)

10:10 Gas Technology Institute Overview, Objectives & Funding

Ron Edelstein, Director, Regulatory Affairs, GTI

11:00 Missouri Public Service Commission Staff Perspective

Craig Branum, Utility Policy Analyst, PSC Staff

11:30 Natural Gas Utility Perspective

Ted Reinhart, Utilization Engineering & Market Development Manager, Laclede Gas Company

12:00 Open Discussion/Question Period for All Participants

Broad Band Over Power Lines (BPL)

- Business models to bring BPL to utilities and their customers are appearing all over the country.
- Utility element monitoring and high speed communication through BPL are some examples of this technology's potential.
- Do electric utilities want into the retail broadband game and how will regulators treat this technology?

Broad Band Over Power Lines (BPL)

1:30 Overview of BPL & AmerenUE's BPL Pilot

Greg Lovett, Product & Services Managing Supervisor, Ameren Services

2:15 Missouri Public Service Commission Staff Perspective

Laura Wolfe, Utility Policy Analyst, PSC Staff

2:45 The Office of the Public Counsel's Perspective

Ryan Kind, Chief Economist, Office of the Public Counsel

3:15 Open Discussion/Question Period for All Participants

Sign-Up Sheet

Make sure you have provided your name, organization, mailing address and phone number so we can include you on future roundtable notices.

Please also include the contact information for others you think would want to receive roundtable notices.

Compendium of Proceedings

We will post a compendium of all of today's presentations to our Internet site (www.psc.mo.gov/) within about two weeks.

Contact Information

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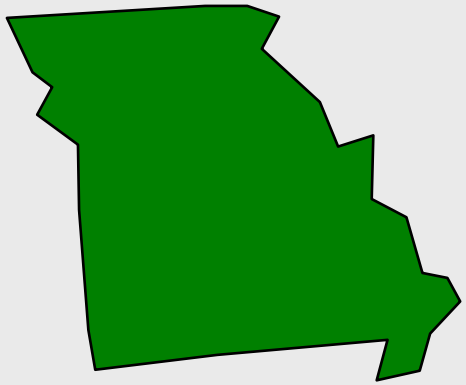
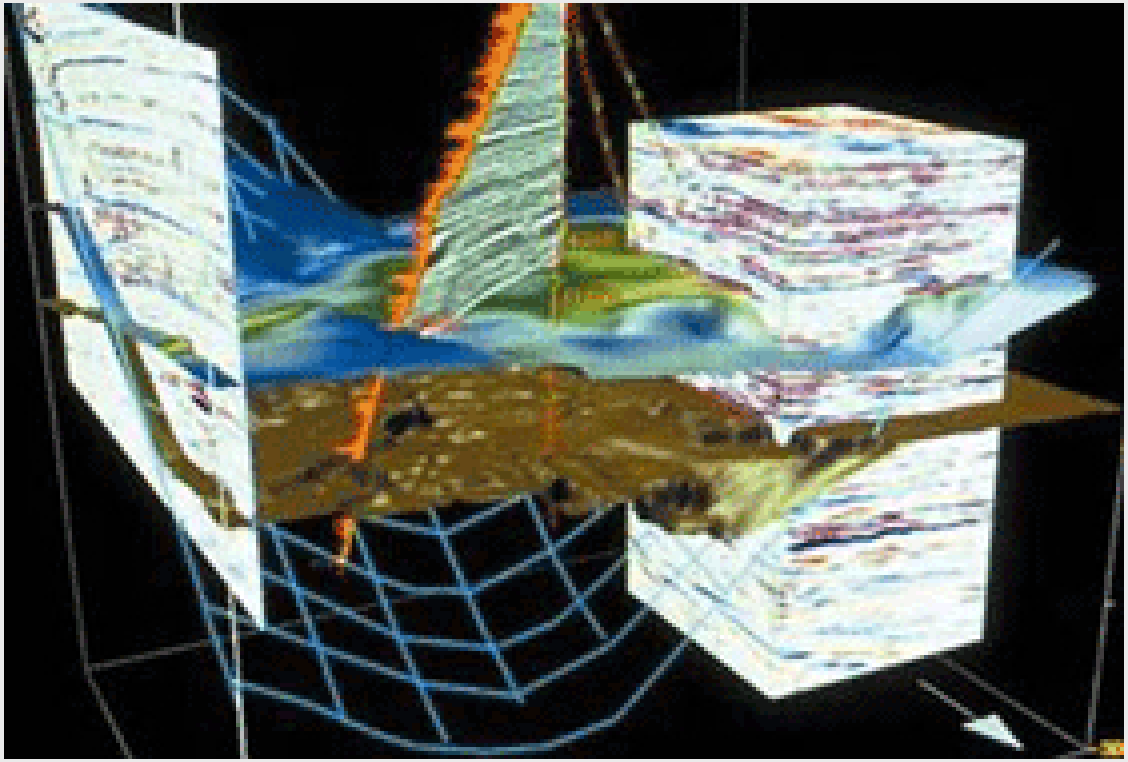
Missouri's Natural Gas R&D Needs

>Ron Edelstein
Gas Technology Institute

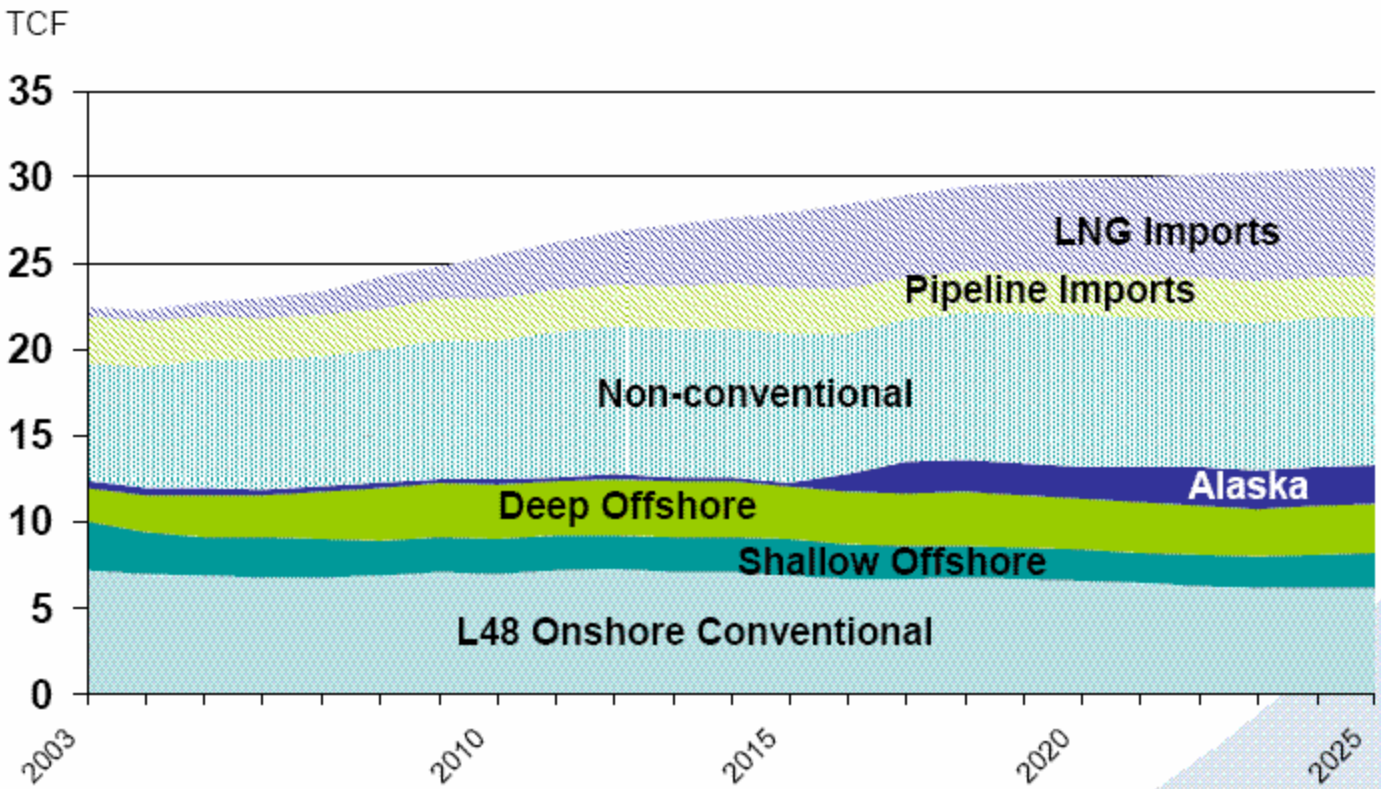
Jefferson City, Missouri
August 26, 2005



Natural Gas Supply



Supply Diversity Will Continue to Grow



Source: EIA

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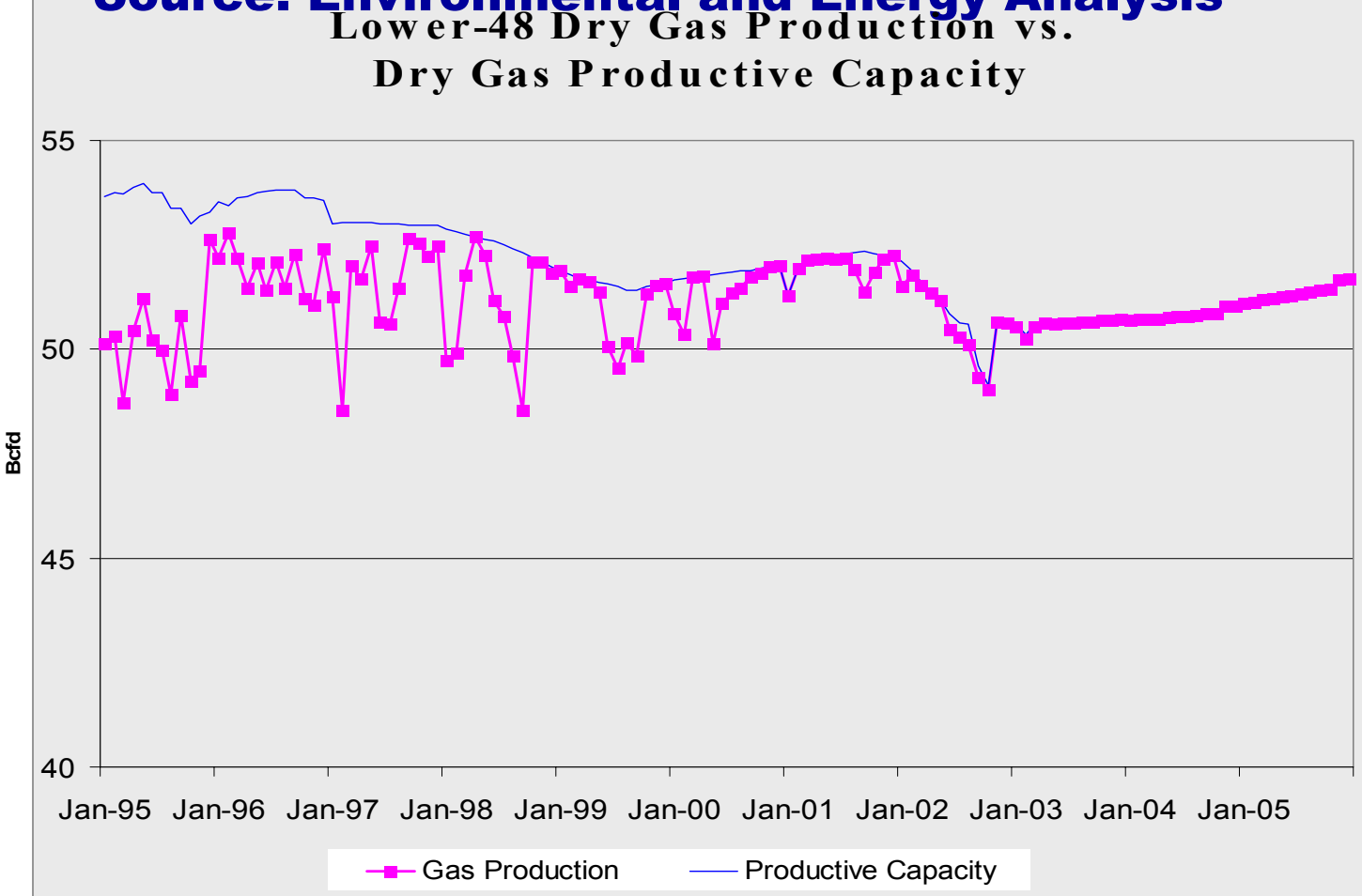
NGSA
Natural Gas Supply Association

Source: Environmental and Energy Analysis

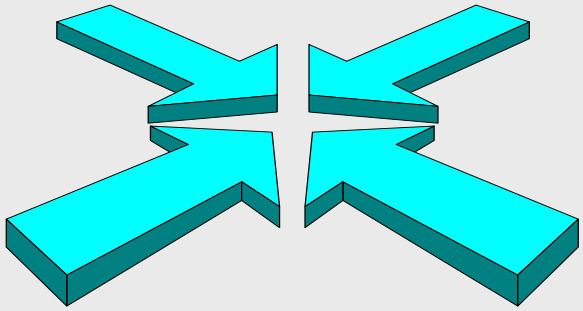


Distribution Operations

Issues that will Increase Costs for Maintaining the Safety and Integrity of Gas Distribution Systems

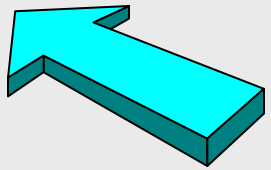
Aging Infrastructure

EPA's PCB Megarule



Distribution Integrity

Bare Steel and Cast Iron Replacement



Pipeline Integrity

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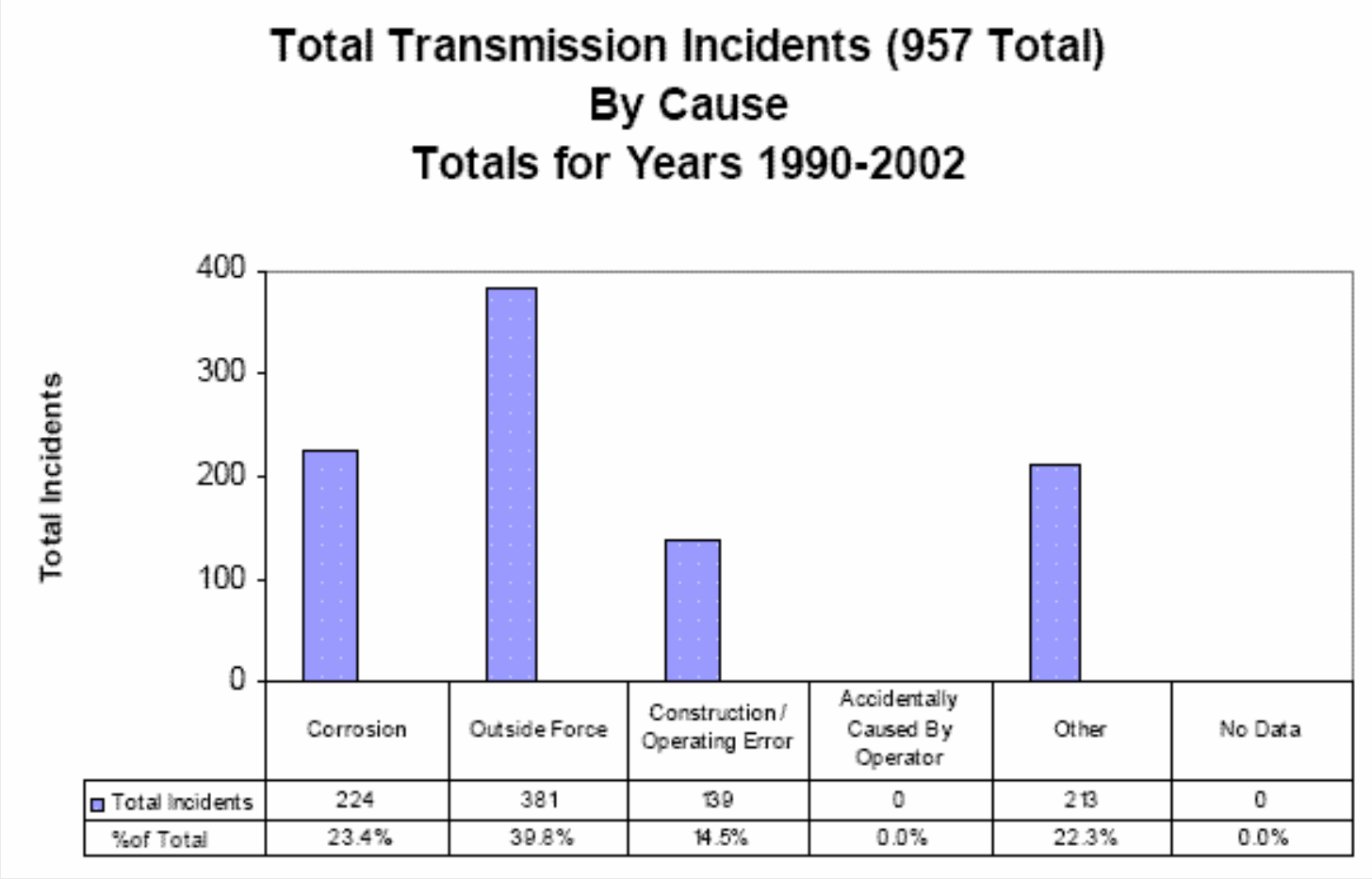
Origins of Integrity Management Planning (IMP)

- High-consequence, high-profile accidents
  - Bellingham 1999
  - Carlsbad 2000
- OPS response included new rules for integrity management of transmission pipelines (liquid and gas)
  - Understand threats/risks
  - Know effect on high consequence areas
  - Periodically inspect (Assess) pipeline condition
  - Remediate identified anomalies
  - Implement preventive & mitigative measures

Mary McDaniel
Railroad Commission of Texas

Outside Forces and Corrosion are Major Sources of Transmission Incidents



DOT PHMSA Will Issue Distribution Integrity Rule

- Will mandate action by distribution companies
- The top processes for distribution integrity management have been identified:
  - Cathodic protection
  - Leak surveys
  - Operator Qualification
  - One-call systems
  - Planned replacement programs
- What action will it mandate?

Ref: AGA presentation, NECPUC, Summer 2005

Where to Go from Here on Distribution System Integrity?

- Doing nothing is not an option
- Simply applying the transmission rule is not an option either
  - Pigging is not practical
  - Hydro Testing is difficult, at best
  - Direct Assessment won't work on plastic pipe
- The basic philosophy does apply
  - Understand where your risk comes from
  - Do something to reduce those risks

Ref: Stacey Gerard, PHMSA
NARUC Summer 2005 Meeting

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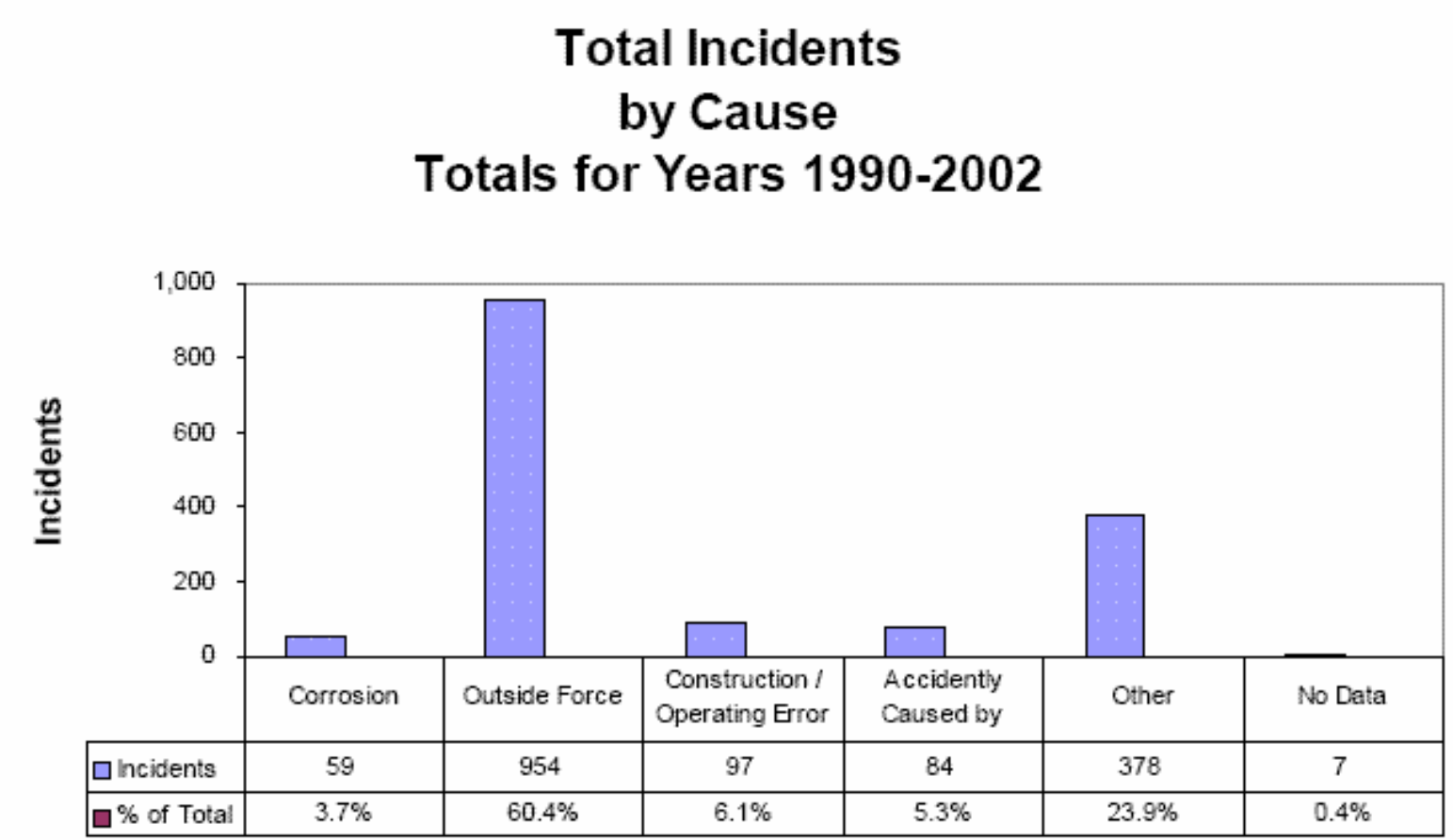
Outside Force and "Other" are the Major Causes of Serious Distribution System Incidents



	Corrosion	Outside Force	Construction / Operating Error	Accidently Caused by	Other	No Data
Incidents	59	954	97	84	378	7
% of Total	3.7%	60.4%	6.1%	5.3%	23.9%	0.4%

Distribution Integrity Management Plan (DIMP) – What Else?

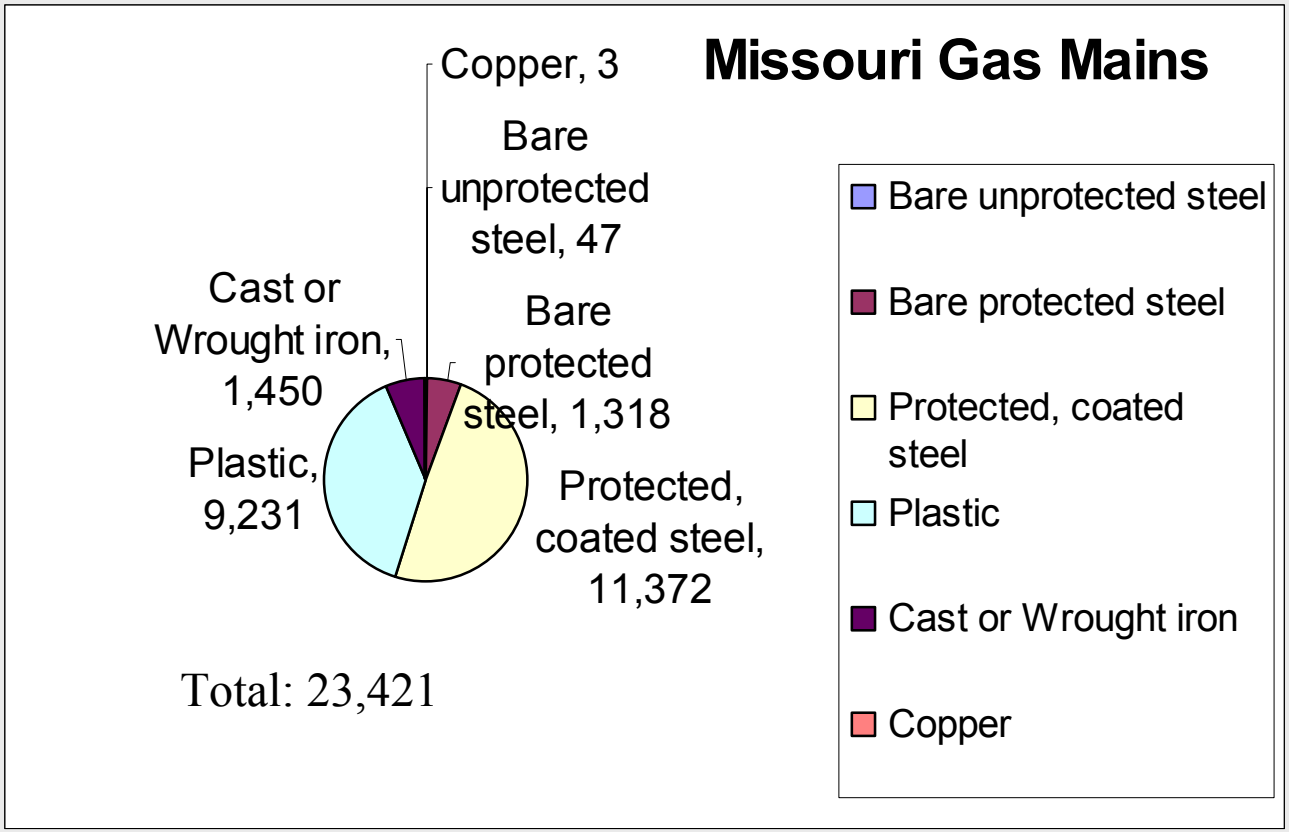
- Specific risk control practices that might be included are still under discussion
- Preventing excavation damage requires change in groups not regulated by PHMSA
- Actions to address “other” threats are more under operator control
  - State requirements
  - Operator practices beyond requirements

Ref: Stacey Gerard, PHMSA
NARUC Summer 2005 Meeting

Focus Resources Where It Will Make A Measurable Difference

- **Excellent opportunity to reduce excavation damage to underground facilities**
- **All other resource requirements should be considered in the context of measurable safety performance improvement**
  - *Data gathering/recordkeeping requirements?*
  - *Additional operator maintenance requirements?*
  - *Additional regulator and operator inspection and administration?*

Missouri Gas Mains



Ref: AGA 2003 Gas Facts

GTI R&D to Enhance Safety

- Miniature Methane/Ethane Detector (EMD) for Leak Survey
- Portable Methane Detector (PMD) Improvements and Field Evaluations
- Remote Leak Survey using Laser
- Evaluation of Flowable Fill around Buried Pipes
- Service-Applied Main Stopper
- Safe, Reliable Operations and Maintenance (O&M) of Aldyl-A™ Plastic Pipe Systems
- Develop a CD-Based Learning Module to Educate Fire and Police on Natural Gas Emergencies

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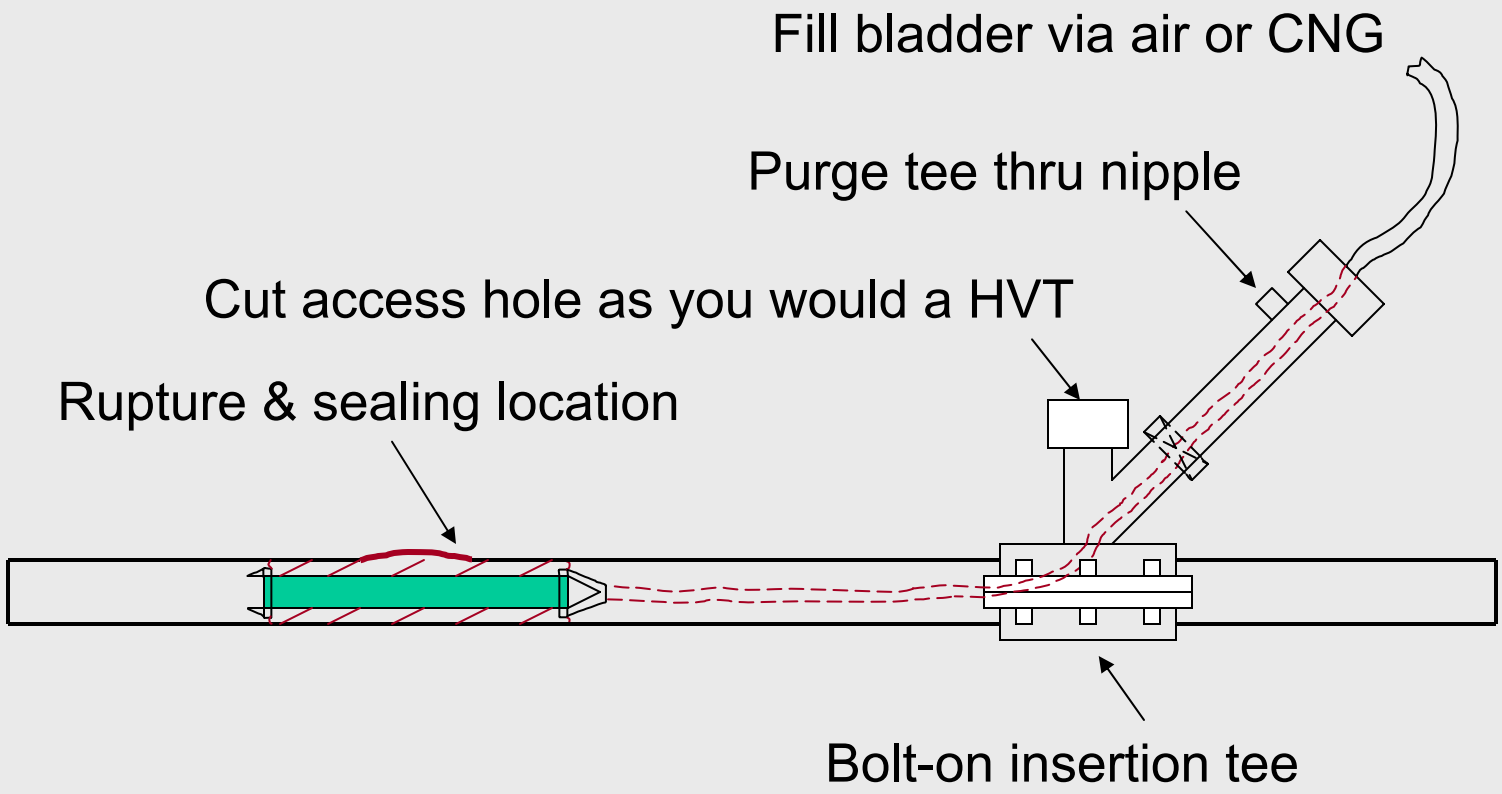
Internal Blowing Gas Stopper with Built-in Internal By-Pass (Prototype)



GTI R&D to Reduce Incidents due to Outside Force

- Detection of Unauthorized Construction Equipment in Pipeline Rights-of-Way
- Underground Facility Pinpointing
- Hand-Held Acoustic Pipe Detector
- Integration of Electromagnetic and Acoustic Obstacle Detections Systems for Utility Construction Operations
- Technology Transfer of an Obstacle Detection System using Ground Penetrating Radar (GPR)
- Buried Pipe Imaging by Capacitive Tomography

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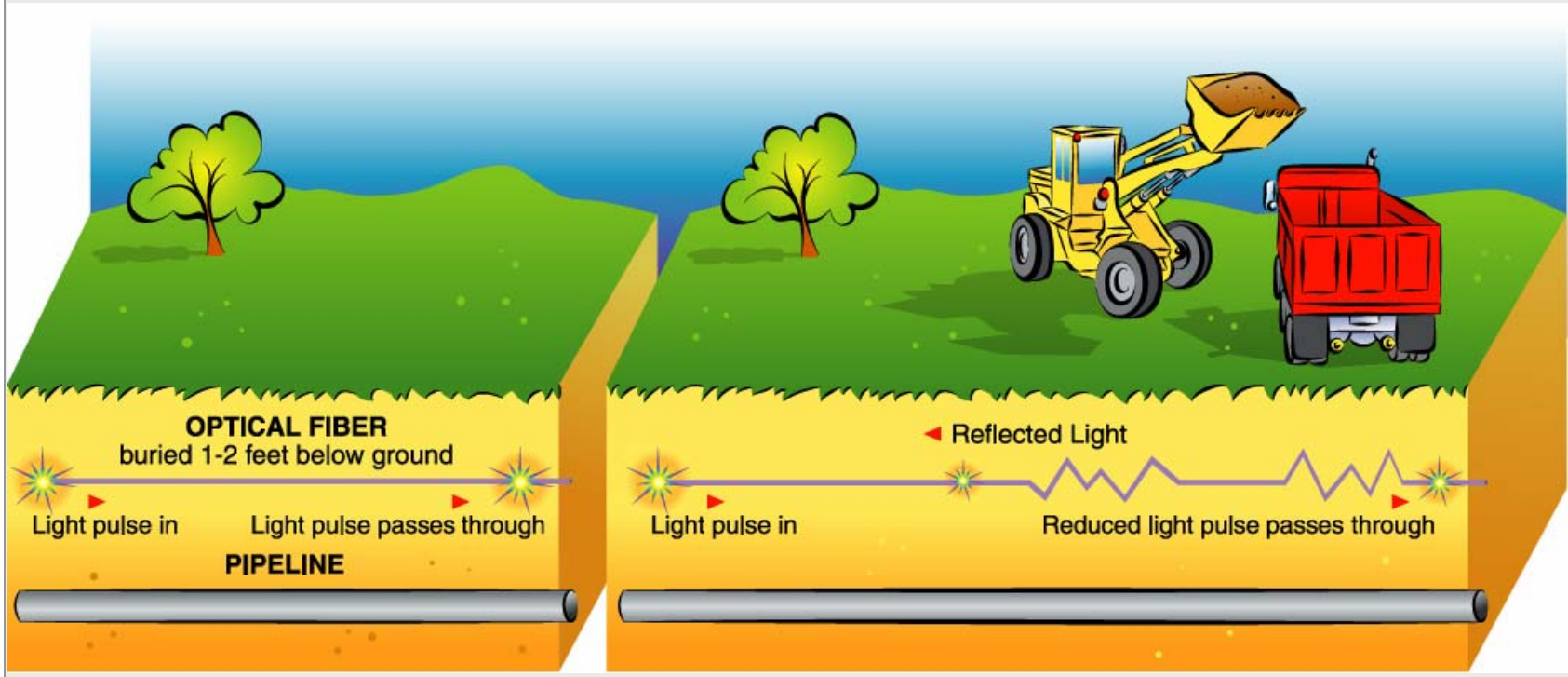
OTDR Technique Can Discriminate Simultaneously Occurring Events



Round trip travel time of a light pulse locates encroachment.

Variations in amplitude identify type of encroachment.

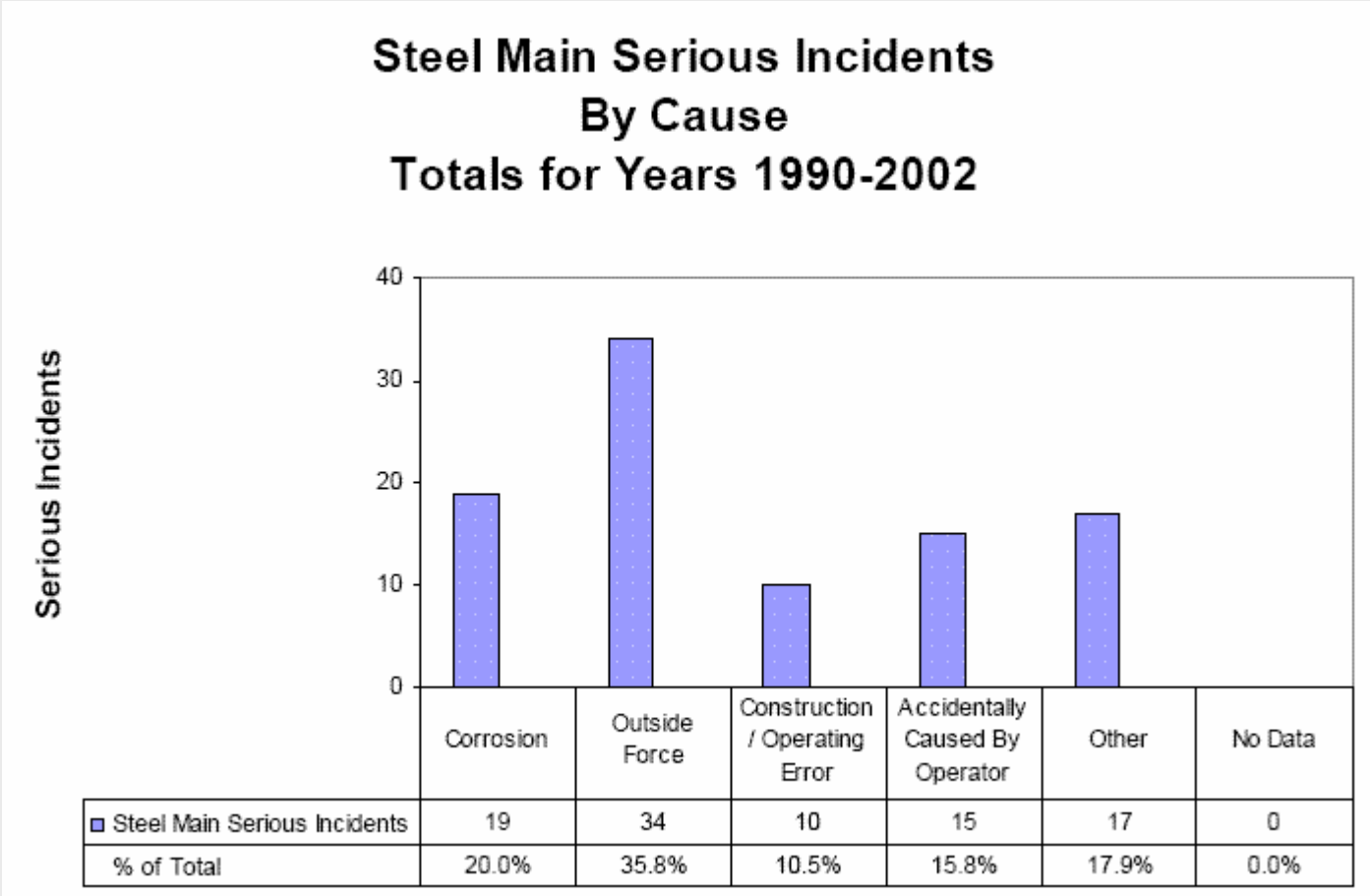
Acoustic Techniques For Obstacle Detection- (Folsom Research Inc.)

- Drill noise reflected from pipes detected by above ground acoustic receivers
- Pre-prototype system developed and tested
- Detected 6- and 8-inch pipes buried in native soil and in concrete pavement at least 6 ft. ahead of drill head
- Strong support from industry to develop prototype systems

Capacitive Tomography for Plastic Pipe Location

Breadboard Test Unit Can Detect Plastic Pipe Through 3 ft. of Clay Soil

For Steel Mains, Incidents are Caused by Outside Force and Corrosion



GTI R&D to Reduce Incidents Due to Corrosion

- High-Pressure Plastic Pipe Materials
- 50-to-70-Year Maintenance-Free Pipeline Coatings for Critical Locations
- Reduce Mandated Inspection Costs by Remote Field Eddy Current Inspection of Unpiggable Pipelines
- Inspection Platforms for Unpiggable Pipelines
- Reducing Riser/Meter Set Corrosion to Lower Life-Cycle Cost
- Broadband Electromagnetic Technology Sensor to Measures Wall Thickness

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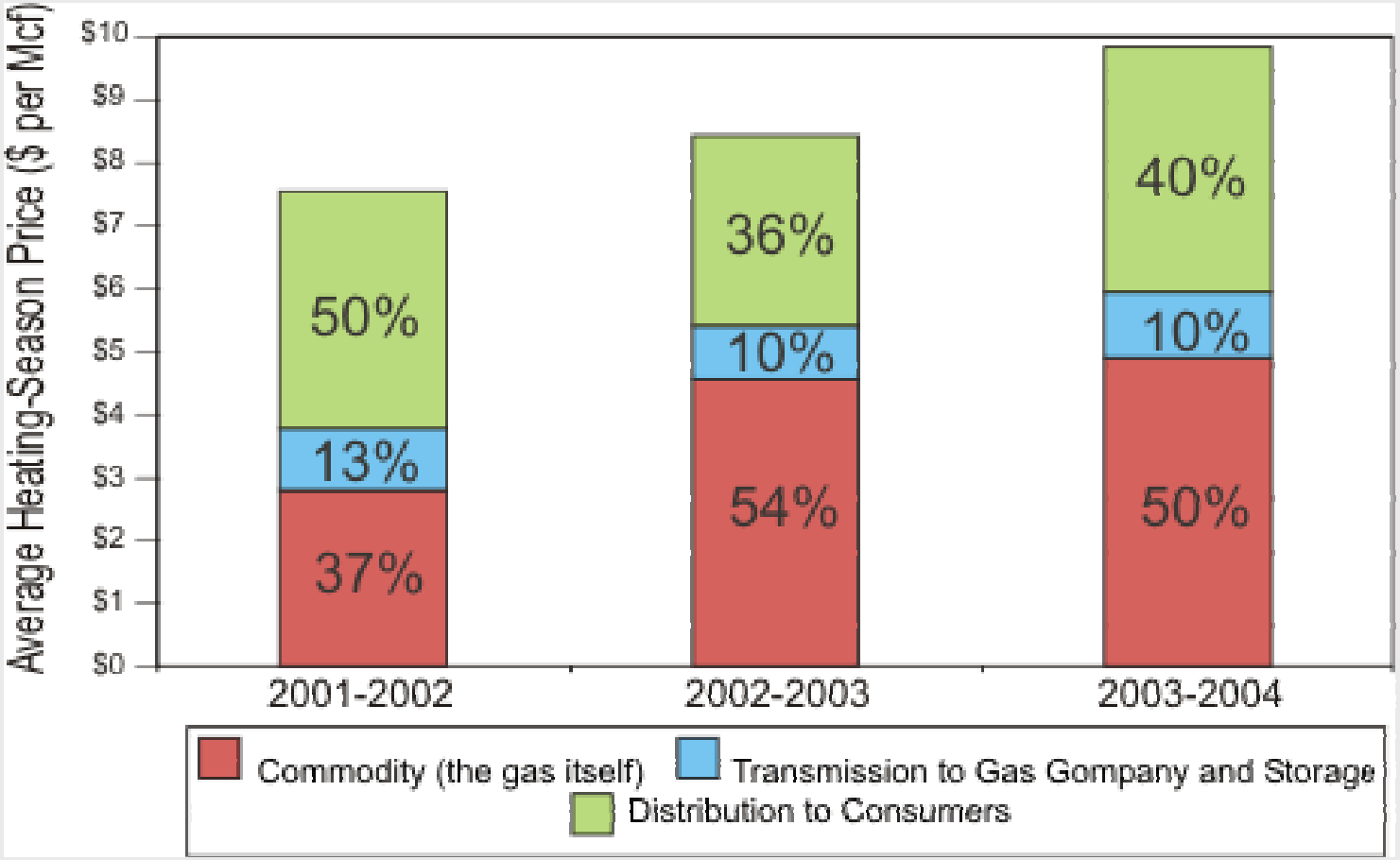
GTI Pipe and Pavement Farm – accelerated testing

- Endurance tests of new pipe materials - PA11, Magpipe and PEX from Europe
- Accelerated life-tests with fully instrumented heated 24" and 8" diameter pipe systems, including coated pipes, simulating compressor outlet stations

Distribution Costs still Represent an Important Component of Natural Gas Prices



GTI R&D to Reduce Distribution O&M Costs

- Improving Crew Truck and Equipment Productivity
- Global Positioning System (GPS) for O&M Tracking Database
- Alternative Methods for Pavement Cutting
- Micro-Excavation Systems Applications
- Development of a Lightweight, Portable Shoring System
- Development/Enhancement of Trenchless Service Installation through Keyholes
- Modification of Soil Compaction Measuring Device for Utility Implementation
- Developing and Demonstrating Rapid, Quantitative PCB Analysis in the Field

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GTI R&D to Reduce Distribution O&M Costs (cont.)

- High-Pressure Plastic Pipe Materials
- Flaw Acceptance Criteria & Repair Options for Low-Stress Natural Gas Pipelines
- Noninterrupted Meter Changeout Kit
- Evaluation for Impact of “Reworked” Plastic Pipe
- “No-Blow” High-Pressure Service Replacement Device Development and Deployment
- Deployment of ‘No Dig” Reconnect Methods for Polyethylene (PE) Inserts
- Increase in Pipe Design Factor
- Continued Development of Inflatable By-Pass Stopper and Repair

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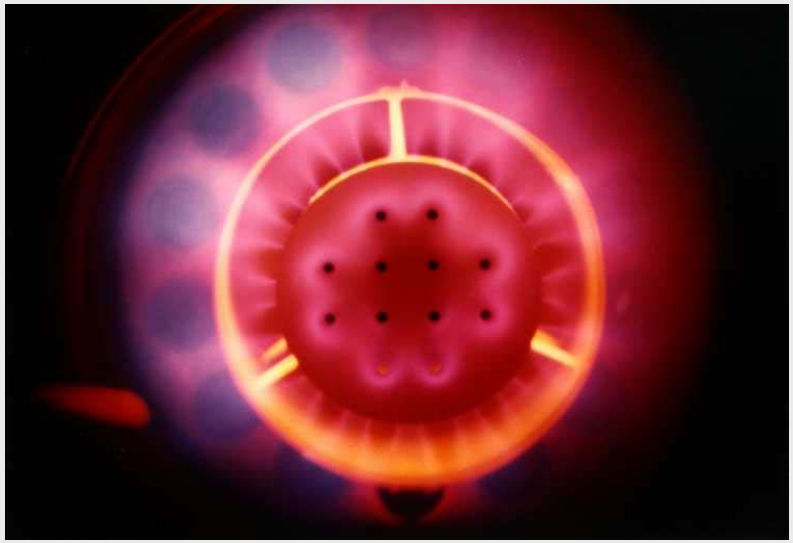
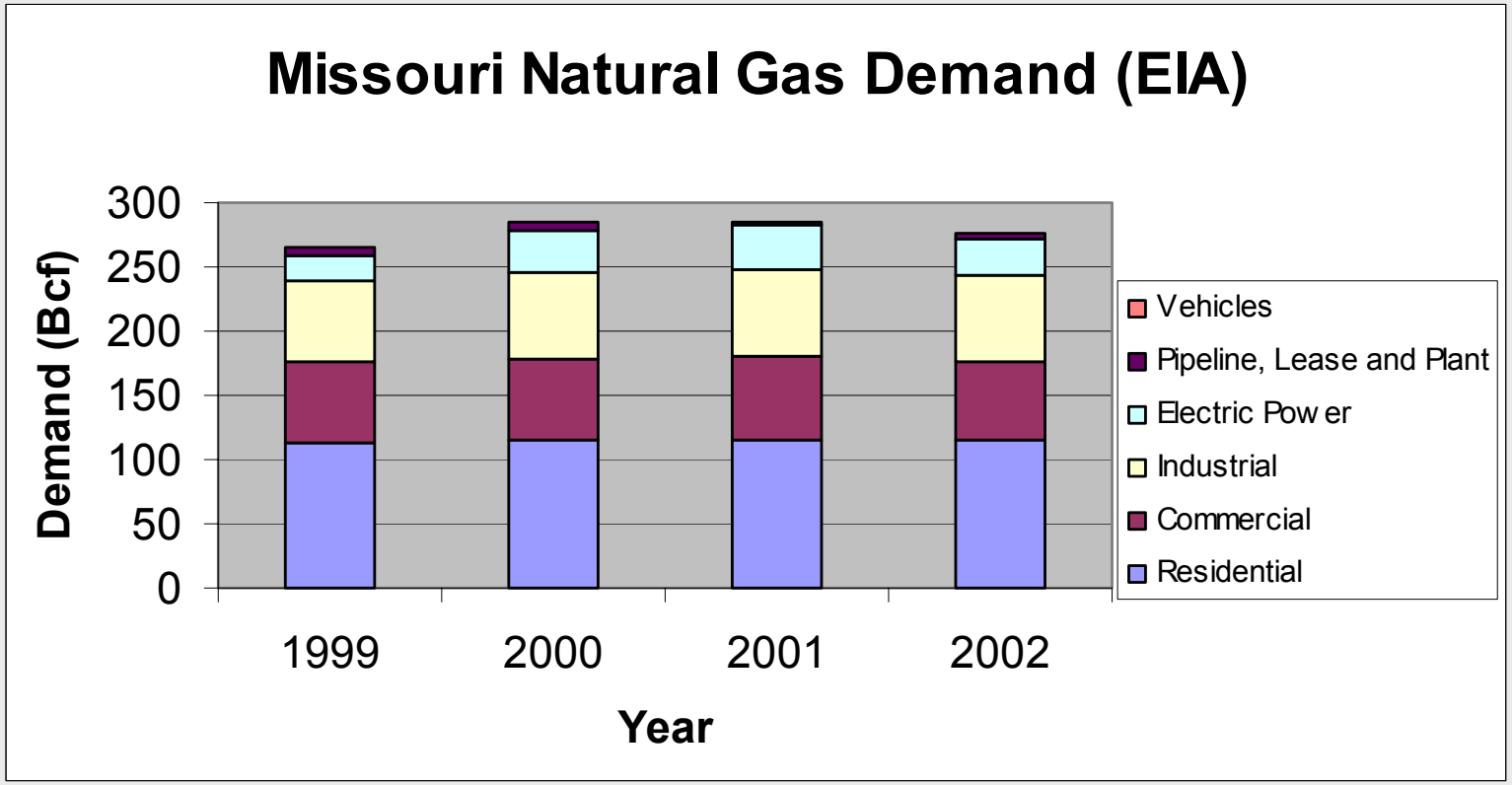
Keyhole Repairs Made Using Long Handled Tools

End User Needs

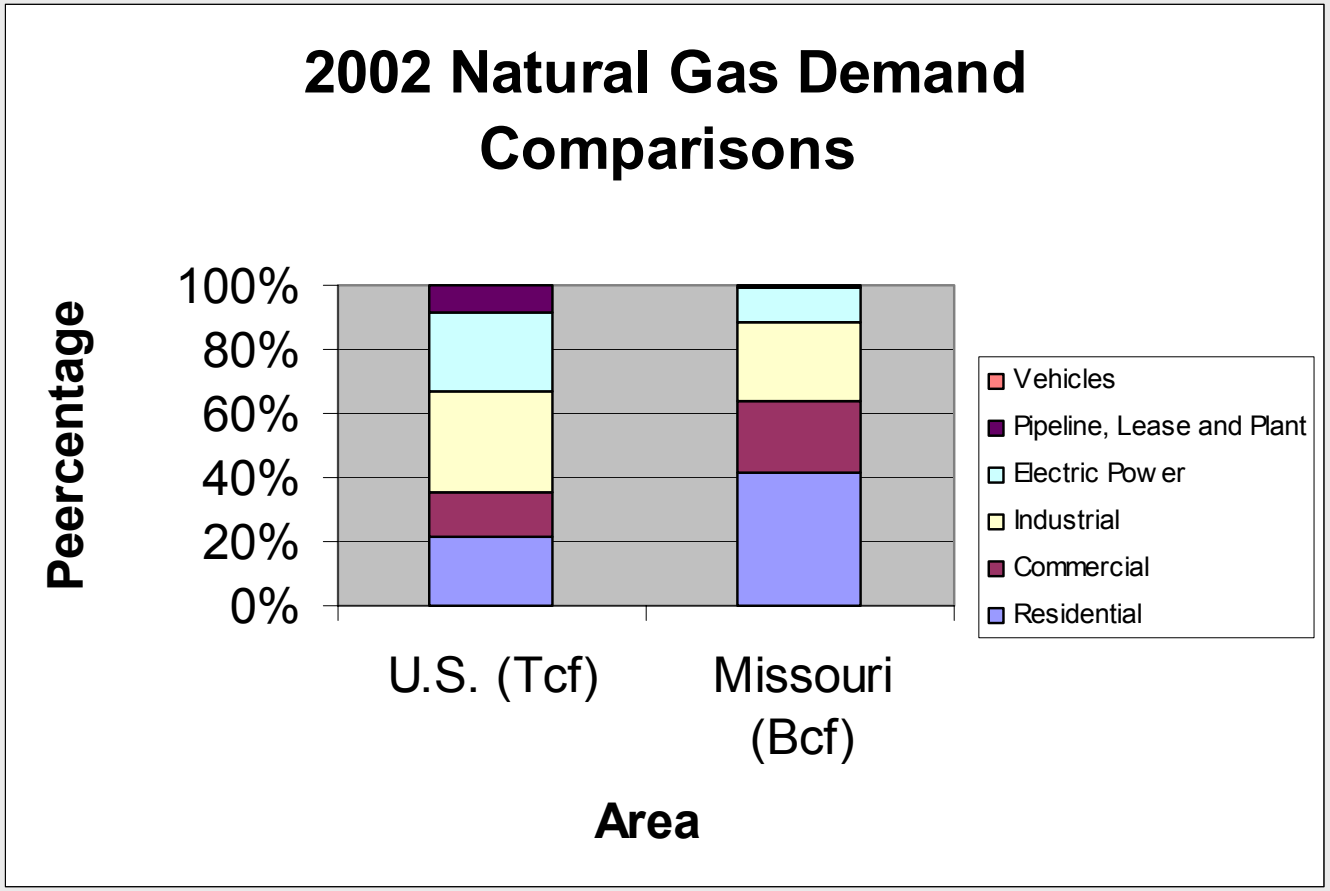


Missouri Natural Gas Demand has been Relatively Constant



Ref: EIA

Missouri Natural Gas Demand is not Typical of U.S. Demand: Residential/Commercial Dominated



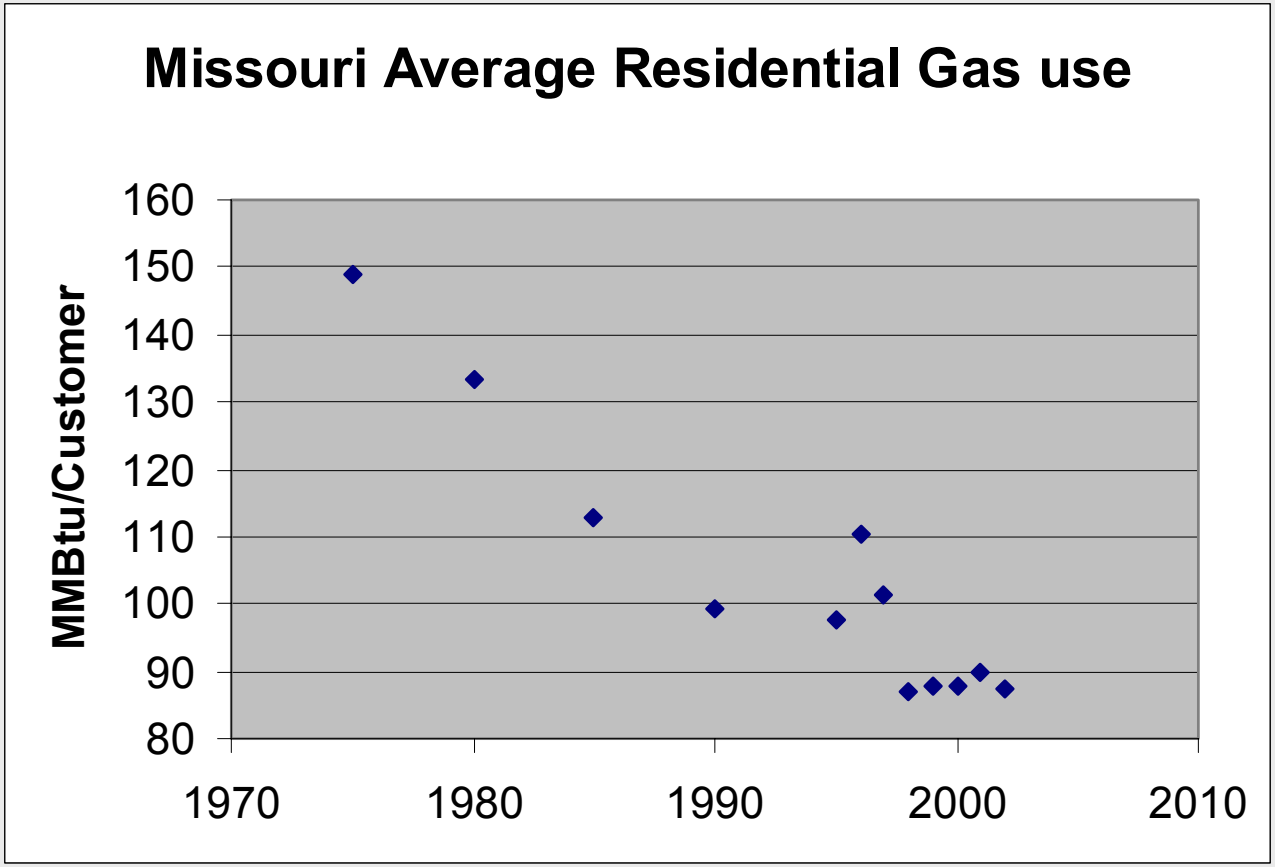
Typical Missouri Homeowner's Annual Use of Gas

- Average Annual Use - 87.5 MMBtu (2002)
  - Furnace - 50-70
  - Water Heater - 20-25
  - Range - 5
  - Gas Dryer - 6

Real-World Example: High-Efficiency Furnaces in Missouri

- GTI developed the first high-efficiency (94%) furnace
- 172,151high-efficiency furnaces sold in Missouri (1995-2000), ***28% of Missouri new furnace sales***
- Net present value is about $365 per furnace
- Leading to consumer benefits of $62.8 million
- Total cost over the same 6 years to all Missouri consumers of *entire* FERC-approved program was $16.3 million
- Benefit/cost ratio to Missouri residential consumers of 3.9 / 1

Has Efficiency Made a Difference? Yes!! Residential gas use has fallen by 40%



Ref: A.G.A. Gas Facts, 2002 and 2003
Note: Uncorrected for weather

Proposed GTI Low-Income R&D Projects

- Combination 92% efficient space/water heater
- Downscaled superboiler at 94% efficiency for multifamily dwellings
- Advanced in-house energy distribution systems
- Instantaneous water heater
- Low-income energy management device

U.S. v. Missouri Poverty Rate

Population Group	U. S. Percentage	Missouri Percentage
Total Population	12.4%	11.7%
Under 18	16.6%	15.3%
18 - 64	10.7%	10.4%
65 and Over	9.9%	9.9%

> Note: The Federal poverty rate is no longer accepted broadly as the only or best measure of well being. For many households, income levels well above those reflected in Federal poverty guidelines are insufficient to support the costs of basic human needs.

Ref: U.S. Bureau of Census 2000

Energy Distribution Systems Issues

- Energy Distribution systems (within the home) have not kept up with the pace.
- Current remedies focus on old systems not designed for efficiency.
- Duct sealing as a prescriptive options can increase system efficiency by 20%.
- Imagine is you could redesign the distribution system with efficiency in mind?

Source: LBL

Highly Efficient Combination Space-Water Heater System

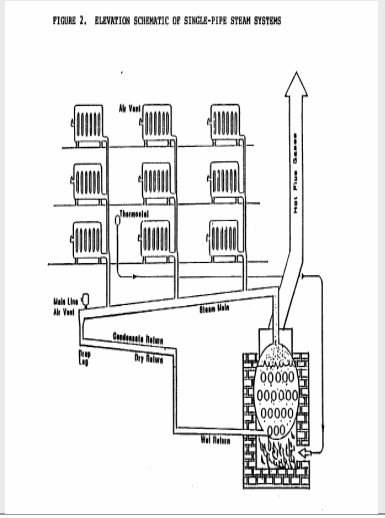
- **Solution:** Low-cost, 92% fully condensing combination gas water/ space heating system
- Research is needed to improve the design of air handling systems
  - Higher heat exchange between water and air
  - improved occupancy comfort

Instantaneous Water Heater

- **Solution:** Develop next generation instantaneous water heater and components.
  - power reduction/elimination
  - improved heat exchanger life and efficiency
  - low NOx burner ≤ 20 ppm, design and integration (80% emissions reduction)
  - reduced maintenance requirements using advanced technology to reduce mineral build-up and sensor fouling to maintain operational efficiency and extend warranty

Super Boiler Technology

- **Solution:** Extend superboiler technology to both steam and hot water boilers below 2 million BTU/hr
  - a minimum efficiency of 94%,
  - emissions target of < 5ppm NOx
  - reduced footprint and weight



Where Do We Go from Here?

- FERC funding no longer available for Gas R&D due to energy industry restructuring
  - GTI funding has decreased from $200 MM per year in 1998, to $90 MM in 2004, to projected $60MM in 2005 and $50 MM in 2006
- GTI's Distribution R&D program is 90% funded by gas LDC's through ratepayer funding (the rest from DOE)
- GTI's End-Use R&D is 25% funded by gas LDC's through ratepayer funding (the rest from DOE, CEC)
- Ratepayer funding is *essential* (as cofunding) to obtaining DOE and CEC funding
- Missouri has a stake in seeing that projects are targeted to its needs and that benefits reach its consumers
- Cost? 90 cents per residential customer per year

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18 States Have Approved LDC Recovery of Gas Consumer Interest R&D Surcharges

- Alabama
- Delaware
- Florida
- Idaho
- Illinois
- Kentucky
- Mississippi
- Minnesota
- New Hampshire
- New Jersey
- New York
- North Carolina
- Oregon
- Pennsylvania
- Utah
- Virginia
- Washington
- Wyoming

Conclusion -- GTI's R&D can:

> Reduce the demand for natural gas by providing increased-efficiency equipment, especially for low-income ratepayers

>Reduce the costs of maintaining the aging gas T&D infrastructure

> Enhance public and gas consumer safety

Natural Gas Research and Development Issues

Missouri Public Service Commission Roundtable Discussion

August 26, 2005

Governor Office Building
Jefferson City, MO

Overview

- Definition of Research and Development (R&D)
- Benefits of Natural Gas (NG) R&D
- Current Trends in NG R&D
- NG R&D Requirements of the Energy Policy Act of 2005
- NG R&D Programs in the United States
- Accomplishments of NG R&D Programs
- NG R&D Program Funding
- Need for NG R&D in Missouri
- NG R&D Actions in surrounding States
- Questions that should be asked if NG R&D is instituted in Missouri
- MoPSC Staff Position on NG R&D

Definition of R&D

"Research" is defined as a systematic study directed toward fuller scientific knowledge or understanding of the subject studied.

"Development" is the systematic use of knowledge and understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes.

Federal Regulation 40 CFR 30.2(dd)

Benefits of NG R&D

- Increased efficiency in residential and industrial uses
- Enhanced safety and health issues
- Increased gas system reliability or integrity
- Increased technological advances in production of NG
- Assists in lowering gas industry operating and maintenance expenses
- Enhanced environmental quality

Current Trends in NG R&D Funding

- R&D funding has decreased over the past few years. Also, the length of time that R&D projects are performed is also decreasing.
- Most R&D funding in the past has been focused on production of NG instead of end use efficiency
- Focus has turned to private or State level funding of R&D programs
- In December 2004, FERC denied GTI's request for additional R&D funding in FERC Docket No. RP04-378[1]
- DOE's budget request eliminated funding for its Oil and NG R&D programs in FY 2006, but was revised by the House and Senate, allowing for $57 to $62 million in R&D funding
- Energy Policy Act of 2005 signed into law on August 8, 2005, promotes funding for R&D projects

1. Based on a 1998 Settlement in Docket No. RP97-149 and RM97-3

NG R&D Requirements of the Energy Policy Act of 2005

Energy Policy Act (EPA) of 2005 and Natural Gas R&D requirements:

- Requires the Secretary of the US DOE to conduct R&D programs having the following objectives: (1) increase the energy conversion efficiency of all forms of fossil energy through improved technologies; (2) decrease the cost of all fossil energy production, generation, and delivery; (3) promote diversity of energy supply; (4) decrease our dependence on foreign energy supplies; (5) improve our energy security; (6) decrease the environmental impact of energy-related activities; and (7) increase the export of fossil energy-related equipment, technology, and services from the US. (Section 961)

Subsections on natural gas R&D programs in the EPA of 2005:

- Oil and Gas Research (Section 965)
- Low-Volume oil and gas reservoir research (Section 966)
- Ultra-deepwater and unconventional onshore natural gas and other petroleum R&D plan (Section 999)

NG R&D Programs in the United States

- Petroleum Technology Transfer Council**
- National Energy Technology Laboratory**
- Strategic Center for Natural Gas**
- Natural Gas & Oil Technology Partnership**
- U.S. Geological Survey - Energy Resources Program
- Gas Technology Institute
- California Public Interest Natural Gas Research Program
- Iowa Energy Center

** Proposed to have funding removed via DOE FY 2006 budget request.

NG R&D Programs in the United States – Cont'd

- Center for Global and Regional Environmental Research
- New York State Energy Research and Development Authority
- Utah Geological Survey Natural Gas Research
- The Energy Institute - Penn State
- The Natural Research Center for Coal and Energy (NRCCE) - West Virginia University
- Appalachian Oil and Natural Gas Research Consortium (AONGRC) - West Virginia University a division of NRCCE

Federal Agency NG R&D Programs - Key Accomplishments

Gas Supply:

- DOE and GRI developed 3-D Seismic advances for fracture imaging and advanced drilling technologies.
- DOE developed air motors for horizontal drilling techniques which use air instead of mud to drive and cool the downhole bit motor and removes drilling debris. This technique increases efficiency of drilling in locations where mud use causes formation swelling and fracture blockage.
- DOE launched NG infrastructure reliability program vision and roadmap process.
- DOE initiated advanced high-delivery gas storage research in non-reservoir rock formations to serve peak power customers in the Northeast.
- DOE initiated research on direct energy meters.

http://www.pi.energy.gov/pdf/library/docs/newecon-appendix.pdf

GTI NG R&D Programs - Key Accomplishments

Gas Supply:

- Diagnostic tools and technologies to exploit coal gas, shale gas, and low-permeability formations
- Processes for gasification of coal (U-GAS®) and biomass (RENUGAS®)

Gas Distribution:

- Plastic pipe performance testing, installation guides and field-failure catalog
- Tools to detect microbiological corrosion in piping systems

Gas Transmission:

- Low-cost retrofit NO_x controls for compressor engines
- Ultrasonic and electromagnetic/acoustic systems for in-line detection of stress/corrosion cracking

http://www.gastechnology.org/webroot/app/xn/xd.aspx?it=enweb&xd=6newsroom\introductiontogtiupdated.xml

GTI NG R&D Programs - Key Accomplishments - Cont'd

Environmental:

- Guidebook for remediation and management of former Manufactured Gas Plant sites
- Guidebook to determine environmentally acceptable end-points for soil remediation

Gas Use:

- Residential furnaces using modulation and pulse combustion for high efficiency
- Advanced commercial food service equipment
- Industrial burners using innovative methods to cut emissions and increase heat transfer
- Engines and other components for natural gas vehicles and fueling systems

http://www.gastechnology.org/webroot/app/xn/xd.aspx?it=enweb&xd=6newsroom\introductiontogtiupdated.xml

University sponsored NG R&D Programs - Key Accomplishments

AONGRC Accomplishments:

- Measuring and Predicting Reservoir Heterogeneity in Complex Deposystems - Completed studies of the Big Injun sandstone in West Virginia and the Rose Run sandstone in Ohio. Produced a book on the Rose Run in Ohio, two West Virginia Geological Survey publications on the Big Injun, and other articles and reports.
- The Atlas of Major Appalachian Gas Plays - 200-page compendium of maps and descriptions of key gas fields in each of 30 gas plays in the Appalachian region. Also produced a companion database with information on more than 5,100 individual gas reservoirs.

http://www.nrcce.wvu.edu/programs/aongrc/

University sponsored NG R&D Programs - Key Accomplishments - cont'd

The Energy Institute at Penn State Accomplishments:

- Characterization of dispersed organic matter to determine a maturation state and hydrocarbon source rock potential
- Study of damage to rock permeability by shaped charges
- Environmental benign drilling and production techniques
- Optimize hydrodynamics attendant to well drilling
- Characterization of reservoir grain structure, porosity, and multiphase relative permeability
- Study of reservoir formation permeability damage using selective extraction and chemical characterization of soluble species and elemental and x-ray diffraction of remaining mineral phases

http://www.energy.psu.edu/png/research.shtml

State NG R&D Programs

Primary Focus of most State programs:

- Educate consumers on energy efficiency and conservation
- Promote renewable energy – solar and wind powered systems
- Study Biomass systems – using livestock waste and landfill methane to operate small power systems
- Promote efforts to decrease dependence on imported fuels and to decrease reliance on energy production from nonrenewable, resource-depleting fuels

NG R&D Program Funding

Where does the money come from?

- Federal Programs - Federal Budget
- GTI - Volumetric surcharge from customers/states who choose to participate in the program
- University Programs - Government grants or cooperative agreements with industry stakeholders
- State Programs - Based on a State required assessment on intrastate revenues of gas and electric companies (Iowa Energy Center)

Need for R&D… Why Should Missouri Care?

Demand for NG is estimated to increase by 30% in the next 20 years (EIA Annual Energy Outlook 2004), yet the production of NG in the US has not significantly increased in the past five years. In addition, the price of NG has also significantly increased over the past four years. With this evolution, NG R&D may be one of the ways to bring about needed increases in efficiency and conservation.

Missouri's NG use in 2004 was: (in MMcf)

Use by All Consumers	Use by Residential	Use by Commercial	Use by Industrial	Use by Electric Power
257,558	109,827	62,389	63,248	22,094

http://tonto.eia.doe.gov/dnav/ng/ng_sum_lsum_dcu_nus_m.htm

R&D Actions in Other Surrounding States

- Kansas - Has opened a generic Docket discussing the benefits of GTI and NG R&D. KCC Docket No. 04-GIMC-814-GIG. KCC Staff submitted its recommendation on April 14, 2005, recommending a 75%-25% price sharing between ratepayers and shareholders of certain GTI projects.
- Iowa - Implemented laws and regulations in 1990 requiring all energy utilities in Iowa to provide funding to the Iowa Energy Center and the Center for Global and Regional Environmental Research. Funds are collected from customers at a level of 0.1% of revenues.
- Tennessee - Has a generic Docket open to examine Tennessee Regulatory Authority (TRA) rules, policies and procedures in light of current trends in gas industries. TRA Docket No. 05-00046.
- Oklahoma - Does not have a docket open to discuss NG R&D, but has discussed the issue in an LDC's case before the OCC. Oklahoma Natural Gas - Case # 200400610 (still pending).

Questions that should be asked regarding R&D for Missouri

Should the Commission institute surcharges to finance R&D programs? If the answer is "yes", then:

- How should the surcharge be determined?
- What documentation is needed to show that Missouri consumers will benefit from R&D?
- If R&D yields benefits to non-funding states, is it in the public interest of Missouri consumers to pay for those programs? Should the Commission only allow support for R&D where all potential beneficiaries contribute funds?
- What role, if any, should the Commission play in determining the selection of research projects and their design?

Questions that should be asked regarding R&D for Missouri-Cont'd

- How often should the Commission review and approve R&D programs?
- Should funding be subject to an annual true-up?
- What support should the utility be required to provide for the calculation of actual surcharge amounts?
- How often should benefits to utility customers be quantified and the process of funding reviewed?
- How should the surcharge appear on the customer bill?
- Should reports be filed with the Commission and, if so, what areas should be addressed?

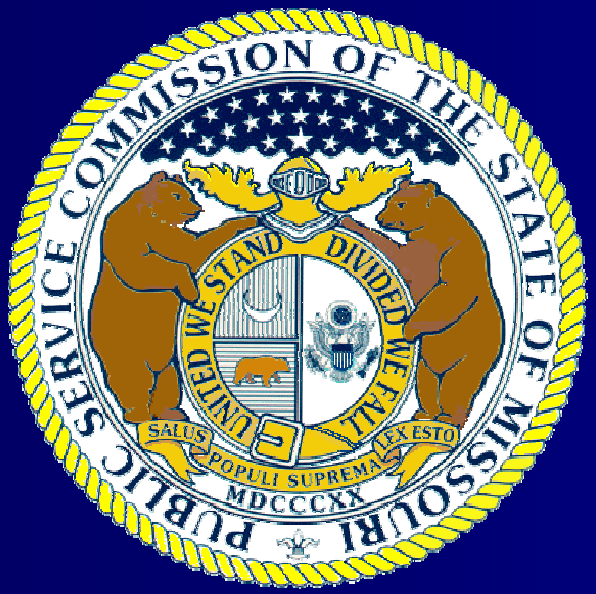
MoPSC Staff Position

Staff could likely support some form of R&D funding under the following circumstances:

- R&D funding shared between ratepayers and shareholders
- Amount allocated to R&D funding not exceed amounts paid in the past
- The PSC, LDCs, and Missouri customers participate in the decision as to which R&D projects receive funding
- *As usual, it would likely take some time to work out the details.*

Questions?

Contact Information:



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The Case for Natural Gas R&D

by

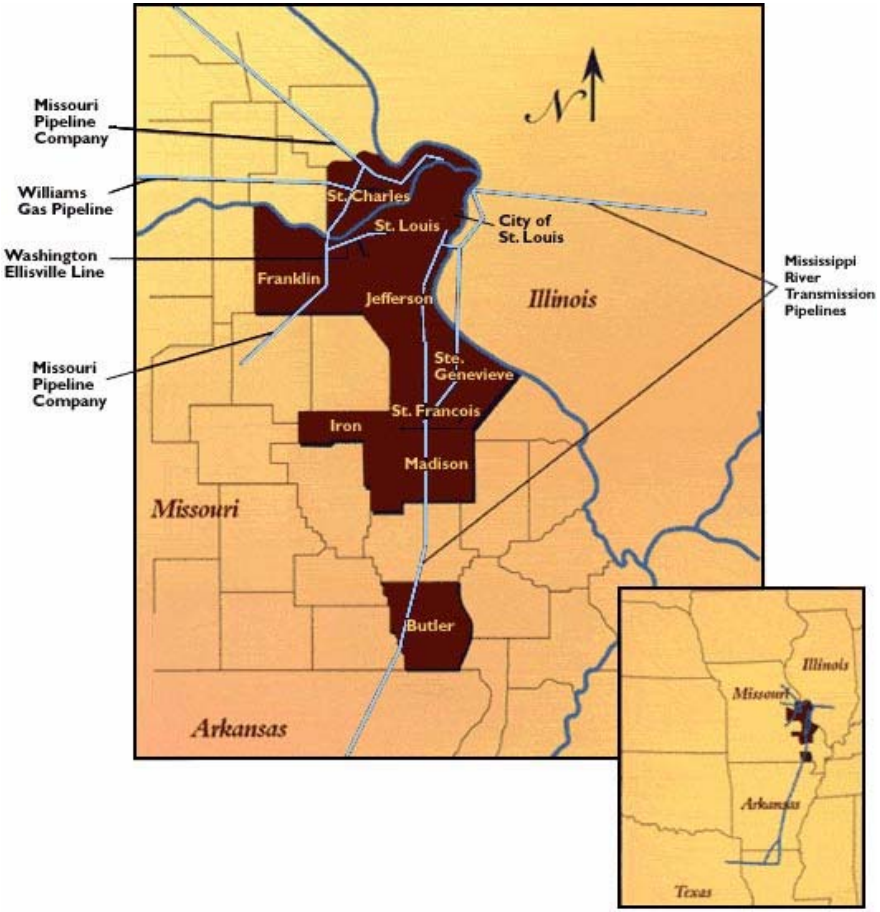
Ted Reinhart

Friday, August 26th, 2005

Jefferson City, Missouri

About Laclede

- largest natural gas utility in Missouri
- serving more than 630,000 customers
- 15,000 miles of distribution pipes
- gas purchasing requirements



Customer Expectations

- Safe
- Reliable
  - There when you want and need it
- Reasonably Priced
  - Commodity costs
  - Equipment & installation costs
  - Service & maintenance costs

Natural Gas R&D

- Natural Gas R&D can be viewed as a tripod
  - Supply
  - Transmission & Distribution
  - End use
- 3 legs are required for stability

Elements of R&D

- Product development
  - Short term
  - May likely occur anyway by “market forces”
- R&D
  - Longer term
  - More costs, risks, difficulty
  - Intellectual assessment & advocacy

Effective Natural Gas R&D

- Examples
  - Updated natural gas appliance venting tables
  - Corrugated stainless steel tubing (CSST)
  - Advancement of desiccant dehumidification

Governance Considerations

- Input into R&D goals
- Assessment of performance
- Certain level of independence

Funding Considerations

- Determining who benefits
- Matching funding to benefits
- Role of national organizations
- Specific review mechanism

Broadband over Power Lines
"BPL"
The Ameren Experience

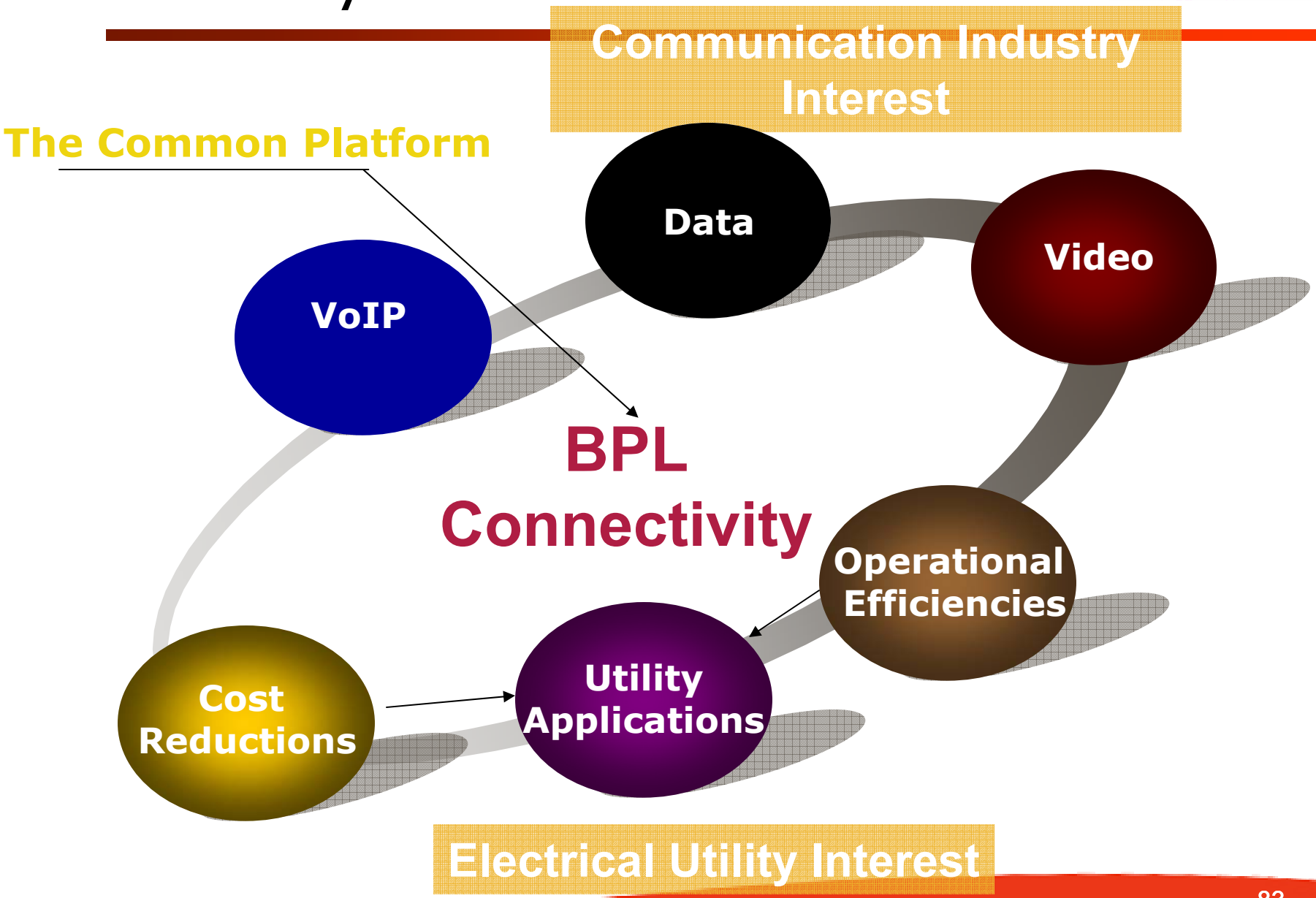
Greg Lovett

August 26, 2005

Today's Presentation

- BPL Overview
- Ameren's BPL technical trial in Cape Girardeau, MO
- Further development of BPL

BPL Key Drivers



BPL Applications

Communications Applications

- High Speed Data
- Voice
- Video Services (On Demand & Conferencing)
- In-Building BPL
  - → System Monitoring & Control
  - → Security Monitoring
  - → High Speed Data

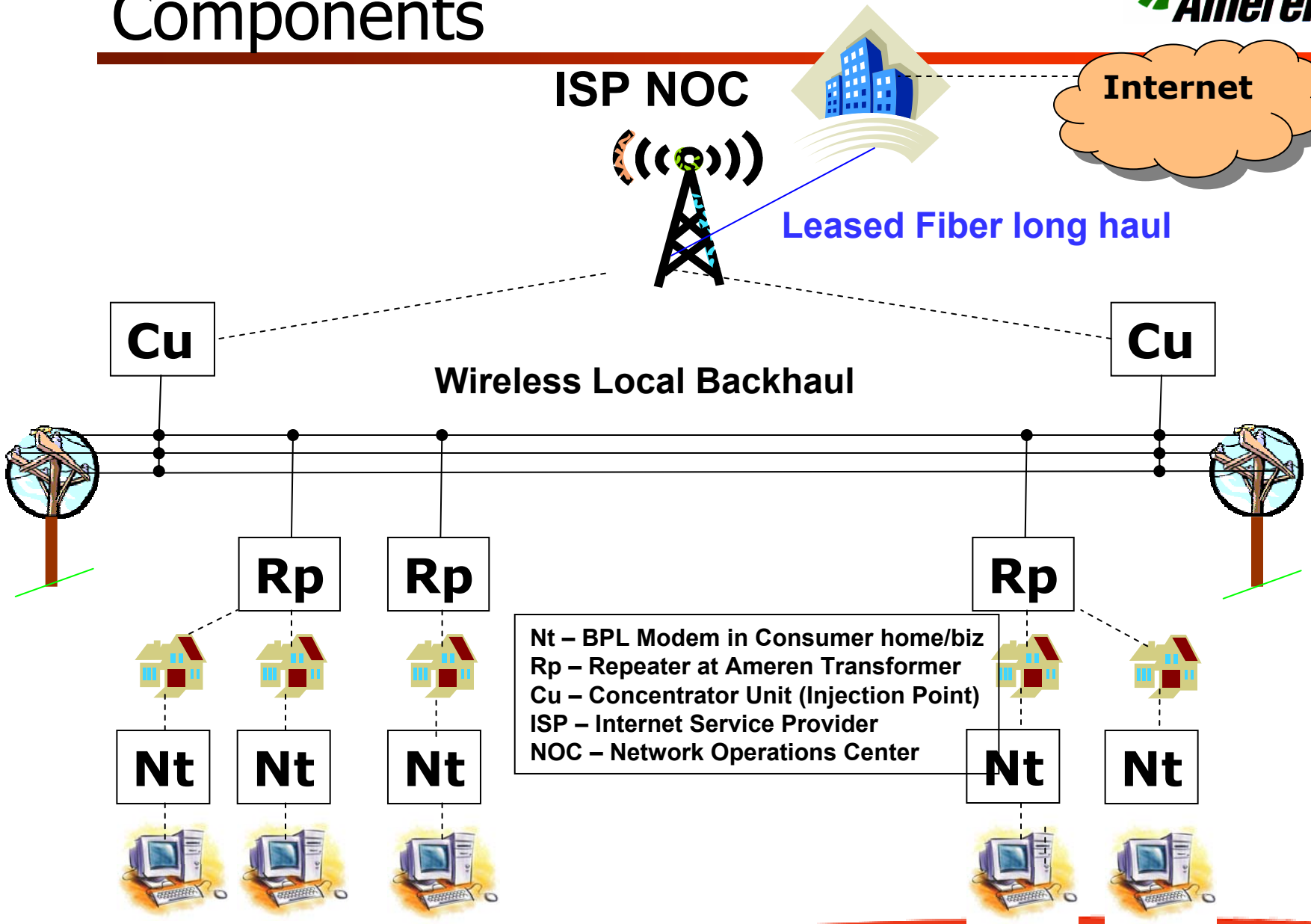
Utility Applications

- Operational
  - → Automatic meter reading
  - → Capacitor control
  - → Power quality monitoring
- Reliability (Prevention & Restoration)
  - → Real Time Demand Monitoring (Transformers & Feeders)
  - → Detection and diagnosis of events at capacitors and regulators
  - → Outage Monitoring, Diagnosis & Isolation
  - → Phase loss detection
  - → Distribution Substation monitoring
- Security Monitoring

Ameren Technical Trial Objectives

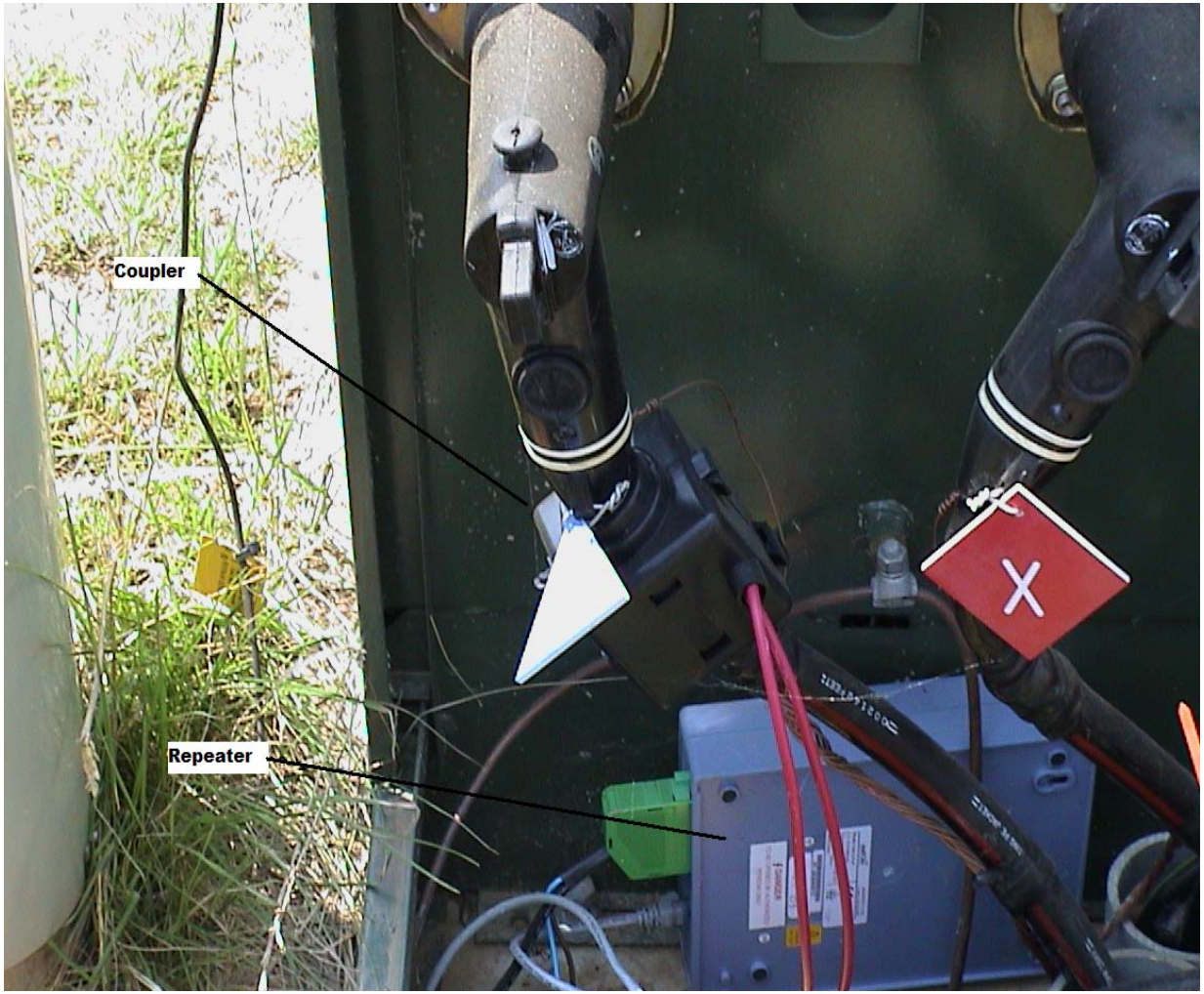
- Better understand BPL components and their impact on the AmerenUE distribution network
- Determine appropriate business model for BPL deployment
- Develop communications backhaul solutions
- Evaluate the customer acceptance of BPL broadband access
- Study utility applications of BPL
- Determine requirements for advancing to a commercial trial of BPL

BPL System Components



BPL Overhead Deployment

BPL Underground Deployment



Cape Girardeau Technical Trial

- Trial deployed in 2001 via Ameren Subsidiary, Ameren Energy Communications, Inc. (AEC)
  - ➔ An unregulated affiliate company
  - ➔ All equipment and time incurred by utility personnel was charged to AEC.
- Equipment development and selection
  - ➔ Main technology provider was Main.net PLC, Ltd.
  - ➔ Partnered with SIU-C to study emissions/interference, do technical performance evaluations.

Cape Girardeau Technical Trial

- Formed partnership with Big River Telephone Company, (Competitive Local Exchange Carrier, Cape Girardeau) for the provision of:
  - ➔ Leased lineT-1 backhaul at Cu (Injection Points)
  - ➔ All Internet Services (transport, web space, email, home page)
  - ➔ Network Management, NOC supervision
  - ➔ Customer Care

Cape Girardeau Technical Trial

- Trial "passes" 300 homes. Geographic area determined based on customer demographics to include Ameren Overhead and Underground facilities.
- The trial area was approximately 5 miles from Big River's backhaul Point of Presence (POP) and 120 miles from the nearest Internet POP (St. Louis).
- Participants were selected first come/first serve in response to a postcard soliciting volunteers. (Sent postcards to all 300 homes, took first 53 participants)
- Participants pay nothing for the service
- BPL equipment is easy to install.
- Biggest challenge was turning away others that wanted the BPL service and continues to be handling requests for expansion.

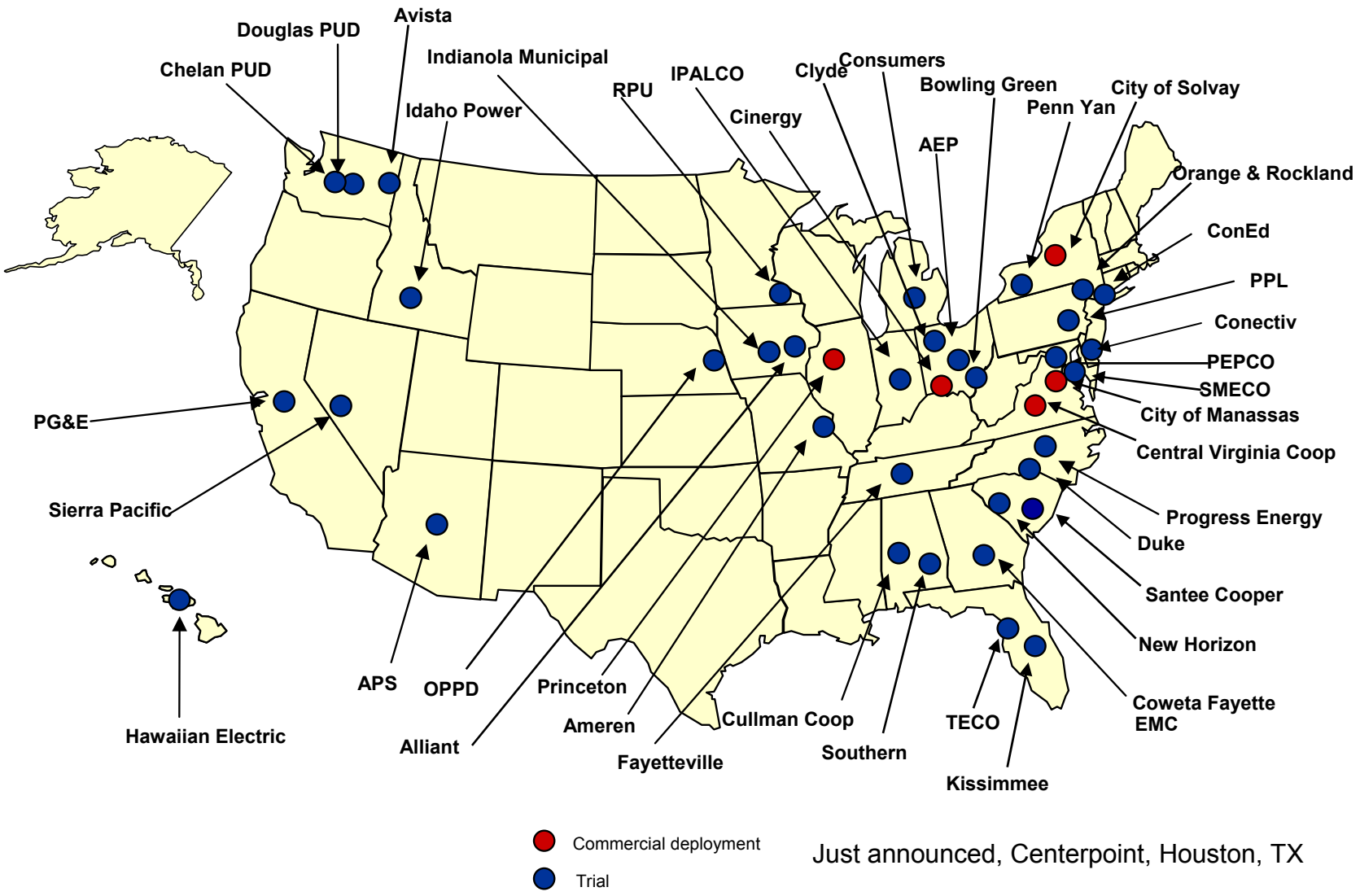
Cape Girardeau Technical Trial

- Lessons learned:
  - The service works. Customer realize speeds between 300-800 kbps, (synchronous) 24/7.
  - BPL equipment is rugged and withstands all weather conditions in SE Missouri. Maintenance and Repair costs minimal during the trial.
  - BPL equipment and service effectively support VoIP service.
  - Utility applications (AMR & Capacitor control) work well. Cost and availability of IP enabled utility end point devices not at mass market level needed for scalable expansion.
  - Participants are pleased and like the flexibility of the modem working in any outlet.
  - The technology continues to evolve, the Cape Girardeau equipment is already out dated.
  - Interference and/or harmful emissions can and were mitigated.

BPL August 2005

- Technical Trial is complete
- Ameren has no plans at this time to expand to a commercial market trial
- More utilities and Munis are looking into BPL
- Service speeds increasing rapidly: 1-3Mbps (synchronous) to user desktop is standard today. Equivalent to cable (only asynchronous) and faster than DSL
- Big names entering the arena: Mitsubishi, Motorola, Google
- BPL continues to gain support from public policy makers
- Internal utility applications are critical to widespread deployment of BPL by Ameren
- BPL standards efforts are quickly developing under IEEE

BPL in the US August 2005



Just announced, Centerpoint, Houston, TX

Questions

- www.plc-test.com

- Greg Lovett
  - glovett@ameren.com
  - 314-554-6415

Broadband Over Power Lines

Missouri Public Service Commission Roundtable Discussion

August 26, 2005

Governor Office Building
Jefferson City, MO

Broadband Over Power Lines

- What is it?
- How can it be used?
- How does it work?
- What problems can it cause?
- Who is providing BPL?
- So what's the catch?

BPL - What is it?

Broadband over Power Line (BPL) is a technology that allows electronic data to be transmitted over utility power lines. (BPL is also sometimes called Power-line Communications or PLC.)

BPL – How can it be used?

In homes and businesses:

- Now, high-speed internet access.
- In the future, remotely control every electronic device:
  - Security system,
  - Heating and cooling,
  - Lighting,
  - Even the coffee pot!

Utility network and system applications:

- Automatic meter reading (AMR)
- SCADA applications
- Load balancing and substation management
- Transformer/capacitor/recloser, etc. monitoring and control
- IP telephony (VoIP, digital telephone service)
- Infrastructure monitoring and video security

BPL – How does it work?

Simply, BPL works by

1. Modulating high-frequency radio waves with the digital signals.
2. The radio waves are added onto the utility grid at specific points.
3. The radio waves travel along the electric wires and by-pass the utility transformers.
4. For Internet access, the “last leg” of the radio waves’ journey can be on either:
   a. The electric line from the transformer to the house or business structure, or
   b. Via another communications technology such as wireless transmission.

To understand in greater detail, we need to look at both the delivery of electricity and the nature of BPL radio signals.

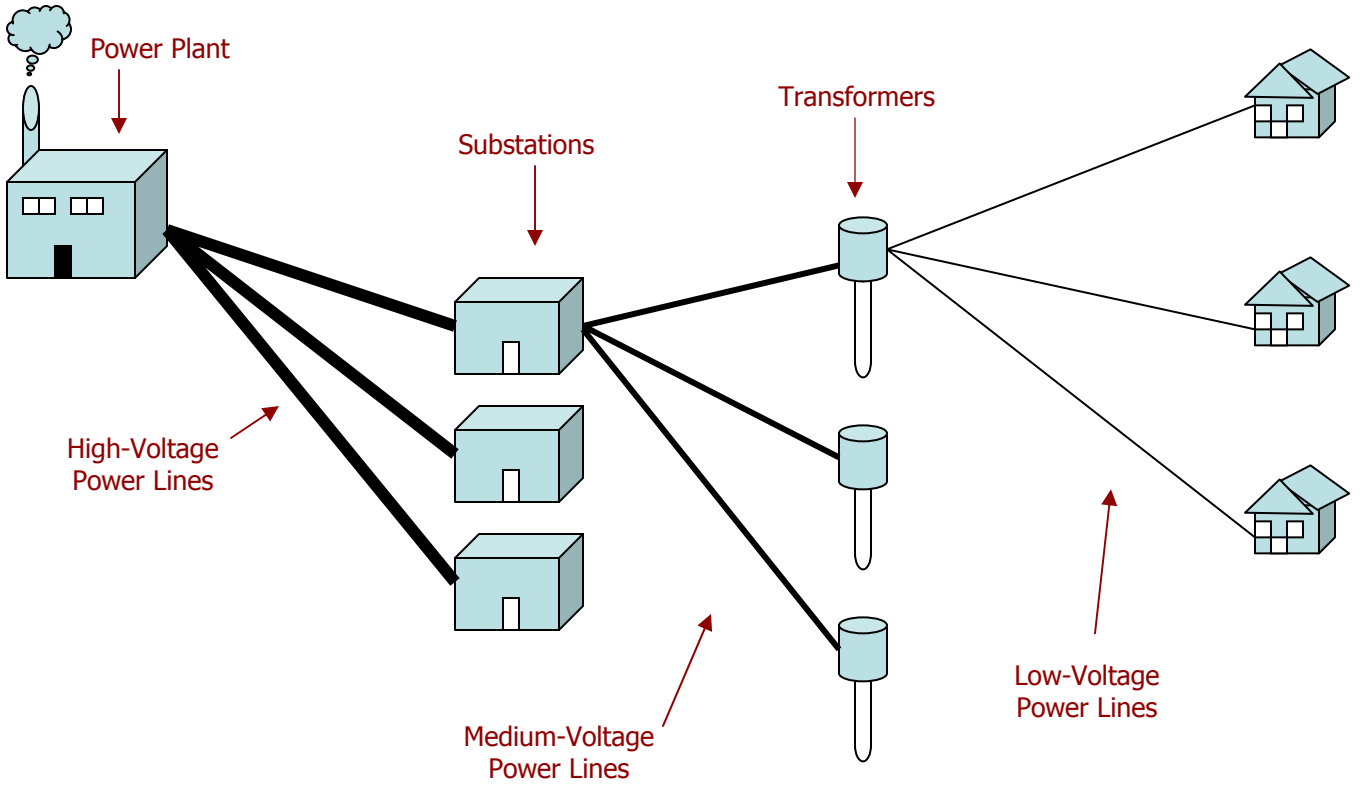
BPL – How does it work?

The basics of how electricity is delivered to our homes and businesses:

1. Power plants generate electricity.
2. That electricity is distributed to a variety of power sub-stations via high-voltage power lines.
3. A substation distributes its share of the electricity to a variety of transformers via medium-voltage power lines.
4. Transformers drop the electricity onto low-voltage power lines that delivery the electricity to a home or small business.

BPL – How does it work?

Here's what the delivery path for electricity looks like:



BPL – How does it work?

Understanding current:

- **Alternating Current (AC)** The electricity that arrives on the low voltage line into a home is referred to as Alternating Current (AC). AC vibrates at a steady frequency.

- **Radio-Frequency (RF)** Another current that vibrates at a steady frequency is Radio Frequency (RF). RF signals can be used to deliver electronic data. One drawback, RF signals deteriorate over distance.

- **The same, but different.** AC and RF both vibrate at steady frequencies. However, AC and RF vibrate at different frequencies. This allows both AC and RF to exist and operate simultaneously on the same power line. This isn't a particularly new discovery. Electric companies have used this technology for years to monitor the performance of power grids.

BPL – How does it work?

Understanding voltage:

- **High-voltage** The power that flows on the high-voltage power lines from the power plant to the substations is between 155,000 and 765,000 volts. Power at that level does not vibrate at a consistent frequency. This is not conducive to transmitting RF.

- **Medium-voltage** After flowing through a substation and being dropped to a medium-voltage power line, the power drops to a consistently vibrating 7,200 volts. This is stable enough to add RF to the lines.

- **Low-voltage** After passing through a transformer, the power that flows on the low-voltage line to a house or business is down to 120 volts. This is also stable enough to RF signals.

BPL – How does it work?

Merging RF unto the electric network to create BPL:

- The BPL signal cannot operate on the electrical distribution system until the electrical current has been dropped down to the level carried on the medium-voltage power lines. BPL can be added at any point from a substation to an end user's premises.

- An RF signal is not a stable signal over distance. It degrades gradually as it travels along the power line. Repeaters take the data being sent along the RF signal and repeats it into a new transmission, essentially "amplifies" the signal.

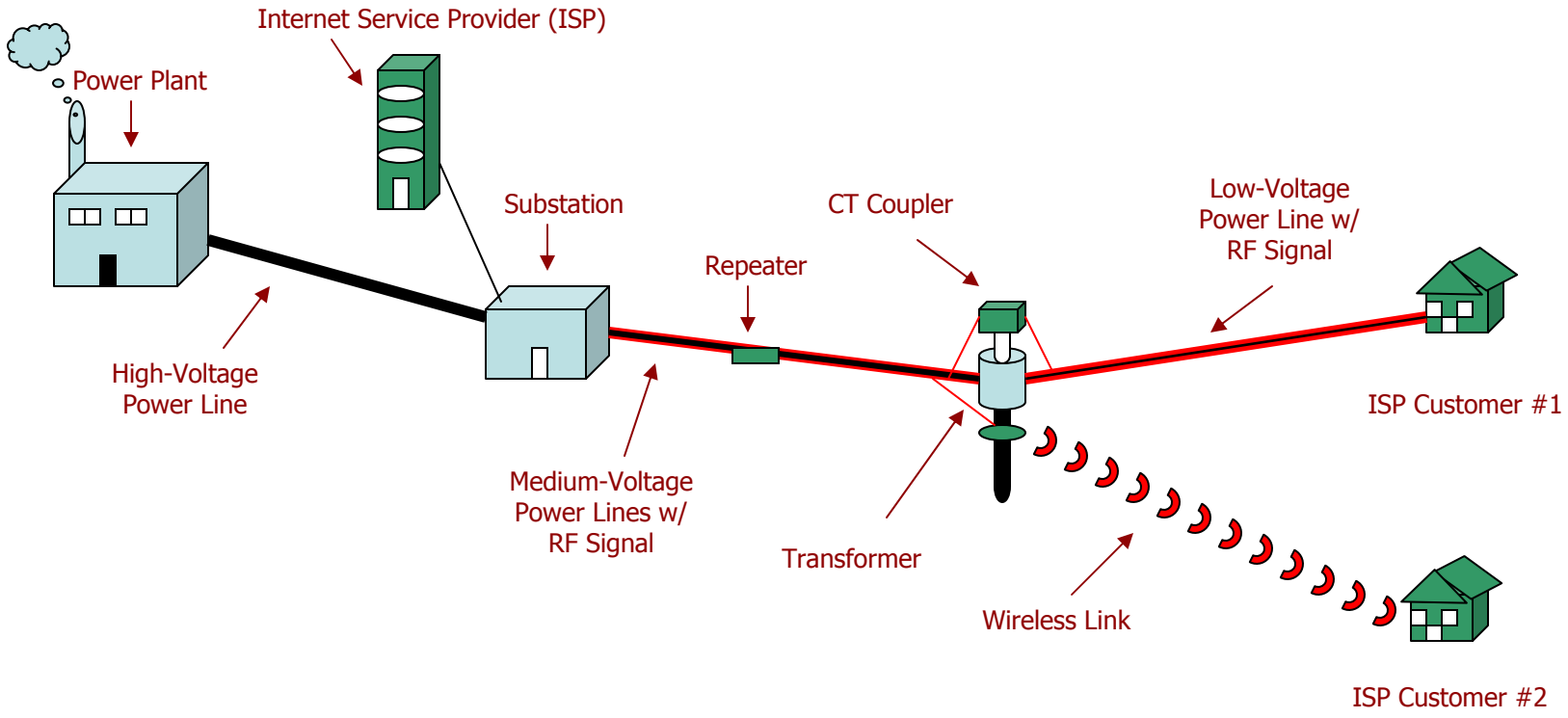
BPL – How does it work?

While the medium-voltage line and the low-voltage line are both stable enough for RF, the RF signal encounters some problems with the transformer. There are three ways for the RF signal to deal with a transformer:

1. The BPL signal can “blast” through the transformer without additional equipment, however the useable bandwidth that is delivered is limited.
2. The RF signal can by-pass the transformer by using a device called a CT (communications transmission) Coupler. The CT Coupler reroutes the BPL signal around the transformer from the medium-voltage to the low-voltage line.
3. The RF signal can be removed from the medium-voltage power line prior to the transformer and be sent via wireless links on the poles to the customer’s premises.

BPL – How does it work?

Here's the delivery path for electricity with BPL:



BPL – How does it work?

Here's what some of the equipment looks like:

Repeater

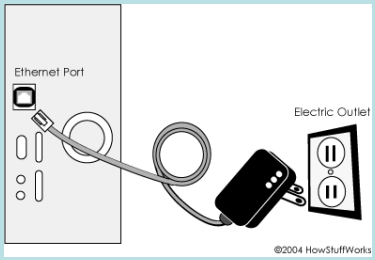
Coupler

Both from Amperion: www.amperion.com/products.asp

BPL – How does it work?

In the case of using BPL for Internet access, once the RF signal comes into a house, a BPL modem is required. A BPL modem is a small, “plug-and-play”, device not much different in size from a common power adapter, and can be plugged into any wall socket in the house and receive the data signal. The modem then uses either a cable or a wireless signal to a computer in the home to complete the connection between the computer and the internet service provided by the ISP.

Plug-in Ethernet BPL Modem



From Current Communications:
www.current.net/LearnMore/HowItWorks/

BPL – What problems can it cause?

Potential Radio Interference

The BPL modem is considered an unlicensed device in the same “class” as a cordless phone and a garage door opener. (Regulated by the FCC’s Part 15 rules.)

These devices must not exceed certain radio-frequency emissions.

Cable TV and Telephone cables avoid excess radio emissions by shielding its cable with braided metal around the signal wire.

BPL travels on, at worst a bare wire, and at best a wire coated only in plastic. The lack of shielding raises the concern over interference.

BPL – What problems can it cause?

April of 2003:

FCC issued a Notice of Inquiry (Docket No. FCC 04-245) seeking comments on the potential for BPL technology and to set standards of practice for its implementation.

Two very vocal entities expressed immediate opposition to the deployment of BPL:

American Radio Relay League (ARRL), and
Federal Emergency Management Agency (FEMA).

Both organizations presented concerns that the transmission of BPL on exposed medium-voltage power lines would create interference with other transmissions such a CB communications, air-traffic control, and government channels.

BPL – What problems can it cause?

October 14, 2004:

FCC *Report and Order* in Docket No. FCC 04-245 adopted rules to encourage the development of Access Broadband over Power Line (Access BPL) systems while safeguarding existing licensed services against harmful interference.

The FCC recognized the significant concerns regarding the potential interference and approved changes to Part 15 rules to ensure that BPL does not become a source of harmful interference to licensed radio services.

BPL – What problems can it cause?

Specifically, the *Order* by the FCC:

- Details rules imposing technical requirements on BPL devices, such as the capability to avoid specific frequencies and to remotely adjust or shut down any unit;
- Establishes “excluded frequency bands” within which BPL must avoid operating entirely;
- Establishes “exclusion zones” within which BPL must avoid operating on certain frequencies;
- Establishes consultation requirements with public safety agencies, federal government sensitive stations, and aeronautical stations;
- Establishes a publicly available Access BPL notification database to facilitate an organized approach to identification and resolution of harmful interference;
- Changes the equipment authorization for Access BPL systems from verification to certification; and
- Improves measurement procedures for all equipment that use RF energy to communicate over power lines.

BPL – Who is providing BPL?

There are vendors providing BPL service, provisioning equipment, as well as customer premises equipment (CPE). It is a growing business! A few examples of each are:

Access Service Providers:

- Ambient – www.ambientcorp.com
- Current Technologies – www.currenttechnologies.com
- Main.net Power Line Communications – www.powerline-plc.com

Provisioning Equipment Providers:

- Amperion - www.amperion.com
- DS2 – www.ds2.es
- Enikia – www.enikia.com

CPE:

- A list of various providers can be found at www.homeplug.com

BPL – So what's the catch?

BPL has a lot going for it:

- The technology works.
- It provides a viable alternative to customers to access the internet.
- It will provide businesses new ways to manage their facilities.
- It will also enhance the ability of the utility to manage and safe-guard the electric distribution network.

So what's the catch?

The only real questions is, as always, "Who pays?"

BPL – So what's the catch?

BPL for Internet Access:

- Access to internet service is competitive.
- The provision of electric service is not.
  - The electric service infrastructure has been paid for by captive customers.
  - The rates those customers pay have been based on the cost of providing only electricity.

Balancing the provision of a desirable, but competitive, service (internet service) to a broader base of consumers at a competitive price against the reality that captive electric service customers have funded the bulk of the infrastructure that is providing that service will be the unenviable responsibility of the regulators.

BPL – So what's the catch?

BPL for Network Applications:

Use of BPL for network monitoring, security, and management creates efficiency incentives. But, outfitting a network will cost money. Additional equipment is needed to implement BPL. In the past, captive ratepayers have carried a significant burden in paying for the network.

Who pays these costs should be made with consideration to all of uses of the technology.

BPL – Summary

What is it? BPL (also know as PLC) is a technology that allows data transmissions simultaneous with electric transmissions on the same electric power line.

How does it work? Since AC (electricity) and RF (radio frequency) vibrate consistently but at different frequencies they can exist and operate on the same wire at the same time. The RF can be used to transmit digital signals. That makes a variety of services, particularly high speed internet service, possible.

What problems can it cause? The main technological concern of BPL is the possibility of interference with other radio transmission. The FCC has addressed this issue and established rules regarding the BPL equipment capabilities.

Who is providing BPL? Although not ubiquitously provided, there are a number of companies providing BPL service, provisioning equipment, as well as CPE.

So what's the catch? The biggest "catch" to BPL is balancing the provision of a desirable, but competitive, service (high-speed internet service) and the equally desirable network management, monitoring, and security applications against the cost recovery mechanisms.

Do you have any…

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Broadband Over Power Lines (BPL)

Missouri PSC Roundtable

August 26, 2005

Ryan Kind, Office of the Public Counsel

Topics Covered

- Technology Overview – FCC slides
- Development Status in US –includes FCC slide
- Comparison with other broadband technologies
- Federal and State Regulations
- Role in expanding broadband access in US
- Regulatory Issues
  - Cost Allocation & Affiliate Issues
  - Radio Frequency Interference Issues

Broadband Over Power Lines
In the U.S.
FCC UPDATE

Bruce Romano
Associate Chief

Office of Engineering and Technology
Federal Communications Commission

6 April 2005

Two Types of BPL

IN-HOUSE BPL

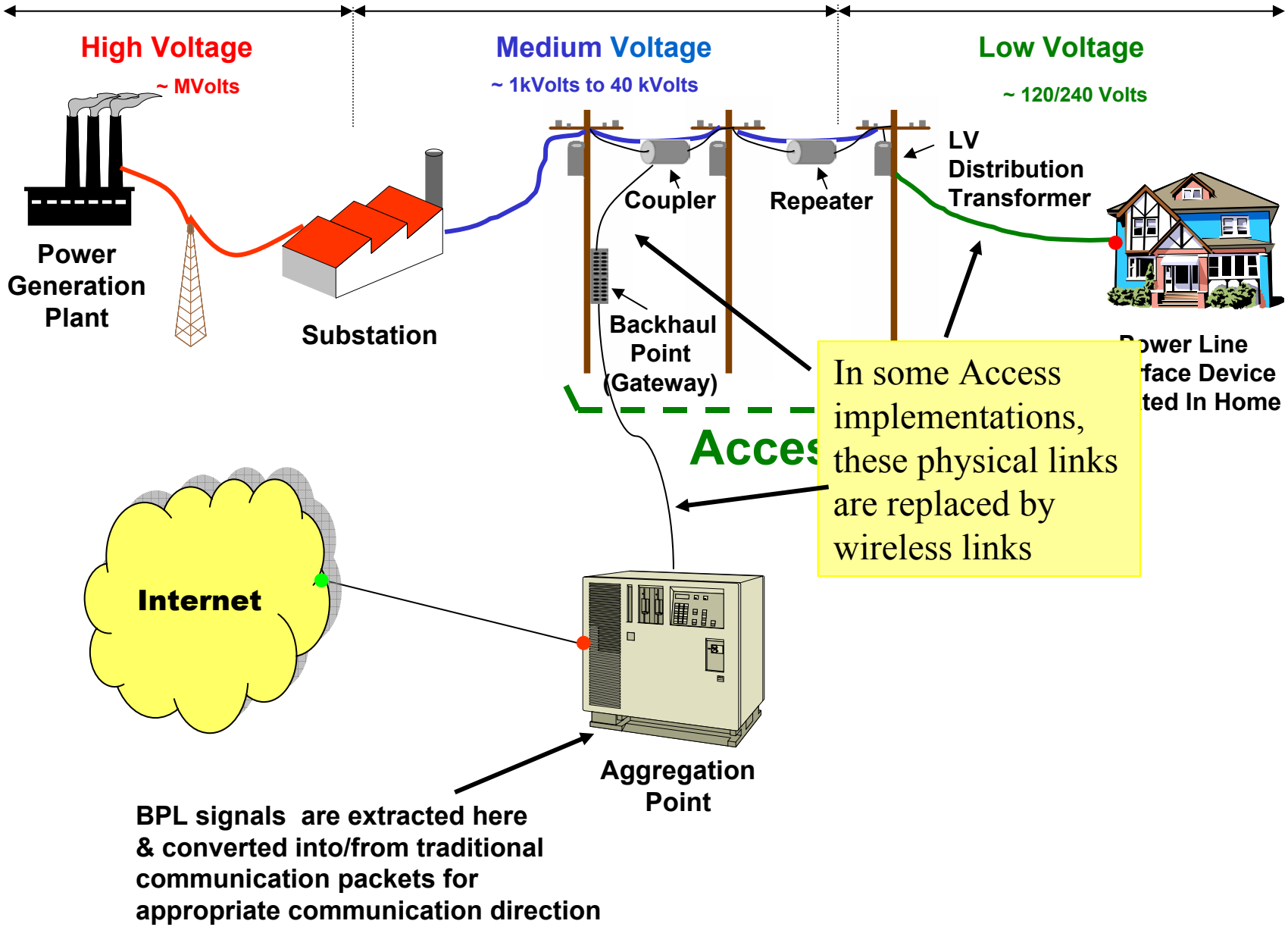
- In-Home Computer Networking, Or Link Between Access BPL & Home
- "Low Voltage" (120/240 VAC)

ACCESS BPL

- Broadband (Internet) Access
- "Medium Voltage" (e.g. 10kV)

Access BPL connects to computers in the home by in-house BPL or by WiFi (wireless)

Bruce Romano FCC Presentation - BPL Update (4/6/05)



BPL Products

Coupler 1

- Safely couples signal onto medium-voltage power lines

Backhaul-Point 2

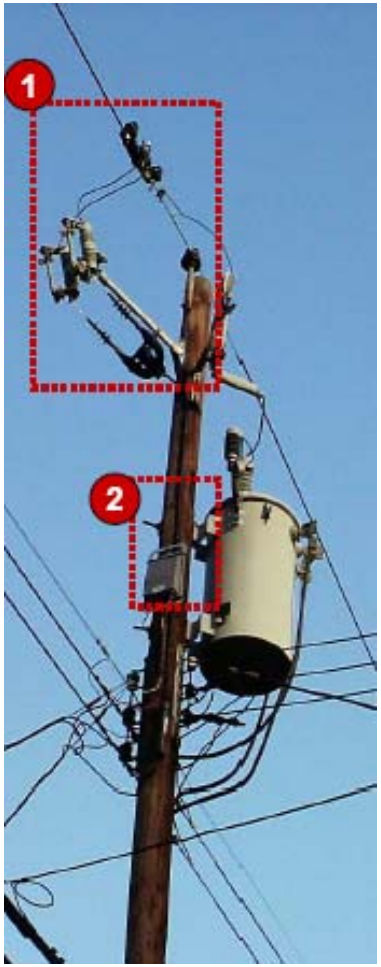
- Aggregates traffic from multiple Bridges and connects to the metro-area network

Bridge 3

- Deployed next to a transformer as gateway between low- and medium-voltage lines

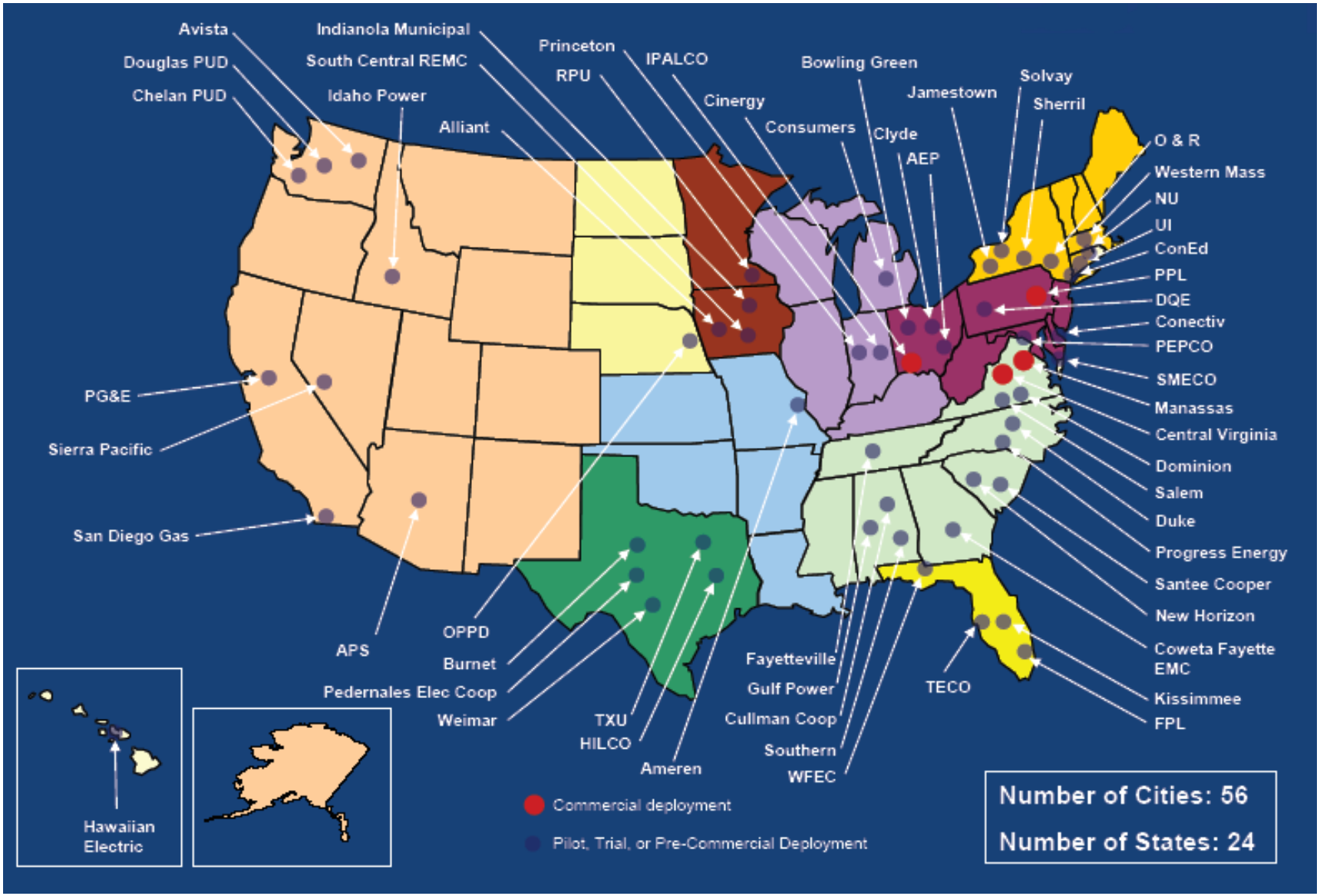
Actual installation of Coupler and Bridge at an aerial transformer

Installed Bridge Pole Assembly at an aerial transformer



Actual installation of Coupler and Bridge at an underground transformer

U.S.A. BPL Activity (publicly announced)



Deployment of BPL

- Involves power lines, so an electric utility (IOU, Muny, or Coop) is always involved.
- Most existing deployments involve the electric utility partnering with a BPL provider.
- Normal progression is:
  - Technical trial/pilot
  - Market trial
  - Phased in commercial deployment

Two Major Commercial Deployments in US

- Cincinnati, Ohio Area -
  - Utility – Cinergy Corporation
  - Utility Partner – CURRENT Communications
  - About 50,000 households signed up
  - $19.95 – $39.95/month depending on connection speed
- Manassas, Virginia
  - Utility – Manassas Municipal Utility
  - Utility Partner – Communications Technologies
  - About 37,000 residents with 12,000 signed up
  - $28.95/month, no long-term contract or equip. purchase

Broadband Technologies That Compete With BPL

- Cable Company - Coaxial Cable Connection
- Telephone line - Digital Subscriber Line (DSL)
- Fixed Wireless
- Satellite
- WiMAX - Wide Area Wireless
- Fiber Optic to the home???

Pricing of Alternative Broadband Technologies

- On June 1, 2005 SBC announced that it is offering SBC Yahoo DSL express to new customers with SBC local service for $14.95/month for a one-year contract.
- On August 23, 2005 Verizon announced that it is offering Verizon Yahoo for DSL to new customers in 28 states for $14.95/month for a one-year contract.
- Both offers are at the low end for broadband speeds but much faster than a dial-up connection.

BPL Strengths Compared to Alternatives

- Low cost of entry, quick deployment and fairly easy installation, in house wiring just needs modem at outlets and any outlet can become a broadband connection.
- Equipment vendors and utility partner providers are available.
- Recent FCC Rulemaking addressed many of the radio interference issues.

BPL Weaknesses Compared to Alternatives

- Cable and DSL providers have significant market penetration and loyal customers.
- Improved distribution operations and Smart Grid applications may be vital part of the business case for BPL (e.g. move towards predictive maintenance approach and away from scheduled maintenance).
- Ability to compete decreases as distances increase and customer density decreases (i.e. it's not the answer for bringing broadband to low-density rural areas).

Key Regulatory Issues

- Federal Issues
  - Radio interference
- State and Local Issues
  - Cost and revenue allocations/affiliate transactions
  - Pole attachments
  - Right of way issues
  - ISP and BPL provider access

Federal & State BPL Regulations

- Federal Communications Commission (FCC)
  - Notice of Inquiry – April 2003
  - Notice of Proposed Rulemaking – February 2004
  - Rulemaking Report and Order
    - Adopted October 14, 2004
    - Published in Federal Register January 7, 2005
    - ET Docket 04-37, FCC 04-245
- Texas Proposed Legislation – SB 21

FCC Rulemaking – Radio Interference Issue

- Concerns raised by numerous parties that BPL could interfere with existing licensed use of radio frequencies.
- Parties raising concerns included:
  - Emergency service providers
  - Aeronautical and Maritime users
  - Government agencies
  - Ham radio operators

Missouri Highway Patrol Expressed Strong Concerns

"The overall effect of BPL implementation will be a potentially significant increase in the noise floor, which will render impossible otherwise acceptable mission critical public safety communications."

(May 3, 2004 Comments of MO Highway Patrol in FCC's ET Docket No. 04-37)

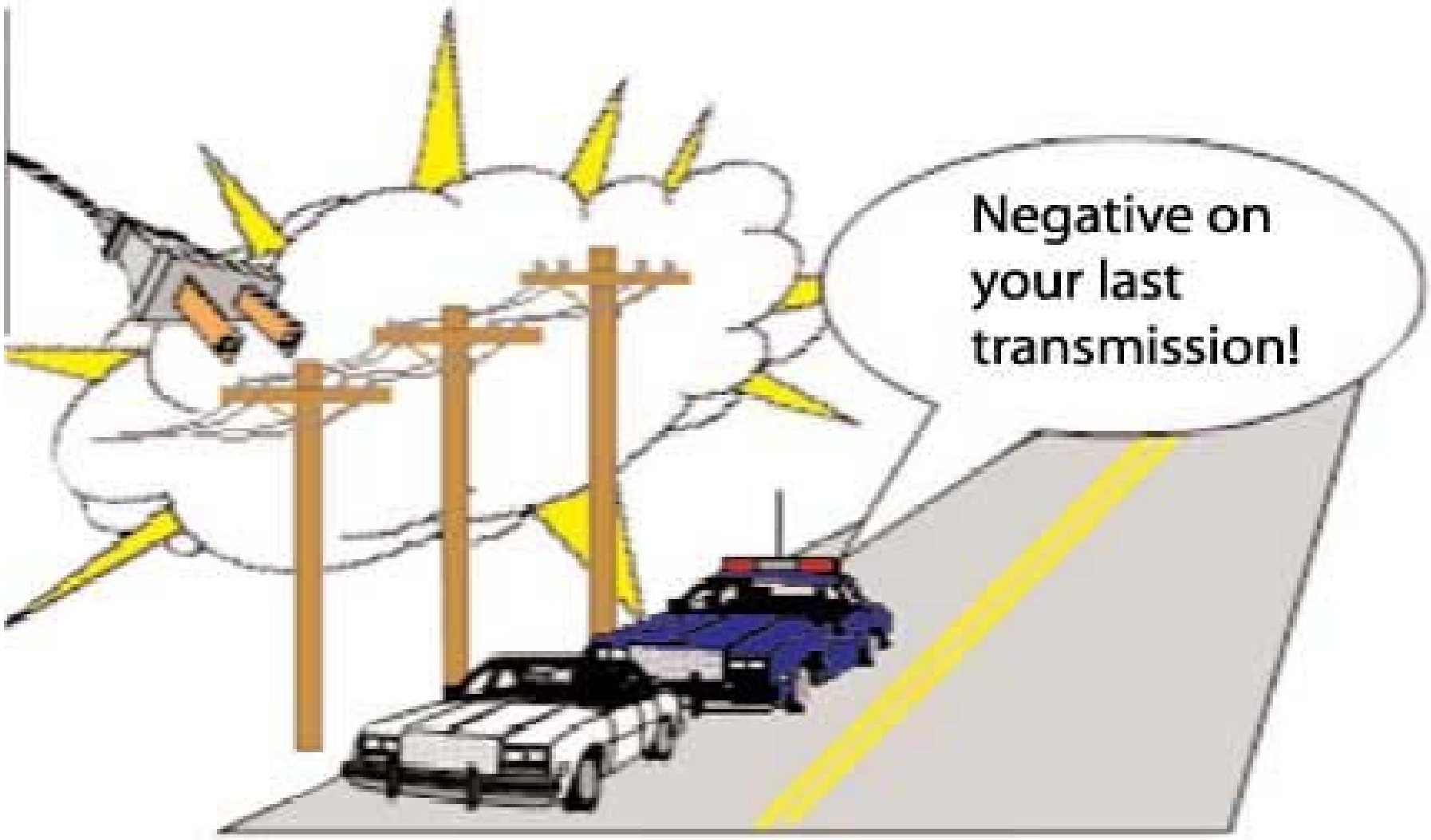
FCC Relied Largely on NTIA Study Filed in Rulemaking

- NTIA (National Telecommunications and Administration Information Agency) Report 04-413 filed in docket on April 27, 2004.
- The NTIA study provided several recommendations for both preventing BPL interference with radio communications and eliminating interference if it does occur.

FCC Order of Rulemaking

- The rules include provisions intended to protect licensed radio services including:
  - BPL cannot operate on “excluded frequencies.”
  - Geographic exclusion zones for other specified frequencies.
  - BPL equipment must have adaptive interference mitigation capabilities.
  - Consultation requirements with public safety officials and other identified sensitive users.
  - Publicly accessible database for BPL systems.
  - FCC certification of BPL equipment for compliance.
  - Measurement procedures and testing guidelines for BPL sites.

New FCC Rules are intended to avoid something like this!



Other (primarily state) Regulatory Issues

- Cost and revenue allocations
- Affiliate transactions
- Pole attachments and right-of-way usage
- ISP and BPL provider access

Allocation of BPL-Related Costs and Revenues

- State regulators will need to decide how to treat the costs and revenues associated with BPL service in situations where the service is provided by an affiliate of the utility or by an unaffiliated entity.
- The costs of building, operating and maintaining the utility distribution systems that enable BPL service offerings are recovered from ratepayers so they must be compensated for non-regulated use of these facilities for BPL purposes.

Allocation of Costs and Revenues (continued)

For utilities entering into arms length transactions with BPL providers that permit the provider to use the utility's distribution system, the NARUC February 2005 BPL report provides the following guidance:

"Based on historic cost accounting principles utilized by many regulatory commissions, the direct costs of BPL and that portion of the common costs of the distribution system attributable to BPL probably should not be supported by core electric ratepayers; rather, these costs should be imputed to the BPL service."

Affiliate Transaction Issues

- The Missouri Affiliate Transaction rule addresses the allocation of costs between affiliated entities. This would apply to BPL where the BPL provider is an entity that is defined by the MO rule as an affiliated entity.
- The MO affiliate rule could also apply if a utility seeks to provide customer specific information to a BPL provider even if it is a non-affiliated entity.

Pole attachments and right-of-way usage

- When utilities or their BPL partners attach additional equipment to poles for BPL service, pole attachment requirements may apply.
- When the right-of-ways of a local government entity are used to provide BPL service in addition to electric service, that entity may seek to collect additional franchise fees.

ISP and BPL Provider Access

- If a utility or its BPL partner starts to offer BPL service, should it be required to provide access to other ISPs?
- The next generation of BPL technology may provide sufficient capacity for more than one BPL provider to use the same power lines. Should the utility be required to permit additional BPL providers to use its lines?

Still interested in learning more about BPL?

- NARUC's "Report of the Broadband Over Power Lines Task Force" (February 2005)

  http://www.naruc.org/associations/1773/files/bplreport_0205.pdf

- EPRI White Paper entitled "Broadband Over Powerline 2004: Technology and Prospects"

  http://www.epriweb.com/public/000000000001011264.pdf