E3

Providers of Strategic Energy Services At The Exponential Interface Among

- Energy
- Economics and
- Environment

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THE E CUBED COMPANY, L.L.C.

November 13, 2008

David Salapa
Administrative Law Judge
Commonwealth of Pennsylvania
Pennsylvania Public Utility Commission
PO Box 3265
Harrisburg, PA 17105-3265

Re: DSR investigation at Docket No. M-00061984, Special En Banc Hearing on Alternative Energy, Energy Conservation and Efficiency, and Demand Side Response - Initial Comment of Joint Supporters Due November 14, 2008

Dear Judge Salapa:

The Joint Supporters wish to express their appreciation to the Commission for conducting the public En Banc Hearing on November 19th.[1] Thank you for permitting Arthur W. Pearson, C.E.M., Director of Project Operations, The E Cubed Company, LLC ("E Cubed") to speak on behalf of the Joint Supporters voluntary association entities.[2]

The Joint Supporters are an ad hoc voluntary association serviced strategically by The E Cubed Company, LLC. It includes leading and local providers of conservation services (both competitive and prescriptive), demand response services (more than 3,000 MW), and equipment providers and developers, including HVAC technology. The Joint Supporters further includes manufacturers of combined heat and power systems, including micro-CHP for residential households and small businesses and micro-turbines for meeting on-site loads of multi-family residential, commercial, and smaller industrial end-users. Since 1989 the Joint Supporters have participated in regulatory and policy proceedings in twelve States, three RTO/ISOs, and the Federal Energy Regulatory Commission.

Entities represented by the Joint Supporters range in size from international, national and regional firms active in Pennsylvania's demand side resource and energy efficiency marketplace, including demand response providers

[1] The Joint Supporters, as filed on November 3rd by The E Cubed Company, LLC, submitted initial comments on Act 129. Positions discussed here should be considered in light of those earlier filed comments.

[2] The National Association of Energy Services Companies (NAESCO) and Comverge, Inc., also voluntary associates of the Joint Supporters, are providing their own comments and spokespersons at the En Banc Hearing.

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active in PJM, New York, New England and California, manufacturers and distributors of energy efficient technology, including 23 locations in Pennsylvania which provide highly efficient energy equipment directly to more 10,000 local contractors. [3]

RECOMMENDATION #1

AEPS of 2004 Set the Stage for Act 129 And Should be Built Upon

Pennsylvania's Alternative Energy Portfolio Standard Act of 2004 serves as a foundation for the recent emphasis on energy resource conservation and set in motion precedents that were not fully recognized and integrated by the Legislature into Act 129, Tier II resources.[4]

The Commission needs to fully recognize the benefit of such precedents, revalidate and employ them going forward, especially for residential and small commercial end-users. Tier II resources including cogeneration, coupled with net metering and interconnection improvements soon to be finalized by publication in the Pennsylvania Bulletin can shoulder major efficiency objectives due to advances in deployment capability (e.g. demand side response and smart grid) and in technology, such as solar systems, ground source heat pumps, and residential micro-cogeneration (micro-Combined Heat and Power or micro-CHP) and microturbines.

RECOMMENDATION #2

Obtain Macro-scale Efficiency Savings Through Micro-scale Action

Pennsylvania has long been at the forefront of energy innovation starting with early utilization of the Commonwealth's indigenous energy resources, including waterpower, wood, coal, oil, and natural gas. In the early 20th century before the rapid spread of electric utilities in Pennsylvania approximately half the power produced in Pennsylvania was produced on-site rather than at remote generating facilities. [5] Energy efficiency is defined as the "first fuel" by the American Council for Energy Efficient Economy (ACEEE)

> "Energy Efficiency vs. Conservation: The difference between energy efficiency and energy conservation often confuses people. Energy efficiency is about doing the same amount of work—often in a better, cleaner and cheaper way—with less energy……
>
> This invisible resource is energy efficiency, or "the first fuel." And it is usually the best approach to meeting energy demand—the logical first step before

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[3] Other Joint Supporters entities listed for this appearance include: APR Supply Company (Lebanon and 21 other PA locations), IRR Supply (Erie), ECR International, Inc., Climate Energy, LLC, American Honda, Capstone Turbine Corporation, Energy Curtailment Specialists, Inc., Siemens Building Technology, Energy Spectrum, Energy Concepts Engineering

[4] The Joint Supporters have participated in previous Commission efforts regarding energy efficiency, net metering, interconnection, and implementation of the Alternative Energy Portfolio Standards Act of 2004

[5] US Census, 1910 (Manufacturing)

building expensive power plants or laying transmission lines. Energy efficiency is also the quickest and easiest approach to reducing greenhouse gases."[6].

At the macro level the Commission should recognize that Pennsylvania's, and indeed the nation's, newest indigenous energy resource in the 21st century is one of the oldest, e.g. the untapped efficiency potential on-site of "delivered energy", such as natural gas and LPG, and renewables that can offset the inefficiencies of undelivered electricity.

A very compelling argument for CHP/Micro-CHP at the residential level is provided by examining residential energy consumption data contained in the Reference Case in the Energy Information Administration's 2008 Annual Energy Outlook. Analogous conclusions can be drawn for commercial energy consumption. Electricity losses are much greater for both categories than for industrial energy consumption. [7]

The outlook shows approximately 21.6 quadrillion btus (100%) per year are needed at the first use to meet residential energy consumption in the US. (i.e. to supply all residential US homes with needed heat and electricity). Of the 21.6 quads, approximately 10.1 quads (47%) are lost to electricity inefficiencies (both in the generation process and line losses) and never reach the residence. About 11 quads of energy actually reach the home, with about 4.6 quads of electricity to be used by lighting and appliances and about 5.5 quads (25%) of natural gas and LPG and .85 quads (4%) of distillate fuel oil to provide heating and other uses. Renewables provide about .45 quads (2.1%) of delivered energy and residential use coal about .01 quads (0.05%).

Looking at percentages rather the quad numbers, the Reference Case data shows that 47% of the original energy needed to meet US residential needs represents electricity losses (due to inefficiency). Delivered electricity reflects about 21% of first fuel energy. Delivered natural gas and LPG reflects about 25% of original energy. Distillate fuel oil meets about 4% and renewables about 2% of original energy.

[See Attachment B for a graphic representation of the above information.]

As can be seen by the enormous amount of energy required to heat and power homes in the US, and the astonishing amount of energy wasted or lost due to the inefficiencies of the processes which we currently employ, there is much room for improvement.

A single micro-CHP system would reduce 30-35% of before fuel consumption. If all residential Natural gas and LPG were utilized in a hypothetical situation, then 10-15% of the overall energy inputs will be avoided. The environmental gains from this avoided fuel come in the form of avoided emissions due to never having to burn the fuel in the

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6 "The First Fuel, The cheapest and cleanest energy is the energy you don't consume", By Glen Andersen, State Legislatures, March 2008 (magazine of the national Conference of State Legislatures) http://www.ncsl.org/magazine/articles/2008/08SLMar08_Fuel.htm

7 http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2008).pdf

first place, and also from the fact that the fuel that is being burned is being utilized at a much higher overall process efficiency. Finally, the support and adoption of processes that represent dramatic first fuel savings addresses many of the national issues at the forefront our nations current agenda, including Energy Efficiency, Energy Independence, and National Security.

The Joint Supporters include E Cubed clients deploying highly efficient combined heat and power capabilities in conjunction with energy efficiency and demand response mobilizations in several states. To date nine states have included combined heat and power and waste energy in their efficiency and/or renewable portfolios.[8] Demand side response is reaching into many more states residing within at least four RTO/ISOs.

RECOMMENDATION #3

Establish First-Fuel Savings as a Goal of Conservation Programs.

The Commission should, on its own recognizance, establish first-fuel savings as a significant criterion in the design of programs pursuant Act 129 and earlier Legislation. EDCs and conservation service providers (both in competitive and in prescriptive programs) would relate kWh/btu savings objectives (and results) back to first fuel energy btu inputs. This would facilitates direct comparison of a wider range of alternatives. Measurement and Validation could be readily adapted to this objective.

RECOMMENDATION #4

Incorporate highly efficient thermally led CHP in emerging efficiency programs

The Commission should recognize highly efficient CHP configured to thermal needs of residential and commercial situations as a component of its emerging efficiency programs, especially micro-combined heat and power systems (micro-CHP) 1-3 family residences and small commercial situations and microturbine CHP systems in a range of behind the fence situations. At least one program of the EDCs deals with CHP in larger industrial situations. The mass market offers a different set of opportunities and challenges. It should not be ignored or deferred.

On-site residential and commercial projects are ideally sized to meet thermal load and some microturbine projects can have power to heat ratios that result in no excess electrons exported to the grid. On the other hand some micro-CHP systems designed to household thermal loads will need to send out some electrons, for example at night during the heating season, but at the end of the period no net excess is expected. Pennsylvania has already established net metering authority for CHP (soon to be finalized), but it is not expected to produce significant revenue for micro-CHP and microturbine systems.

Preferred up-front incentives in the current economic climate would help offset up-front investment including grants, rebates, loans, lowered interest arrangements, and

[8] Pennsylvania, Arizona, Colorado, Connecticut, Hawaii, Massachusetts, North Carolina, North Dakota, Nevada, and Washington. For perspective twelve states and the District of Columbia, including Pennsylvania, allow net metering for CHP.

other ratepayer incentives. State treasury incentives, such as loans and tax credits could assist as well, and should be expanded. Eligibility at the Sustainable Energy Fund should be endorsed and additional funding made available.

Preferred ongoing incentives would reward onsite consumption for example by monetization of environmental benefits and first fuel savings benefits. These may also factor into upfront considerations, including meeting more broadly defined TRC tests.

This is not just a recommendation about specific measures, which we recognize the Commission will address again. It is a also recommendation

RECOMMENDATION #5

Encourage EDCs and CSPs to deploy highly efficient thermally led micro-CHP for residential loads and highly efficient thermally led microturbines for commercial loads.

To portray potential efficiency benefits of a sample micro-CHP technology, we offer the following facts regarding the situation in Pennsylvania. There are approximately 3.9 million single-family homes in the Commonwealth that could be candidates for highly efficient production of clean and quiet heat and power at the home site. The homes heated by natural gas and propane are immediate candidates as their heating systems need replacement (approximately 120,000 gas boilers and furnaces are replaced each year). Conversions from oil system may also be candidates. Highly efficient micro-CHP systems are now available that demonstrate societal (before and after) fuel savings in the range of 30-35%, and societal emissions reductions in the range 85% (NOx), 50% (CO2), and SOx (100%). One such system is the freewatt® system[9] that combines ECR International's high efficiency boilers and furnaces and Honda's 1.2 kW clean, quiet CHP system. It is thermally led and operates during the entire heating season. It could be activated also to meet the 100 hour opportunity. The aggregate of systems installed within a network could provide relief of peak load requirements. [10]

SPECIFIC QUESTIONS PROVIDED BY STAFF

Joint Supporters comments are in bold italics.

1. The Electric Distribution Companies (EDCs) currently have some Demand Side Reduction (DSR) programs available to various customer classes. They have developed these programs voluntarily without any mandates.

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[9] http://freewatt.com

[10] The updated USEPA CHP emissions calculator has been utilized to demonstrate some of the benefits of 1,000 such installations deployed as a "CHP Fleet" in the Commonwealth. It is attached as Attachment B. Societal fuel consumption is reduced 39,000 MMBtu/year, societal emissions are reduced (NOx 9.2 tons / year, So2 41 tons / year, CO2 4,400 metric tons / year, Carbon 1,100 tons / year.) This carbon reduction is equal to the carbon emissions of 726 passenger vehicles on Pennsylvania's streets and roads and the annual carbon stored by 906 acres of pine and fir forests. The calculator is available as an Excel workbook at http://www.epa.gov/chp/basic/calculator.html

a. Should the EDCs' existing DSR programs provide the starting point or baseline from which new offerings could be developed?

Opportunities for new CHP measures such as outlined above, demand response, and energy efficiency should be encouraged.

c. Should EDCs re-open closed programs in order to fill in the gaps of the existing EDC DSR programs?

Selectively but keep the door open for new initiatives and new performers

d. Examples of existing EDC DSR Programs (2007):

1) Duquesne, FirstEnergy, PECO, PPL and UGI have load reduction programs requiring use of an interval meter for Commercial & Industrial (C&I) customers.

2) Duquesne and FirstEnergy have load control programs for residential and small C&I customers.

3) FirstEnergy has a distributed generation program for C&I customers. ***We recommend a DG/CHP program for residential customers.***

4) PennPower has an hourly pricing program available to C&I customers.

5) Most of the EDCs already have some Time of Use (TOU) or Billing Demand programs available to various customer classes.

6) UGI offers to audit customer facilities as well as provide a rebate program for high-efficiency heat pumps.

7) FirstEnergy offers customers a web-based calculator. FirstEnergy is also currently considering two new programs: Power Factor correction for C&I and a Thermostat/Appliance Price Response Program for residential and small commercial customers.

2. Should the DSR/Energy Efficiency (EE) programs be combined to have the greatest impact? For example, should an education campaign combined with an offer to install frequently-used EE measures be one program? Can be combined but may need to track components in planning, implementation and during evaluation.

We support multiple competitive and prescriptive opportunities. EE, DR, and CHP should be distinctly solicited. And not all DR or all EE or all CHP should be assigned to a single supplier.

3. Should DSR and/or EE programs be fully recoverable in rates if demonstrated to be cost effective by satisfying the Total Resource Cost (TRC) benefit test? Are there other cost/benefit tests the Commission should use? Should the Commission use multiple tests in evaluating programs?

TRC does not adequately recognize societal benefits, such as energy – in/energy-out

computations, emissions reductions and benefits, and others – we need to review PUC formulations currently in use.

The Joint Supporters encourage the Commission to consider widening the Total Resource Cost Test (TRC) criteria in order to recognize societal energy (fuel) savings and which recognizes societal environmental savings.

Typical TRC tests have not addressed the equivalents of the total 21 quadrillion btus as energy inputs to the residences, only the equivalents of the 11 quadrillion btus that are delivered. In short, delivered btus are acknowledged with possible recognition for "line losses" avoided, but not the inefficiencies of off-site conversion of fuel to electricity. That whole benefit of EE and CHP is not acknowledged significantly in typical TRC Tests.

On-site production of clean heat and power offers a dramatic resource to reduce these inefficiencies that are not now typically recognized in the TRC test. The EPA CHP emissions calculator identified above calculates the societal energy savings (btus in and btus out) as a by-product of the calculation of emissions reductions. In the illustration in Attachment B, the traditional model requiring btus supplied for remote electricity generation plus on-site thermal generation is compared to on-site micro-CHP generation where the thermal and electrical loads are partially or fully satisfied on-site. The results of the comparison corresponds to a 34% reduction in societal energy needs in order to heat and electrify one thousand homes with a portion of the electricity produced on-site.

If the additional potential of delivered natural gas and propane can be mobilized to produce electricity at the site, then a dramatic savings in societal energy could occur.

We recommend that the TRC tests authorized by the Commission should be altered to recognize the entire chain of electricity efficiency losses as being displaced by an EE measure, for example efficient clean heat and power.

4. Should the Commission specify smart meter capabilities or standardize meter interoperability for new meter installations? If so, what should those standards be?

All need to be interoperable but frankly with internet-ready on-site capabilities, e.g. direct load control, micro-Combined Heat and Power and microturbines, communication directly with on-site equipment is now readily achievable. Results can be verified readily by third parties.

5. Should time-of-use rates and other load-management type rates be introduced as a cost-saving measure? Should these programs be launched prior to rate cap expiration or to coincide with rate cap expirations?

Standards should be set that allow the energy efficiency benefits of "bridging technology" with all fuels to come to the fore before renewables can be widely and

cost-effectively deployed. Policies encouraging the deployment of "bridging technology" helps to emphasize and recognize such efficiency and emissions reduction benefits as those of combined heat and power and especially micro-combined heat and power illustrated above in a footnote. Increasing the availability of a varied set of measures increases the likelihood of adoption of some type of measure by customers who have limitations to implementation of certain measure – adoption is the goal. [11]

BRIDGING TECHNOLOGIES: Bridging technologies, such as energy efficiency, combined heat and power, and load management are consciously part of the Alternative Energy Portfolio in Connecticut and Massachusetts, and to a certain extent in the AEP in Pennsylvania. For example, all three recognize CHP as part of their AEPS approach and provide overlapping incentives, including net metering and monetary incentives in the case of the other two jurisdictions. Connecticut, which converts the thermal benefit of CHP to kWh units as illustrated above, then grants Class III certificates to the CHP projects. It is advantageous when a State has already recognized the benefits of a measure, such as Pennsylvania has with its inclusion of CHP in net metering rules. It is important to encourage distribution companies to seek out other roles for bridging technology in the programs that they are preparing, including by program design encouraging the bidding Conservation Service Providers to seek out bridging technologies and services.

> ***We recommend that the Commission encourage the deployment of bridging technologies in the submissions of the distribution companies and that these become an accepted part of the approval process. Regulators and/or State Energy Offices and other authorities when local custom requires are addressing these issues in other States in order to optimize the benefits of bridging technology. It is fitting that Pennsylvania do so.***

6. Should some or all DSR/EE programs be coordinated across the Commonwealth to act as one program? If so, what types of programs? What types of programs should be utility specific?

DSR/EE/and CHP could be implemented either way. A prime criteria is access to resources. If one avenue does not open up promptly, the Commission should maintain flexibility to re-position programs. A central funding avenue provides substantial flexibility in the face of slower moving initiatives by other parties.

7. Should statewide energy and demand-reduction (DR) targets be identified and set? Yes How would these targets be set, and what are reasonable targets?

Targets should be set but should not be exclusively for either kWh or kW reductions.

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[11] That efficiency benefit of that 35% societal fuel reduction converted from MMBTu to kWh (3,413 btu per kWh) in that example is the equivalent of 11,500,000 kWh saved over the course of a year. Connecticut and various other States employ this device to evaluate in electricity terms the input and output energy comparisons for at-the-site thermal generation and at-the-source electrical generation.

Targets should be set for reducing society's original fuel use.

The five year window is too long to wait for the introduction of new approaches and to provide for the addition or substitution of measures. We suggest an annual review.

8. Should utility-specific EE and DR reduction goals be established? Yes.
a. If yes, how should such cost-effective reduction goals be determined?

Goals should be mandated. Means should be negotiated.
b. If yes, how should this be accomplished?

A shareholder process may be appropriate but should not delay mobilization of measures.

9. How many and what types of programs should be selected?

Standards should be set that allow the energy efficiency benefits of "bridging technology" with all fuels to come to the fore before renewables can be widely and cost-effectively deployed. Policies encouraging the deployment of "bridging technology" helps to emphasize and recognize such efficiency and emissions reduction benefits as those of combined heat and power and especially micro-combined heat and power illustrated above in a footnote. [12]

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authorities when local custom requires are addressing these issues in other States in order to optimize the benefits of bridging technology. It is fitting that Pennsylvania do so.

10. How should the programs be selected?

The Joint Supporters are strong advocates of providing competitive opportunities for conservation service providers (CSPs), offering multiple measures to participate in many aspects of implementing a plan. They have assisted in the design and implementation of a number of programs that have been competitively bid by CSPs.

However, they also believe that there is a major role for standard offers for measures in the form of rebates, other incentives, and monetary awards, such as incentives with parity for residential solar installations and for residential micro-CHP systems, e.g. up to 50% of installed cost.

11. Should these programs be subjected to rigorous program evaluation?

Yes. Going in and after implementation.

a. Is a determination of cost-effectiveness based on a TRC test sufficient? Is there a need to conduct classical program evaluation where net impacts are actually measured?

Cost-effectiveness tests should include societal and participant benefits, original societal fuel inputs should be included, monetization of emissions savings should be considered, including carbon dioxide and other emissions.

b. What it is the likely cost to properly evaluate these programs? **2-4%**

c. How often should the programs be evaluated?

More frequently than every five years. New York's SBC program is evaluated every year by the SBC Advisory Board on which several representatives of Joint Supporters entities have experience. With contracted help it is quite feasible. However, scaling to multiple EDC programs may require a multi-tier capability and increased staffing capability for the Commission, the Consumer Advocate and other state sponsored entities.

d. Should the programs undergo process evaluations to determine if they are being implemented and targeted as designed, or is there is a need for early implementation adjustments to increase their effectiveness?

Staged implementation requires staged process evaluations.

12. Who should (1) select, (2) develop, and (3) administer the EE and DR programs? The utility, the PUC or a third-party administrator?

All are needed. Each approach offers value. Different models are being employed elsewhere. Good features exist for each. Third-party administrator offers value as able to expand existing institutions' mission taking advantage of expertise at hand.

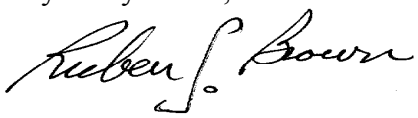
13. What level of costs is reasonably required to administer these programs successfully, expressed as a percent of total costs? What types of costs should be considered "administrative" costs?

6-8%

14. Should the Commission establish standardized rules for meter and meter data access to facilitate third-party DSR programs and other energy-management services by Curtailment Service Providers and other energy-management providers? ***Yes***

The E Cubed Company, LLC and the Joint Supporters appreciate this opportunity to submit these comments.

Very Truly Yours,



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President, The E Cubed Company, LLC

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On behalf of The Joint Supporters who for this purpose include:

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ECR International, Inc.
Energy Concepts Engineering, PC
Energy Curtailment Specialists, Inc.
Energy Spectrum, Inc.
Siemens Building Technology, District One

Attachment A

EXPERIENCE OF THE JOINT SUPPORTERS IN AEPS, EPS, AND EE PROGRAM DESIGN

The Joint Supporters have participated in previous Commission efforts regarding energy efficiency, net metering, interconnection, and implementation of the Alternative Energy Portfolio Standards Act of 2004. They have addressed similar design and implementation issues in other States, including Connecticut's Energy Independence Act of 2005, Rhode Island's Energy Policy of 2006, New York's Efficiency Portfolio Standard of 2007 (15% reduction by 2015), and the Massachusetts Green Communities Act of 2008,

Earlier they negotiated the design of New York's independently administered System Benefit Charge (SBC) program (more than one billion dollars over ten years) and the demand resource programs of several wholesale market institutions now involving thousands of Megawatts of demand response and energy efficiency. New York's individual regulated utilities who were moved out of DSM a decade ago started returning via demand response several years ago. The North American Electric Reliability Council's current ten year outlook anticipates 80% of load growth between now and 2016 will be met by 34,000 MW of demand response and 11,000 MW of energy efficiency. New York comprises a significant component of these amounts.

In 2005 and 2006 the Joint Supporters negotiated the design and implementation of a $250 million effort to mobilize energy efficiency, demand response, and distributed generation to meet 100% of load growth from 2005-2008 (850 MW) in the Consolidated Edison Company of New York territory. This effort is in the process of transforming into an incremental $180 million per year for a three year series of programs run by multiple program administrators, including the independent administrator (NYSERDA) and all regulated electric and gas utilities who are returning to the management of energy efficiency programs, clean distributed energy, and demand response. The Joint Supporters have been active in six of eight stakeholder workgroups designing the EPS over the past eighteen months. See recommendations below regarding employing a modified New York approval plan.

In addition to these activities, The E Cubed Company offers outsourced energy management services and project management services. Most recently these services were provided for the development of a one megawatt combined heat and power plant for a mixed-use development in Brooklyn. The project provides electric and thermal energy to 45 apartments, offices and a supermarket and received an Energy Star Award from the US EPA in June of this year.

The Joint Supporters include E Cubed clients moving to deploy efficient combined heat and power capabilities in conjunction with energy efficiency mobilizations in the several states. To date nine states have included combined heat and

power and waste energy in their efficiency and/or renewable portfolios.[13] We would like to encourage Pennsylvania to recognize highly efficient CHP as a component of its emerging efficiency incentive programs, especially for micro-combined heat and power systems (micro-CHP) for residences and smaller commercial situations and microturbine CHP systems in all situations.

The procedures employed in other jurisdictions for approval procedures for similar measures may be instructive, although not determinative, of course, given the uniqueness of Pennsylvania's policy determination and regulatory system. It is important to note, for example, that clean energy, efficiency and renewable portfolio policies in the States of Connecticut, Massachusetts, New York, and Michigan typically involve both the electric and the gas distribution companies. The instant legislative mandate here in Pennsylvania appears more narrowly focused on electric distribution companies.

> The Joint Supporters believe that the Commission should broaden the effort at its own initiative in order to bring in the gas distribution companies with parallel and/or analogous planning and mobilization objectives.

This helps permits the energy efficiency benefits of "bridging technology" with all fuels to come to the fore before renewables can be widely and cost-effectively deployed. Policies encouraging the deployment of "bridging technology" helps to emphasize and recognize such efficiency and emissions reduction benefits as those of combined heat and power and especially micro-combined heat and power illustrated above in a footnote. [14]

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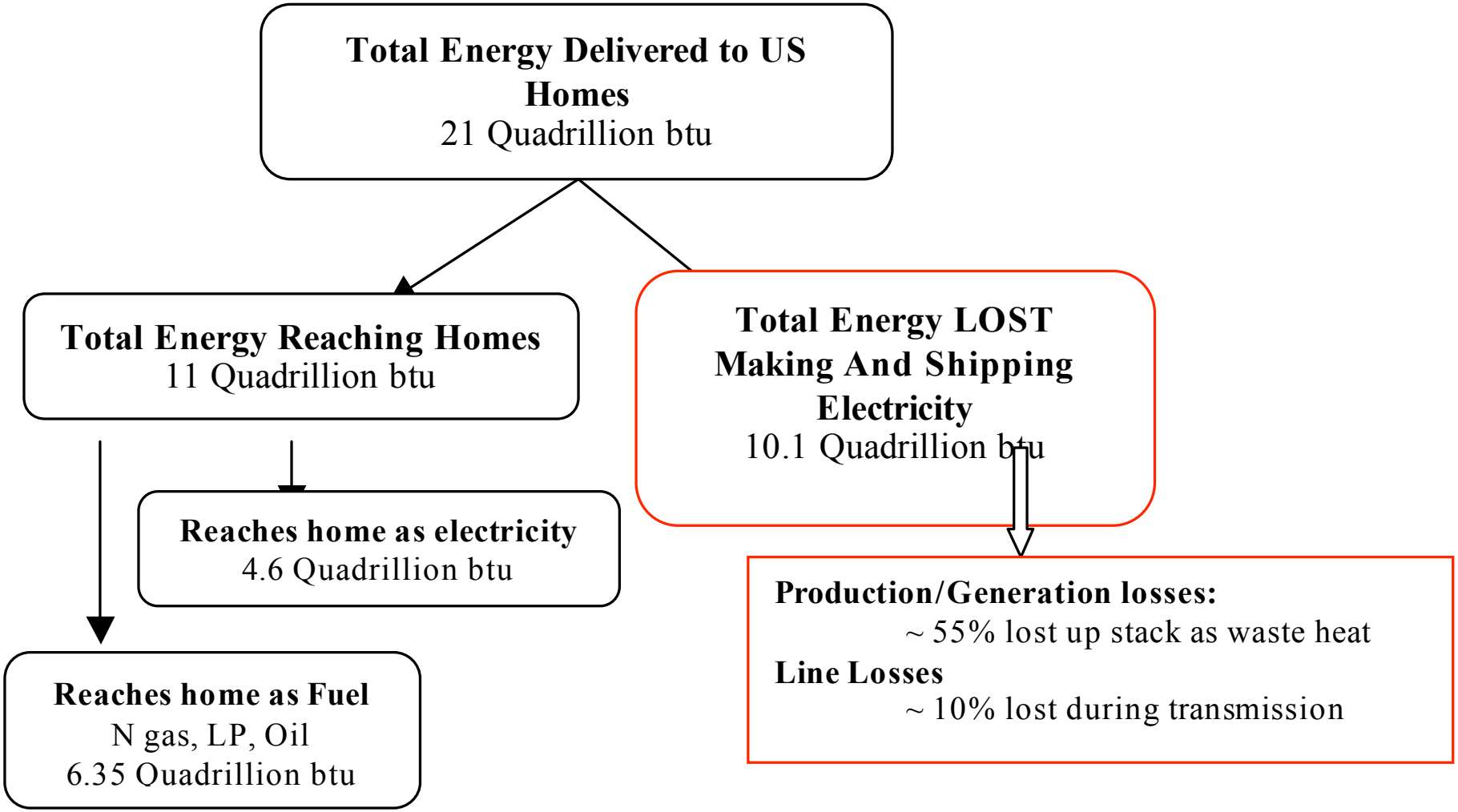
Total Energy Delivered to US Homes
21 Quadrillion btu
Total Energy Reaching Homes
11 Quadrillion btu
Total Energy LOST Making And Shipping Electricity
10.1 Quadrillion btu
Reaches home as electricity
4.6 Quadrillion btu
Reaches home as Fuel
N gas, LP, Oil
6.35 Quadrillion btu
Production/Generation losses:
~ 55% lost up stack as waste heat
Line Losses
~ 10% lost during transmission