

# ***Minnesota Combined Heat & Power Policies and Potential***

## **Presentation to Minnesota Department of Commerce CHP Stakeholder Workshop**

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**Sept. 3, 2014**



*Global Presence  
Local Solutions*

# *Agenda*

- **Introduction to FVB**
- **CHP Overview**
  - **Why CHP is important**
  - **State and federal policy context**
  - **Key challenges**
  - **CHP technical potential**
- **Policy Options and Analysis**
- **Recommendations**



Global Presence  
Local Solutions

A partial view of the Earth from space, showing the blue oceans and white clouds of the planet's surface.

District Cooling

Thermal Energy Storage

Combined Heat and Power

Deep Water Cooling

District Heating

Geothermal Energy

Biomass Energy

- Consulting firm specializing in sustainable energy systems for over 40 years
- Offices in Sweden, Canada and USA
- Design Services
  - Conceptual design engineer
  - Owner's engineer in projects delivered through Engineer/Procure/Construct
  - Final design, specifications and construction drawings and field supervision
- Management Consulting Services
  - Feasibility studies
  - Energy business structuring and financing
  - Marketing and negotiation of energy service contracts
  - Cost of service and rate design studies
  - Due diligence analysis for energy business sale or acquisition
- Policy and Legislative Analysis and Advocacy

*Minneapolis Toronto Edmonton Vancouver Stockholm Västerås Bahrain*



## Mark Spurr

- President, FVB Energy USA
- Legislative Director, International District Energy Association (IDEA)
- Executive Committee for International Energy Agency DHC/CHP program
- 35 years of energy analysis experience
- Directed the development of first complete analysis of Minnesota's energy future (Energy Policy and Conservation Report, 1980)

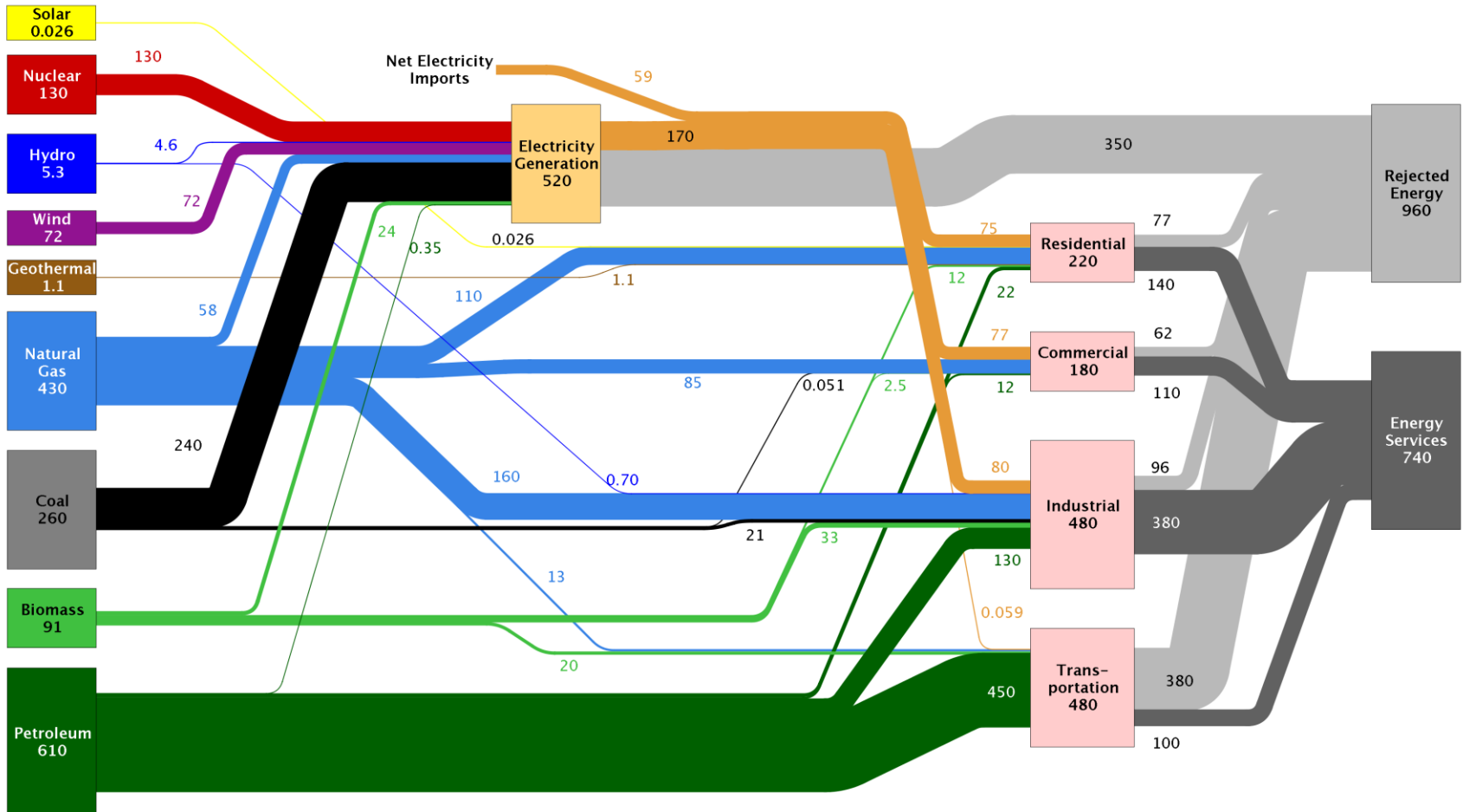
### Recent work includes

- Minnesota Department of Commerce:
  - *Minnesota Combined Heat and Power Policies and Potential*
  - *Assessment of the Technical and Economic Potential for CHP in Minnesota*
- International Energy Agency: *Economic and Design Optimization in Integrating Renewable Energy and Waste Heat with District Energy Systems*
- International District Energy Association, *District Cooling Best Practice Guide*
- University of Virginia: *Strategic Fuels Alternatives Assessment*
- Metropolitan Washington Council of Governments:
  - *Integrating Energy into Local Regulations and Programs*
  - *Business Case for Integrated Energy Solutions*

# Why CHP is Important

*Minnesota is only 43% efficient in converting fuel to useful energy*

Estimated Minnesota Energy Use In 2012  
~1700 Trillion BTU

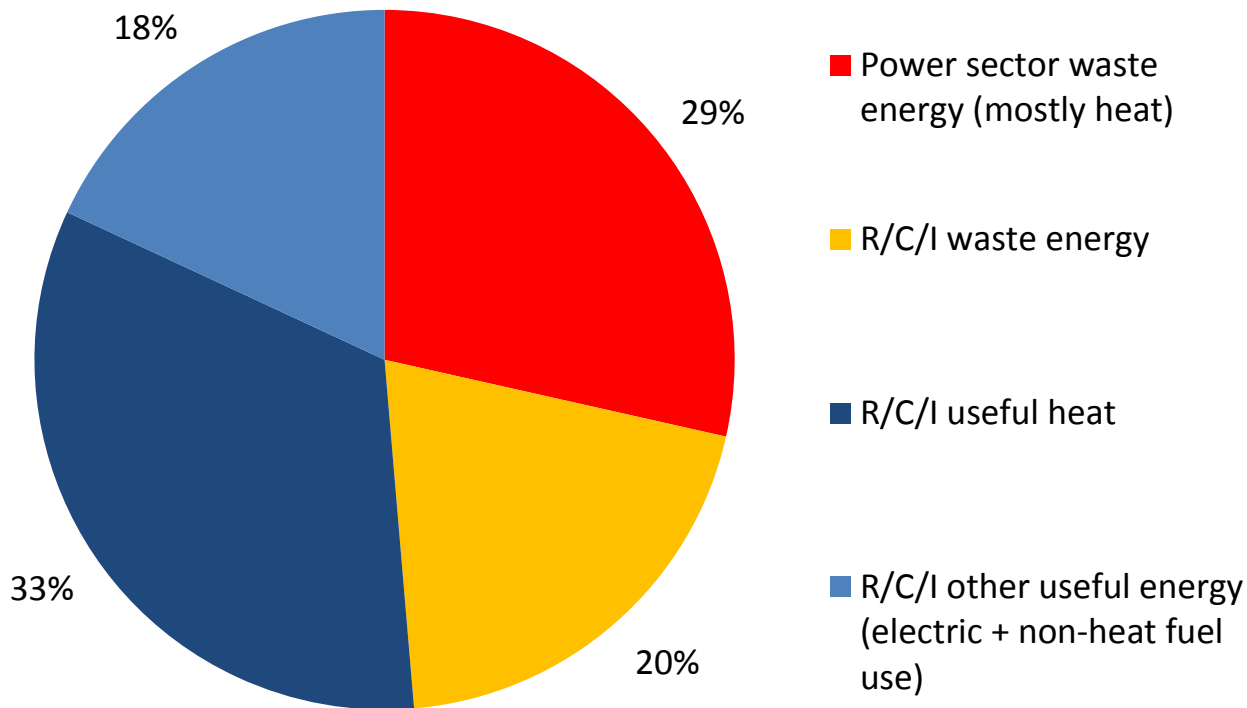


Source: LLNL 2013. Data is based on DOE/EIA-0214(2011), June 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports flows for non-thermal resources (i.e., hydro, wind and solar) in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. Interstate and international electricity trade are lumped into net imports or exports and are calculated using a system-wide generation efficiency. End use efficiency is estimated for each sector as 65% residential, 65% commercial, 80% industrial and 21% transportation. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527



# Why CHP is Important

**Minnesota Non-Transportation Energy 2012 (Total 1,227 Trillion Btu)**



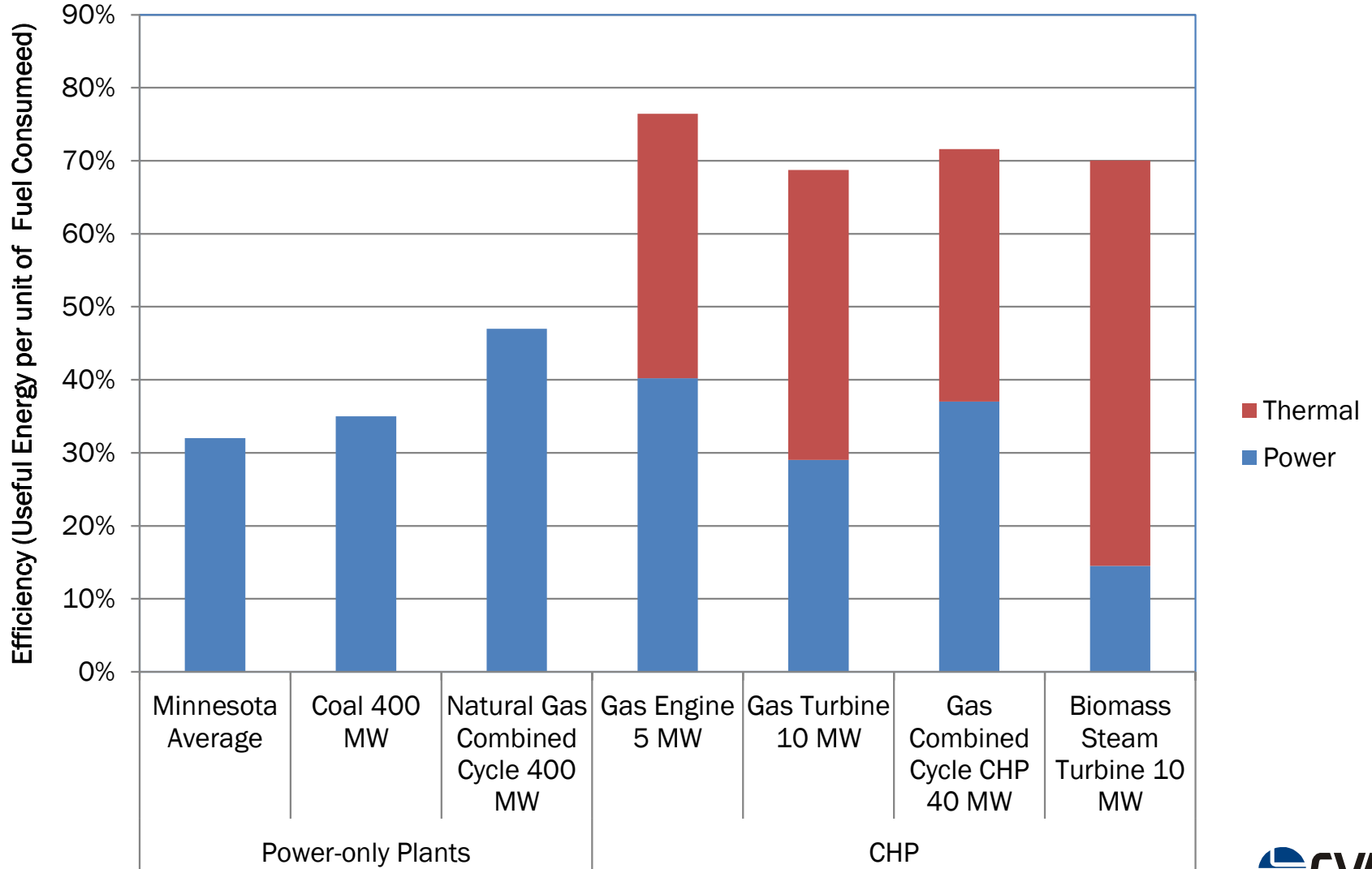
**Power sector is < 33% efficient. Of the 520 Trillion Btu (TBtu) of fuel consumed in power plants:**

- 170 TBtu delivered power
- 10 TBtu line losses
- 340 TBtu waste heat

**In comparison, the total estimated requirement for heat in buildings and industry is 408 TBtu**

# Why CHP is Important

## Comparative Efficiency of CHP and Power-Only Plants



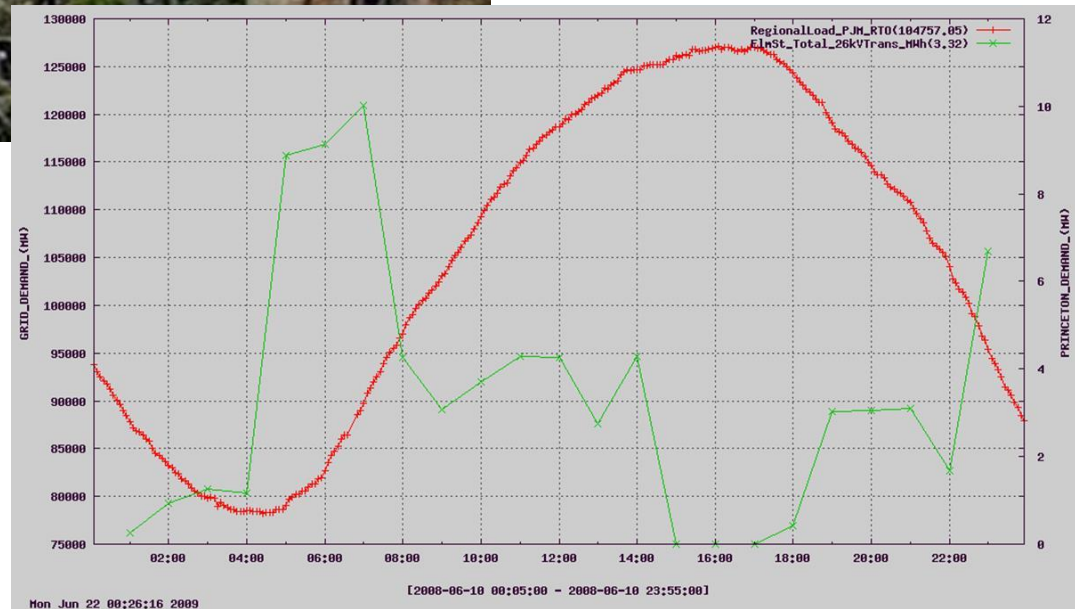


# Why CHP is Important

## Power supply resiliency

CHP enabled universities and hospitals to maintain power supply and thermal services during Superstorm Sandy and other extreme weather events or power transmission grid failures

## Enhanced peak power demand management





# ***Current Minnesota Energy Policies***

- **GHG reduction goals (30% by 2025; 80% by 2050)**
- **Renewable Portfolio Standard (RPS)**
  - **Goal: 25% of total energy from renewables by 2025**
  - **RPS requirements by utility type**
    - **Xcel: 31.5% by 2020, including 24% wind, 1.5-2.5% solar, 4.0-5.0% other**
    - **Non-Xcel public utilities: 21.5% by 2020, including 1.5% solar, and 26.5% by 2025**
    - **Non-public utilities: 20.0% by 2020, and 25% by 2025**

# ***Current Minnesota Energy Policies***

## **Conservation Improvement Program (CIP)**

- **Annual energy savings goals for electric and natural gas utilities**
  - Goal of 1.5% of average retail sales
  - Utilities can petition for reductions
  - Interim savings goal for qualifying gas utilities 0.75%
- **Minimum level of spending based on annual gross operating revenue (GOR)**

# ***Current Minnesota Energy Policies***

## **Conservation Improvement Program (CIP)**

### **Electric Utility CIP Savings and Expenditures by Year, 2006-2011**

	Incremental Savings (GWh/year)	Expenditures (\$ million)	Incremental CO2 Savings (tons/year)	\$ / Lifetime MWH *	\$ / Lifetime ton of CO2
2006	412	\$ 82.2	375,537	\$ 13.31	\$ 14.60
2007	468	\$ 91.2	426,646	\$ 13.00	\$ 14.26
2008	597	\$ 102.0	544,428	\$ 11.39	\$ 12.49
2009	669	\$ 144.9	609,905	\$ 14.44	\$ 15.84
2010	826	\$ 174.3	753,260	\$ 14.07	\$ 15.43
2011	965	\$ 140.6	879,936	\$ 9.71	\$ 10.65

Average last 3 years \$ 12.74 \$ 13.97

\* The cost per unit of savings were calculated using a typical weighted average energy efficiency measure lifetime of 15 years.

# ***Current Minnesota Energy Policies***

## **Conservation Improvement Program (CIP)**

### **Natural Gas Utility CIP Savings and Expenditures by Year, 2006-2011**

	Incremental Savings (BCF/year)	Expenditures (\$ million)	Incremental CO2 Savings (tons/year)	\$ /Lifetime MMBtu *	\$ / Lifetime ton of CO2
2006	2.1	\$ 16.3	126,750	\$0.52	\$ 8.56
2007	1.9	\$ 16.4	115,987	\$0.57	\$ 9.43
2008	1.6	\$ 18.1	94,592	\$0.77	\$ 12.77
2009	1.8	\$ 22.8	111,522	\$0.82	\$ 13.61
2010	2.6	\$ 38.0	158,039	\$0.97	\$ 16.01
2011	2.8	\$ 41.5	170,001	\$0.99	\$ 16.27

Average last 3 years

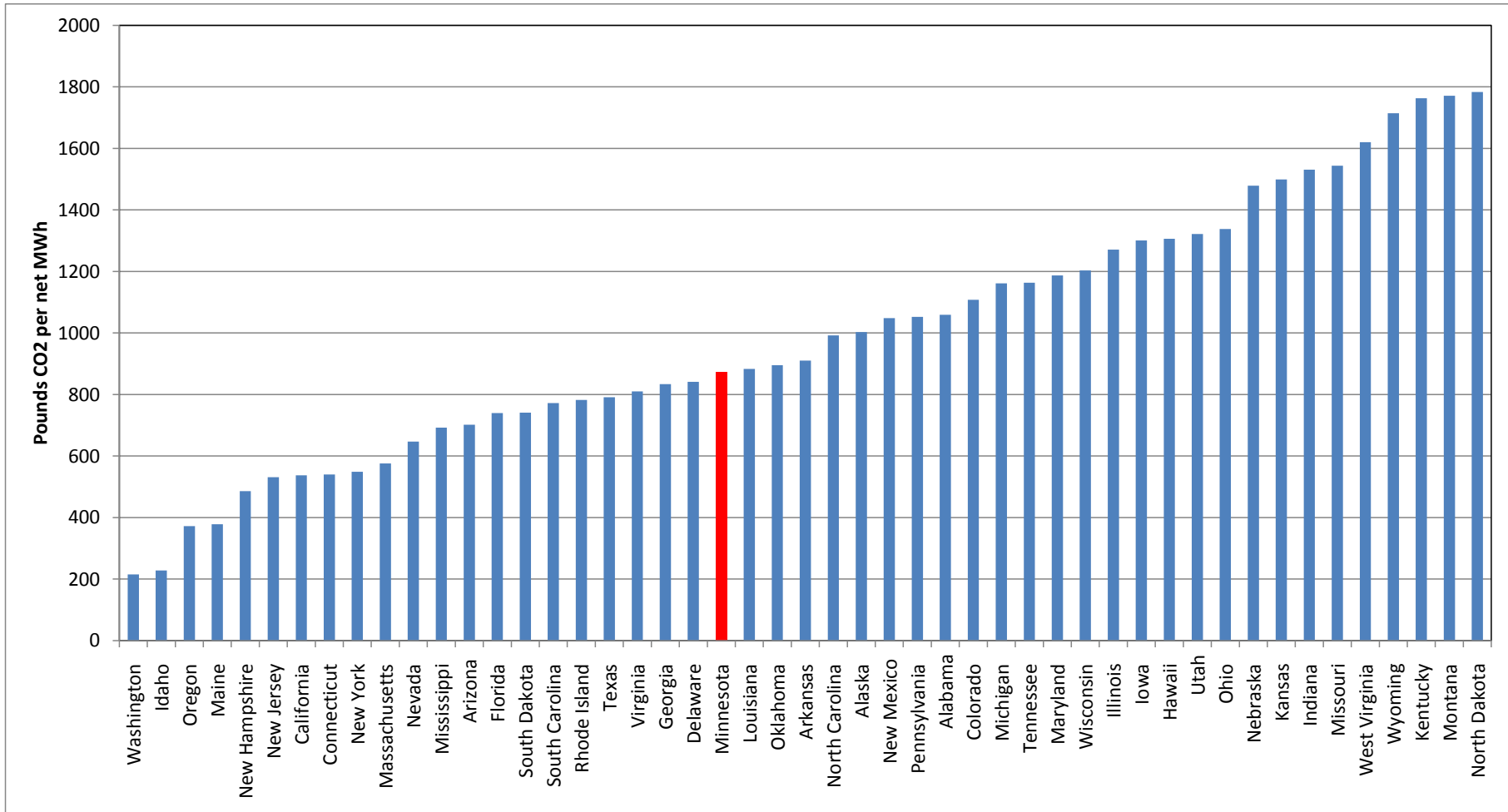
\$0.93

\$15.30

\* The cost per unit of savings were calculated using a typical weighted average energy efficiency measure lifetime of 15 years.

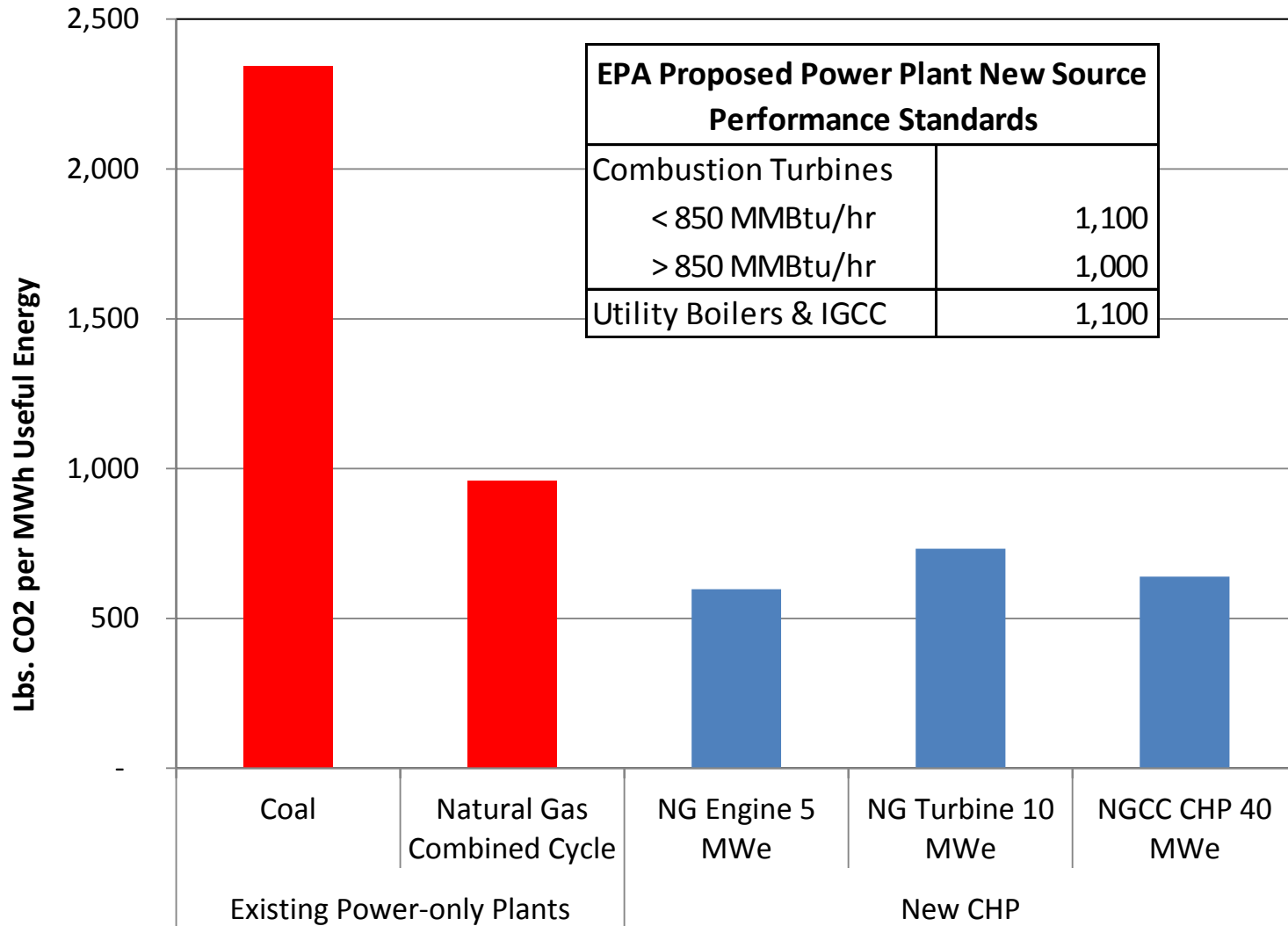
# Federal Policy

## Clean Power Plan State Goals (lbs CO<sub>2</sub>/MWh)



# Federal Policy

## Comparison of GHG Emissions from CHP and Power-Only Plants



# *Key Challenges*

- **Spark Spread**
- **Cost of Capital**
- **Utility Value Proposition**
- **Interconnection and Standby Rates**
- **Lack of Economic Value of Benefits**
- **Expertise**
- **Economic Uncertainty**



# *CHP Economic Equation*

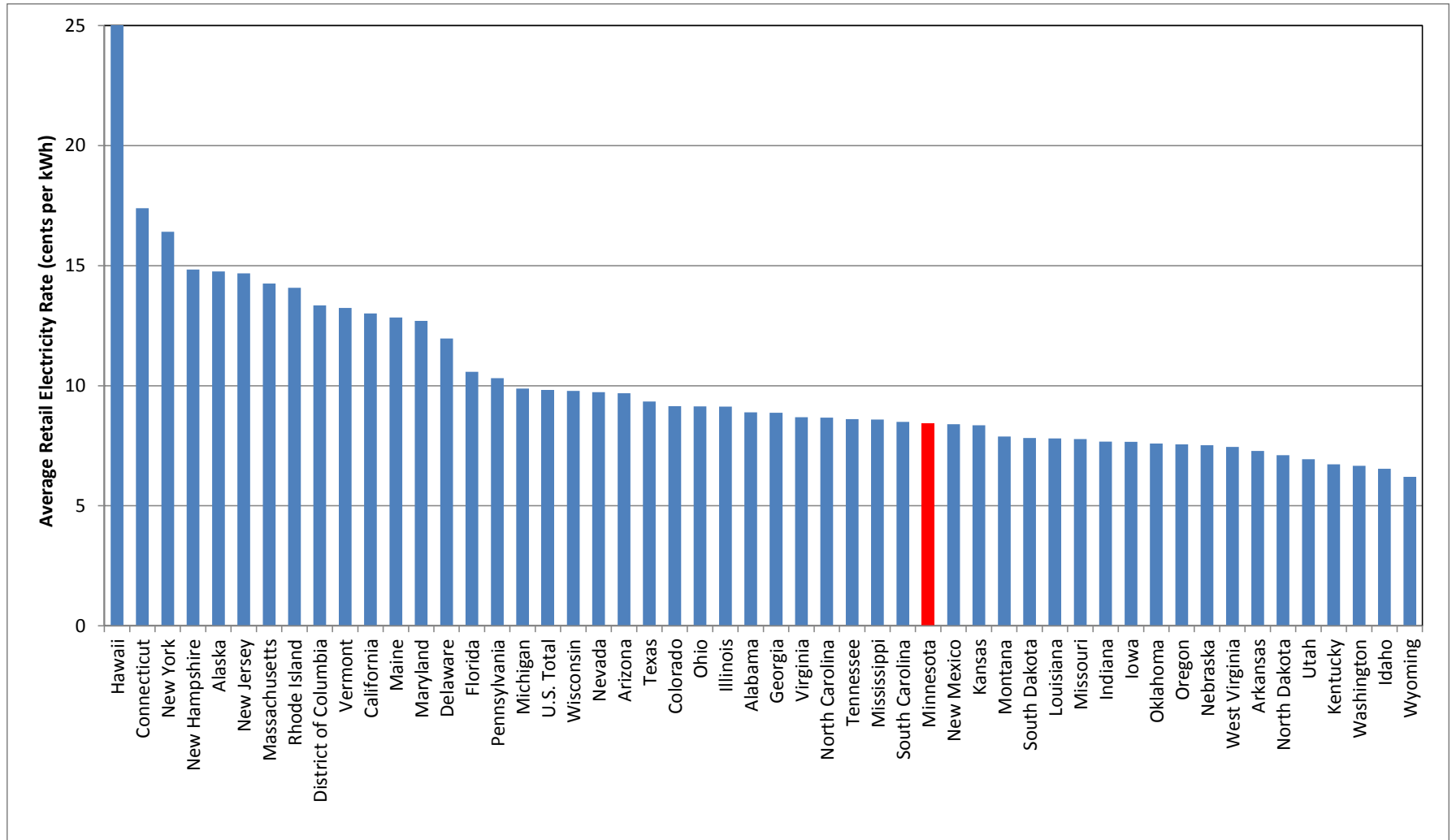
- **Costs**

- Capital recovery (capital cost, WACC)
- Fuel (heat rate, power production)
- O&M (fixed and variable)

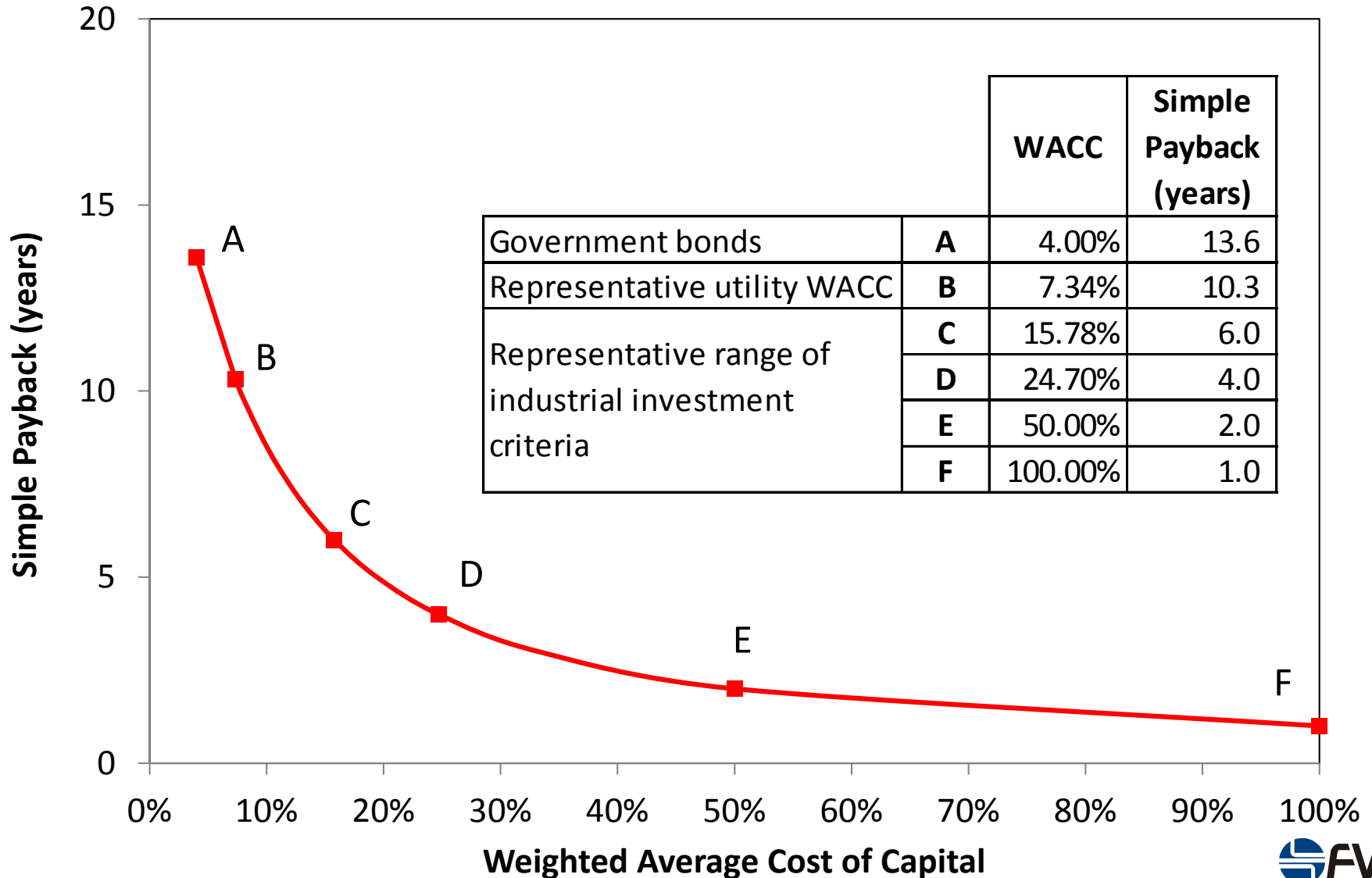
- **Savings**

- Offset boiler fuel (thermal production, fuel price)
- Offset electricity purchases (power production, power tariff, standby rates)
- Revenue from power exports (power production vs. consumption, export sales price)

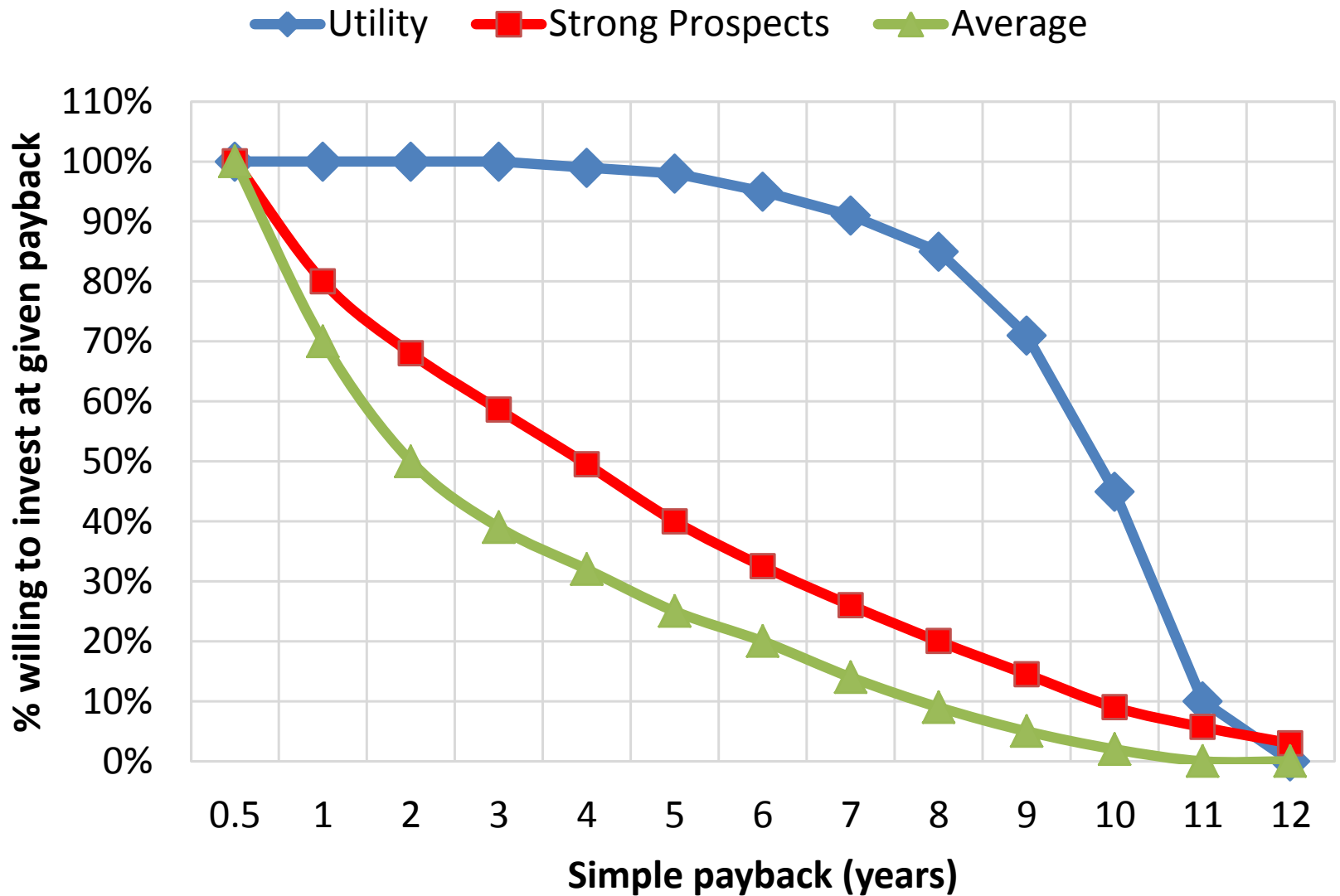
# Minnesota has relatively low power prices



# Weighted Average Cost of Capital (WACC)

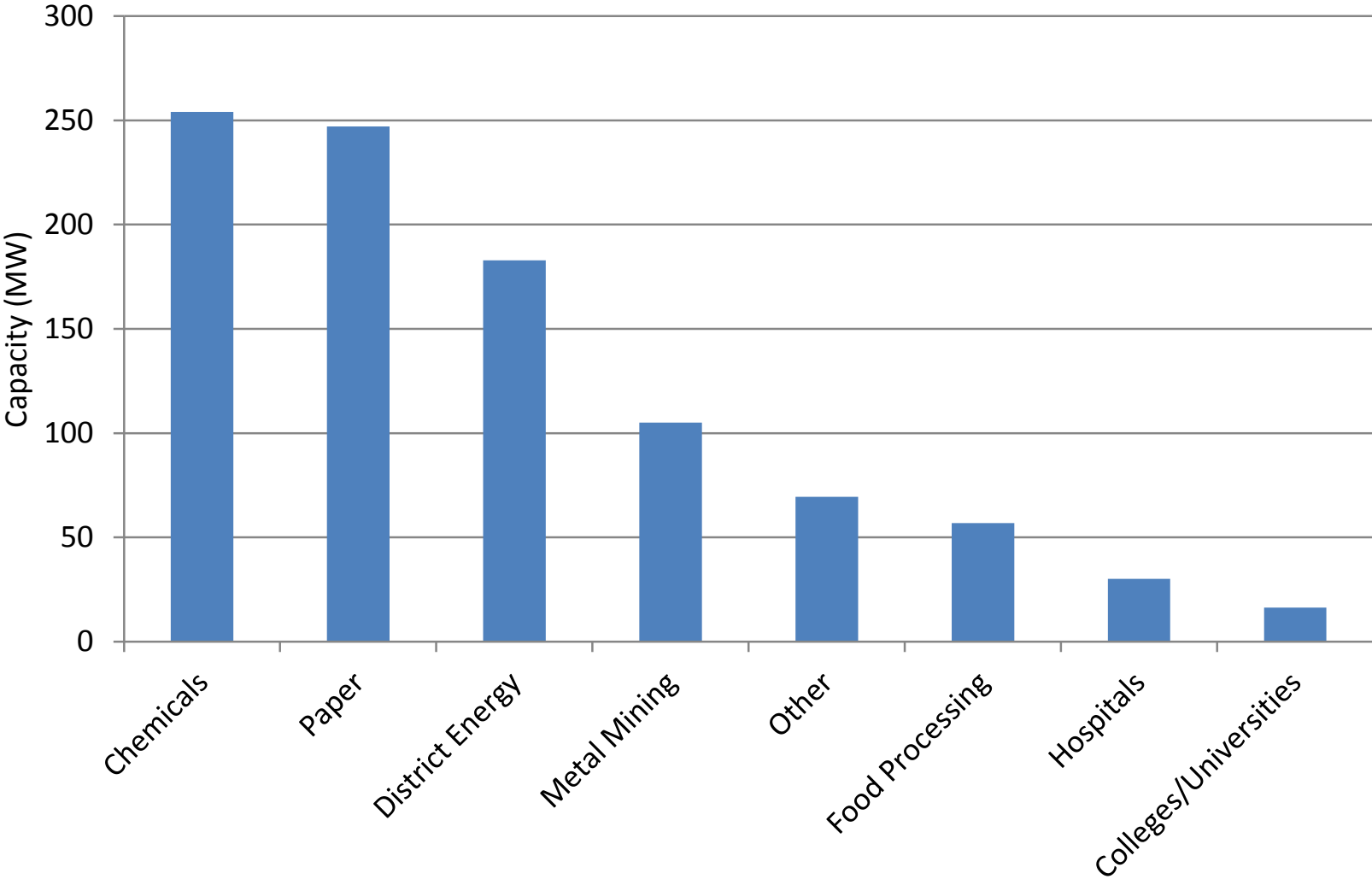


# Acceptance Curves



# Current Minnesota CHP

962 MW



# *CHP Technical Potential (MW)*

	Current Technical Potential					Total
	50-500 kW	500-1 MW	1-5 MW	5-20 MW	>20 MW	
<b>Sites</b>						
Industrial	860	140	143	39	15	1,197
Commercial	2,403	147	97	15	3	2,665
Total	3,263	287	240	54	18	3,862
<b>MW</b>						
Industrial	146	97	317	430	730	1,720
Commercial	399	384	299	132	114	1,330
Total	545	481	616	562	844	3,049

Questions and Answers?



# ***Agenda***

## ***Policy Options and Analysis***

- **Description of policy options**
- **Stakeholder feedback**
- **Impacts of policy options**
  - **Market penetration**
  - **Cost-benefit tests**

# *Policy Options*

- **Policy Option group 1. Separate new CHP tier in natural gas utility CIP, providing incentives to customers or third parties**
  - **Option 1.1. Capital incentives (\$100 per 1000 Btu/hr thermal output)**
  - **Option 1.2. Operating incentives (\$0.75 per MMBtu)**
  - **Option 1.3. Both capital and operating incentives**
- **Policy Option group 2. Separate new CHP tier in electric utility CIP, providing incentives to customers or third parties**
  - **Option 2.1. Capital incentives (\$500 per kW)**
  - **Option 2.2. Operating incentives (\$10 per MWh)**
  - **Option 2.3. Both capital and operating incentives**

# *Policy Options*

- **Policy Option group 3. Separate new CHP tier is established in either gas utility (Option 3.1) or electric utility (Option 3.2) CIP:**
  - **Operating incentives for customer- or third party-owned CHP**
  - **CIP credit for utilities equivalent to the operating incentive that would be provided to others**
  - **Utilities encouraged to use their low weighted average cost of capital (WACC) to fund CHP systems**

# *Policy Options*

- **Policy Option 4. Specific carve-out for bioenergy CHP in either existing or expanded RPS**
  - **1.5% by 2030 for IOUs**
  - **0.6% by 2030 munis and coops**
- **Policy Option group 5. Alternative Portfolio Standard (APS) requiring electric utilities to obtain a given % of sales from CHP (regardless of fuel) by a given year**
  - **Option 5.1 – by 2030, 8.0% for IOUs; 3.2% for munis/coops**
  - **Option 5.2 -- by 2030, 12.0% for IOUs; 4.8% for munis/coops**

# ***Stakeholder Feedback***

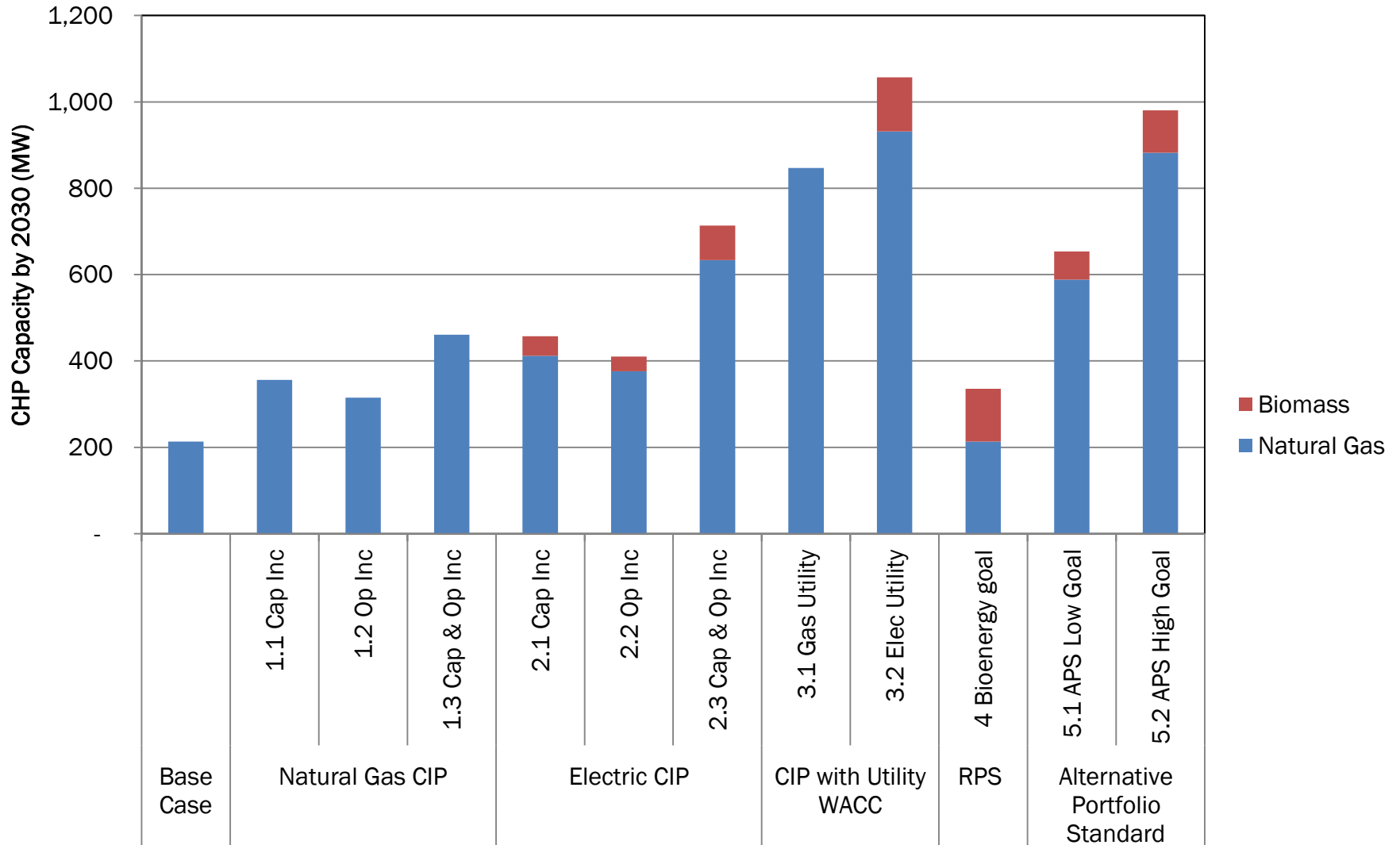
- 1. Utilities noted weak customer interest**
- 2. Utility aversion to more goals/mandates**
- 3. Recognition of benefits of utility financing/ownership**
- 4. Concern about over-emphasizing utility ownership**
- 5. Ratepayer risk issues associated with utility ownership**
- 6. Support for inclusion of natural gas utilities**
- 7. Strong awareness of synergy with Clean Power Plan**
- 8. Policy and economic framework changes without Sherco**
- 9. Differences in CHP potential**
  - Coops/Munis (rural)**
  - IOUs (urban/industrial)**
- 10. Lumpy flow of CHP MW**
- 11. What about retrofit of existing power plants for CHP?**
- 12. Ability to wheel power would boost CHP**
- 13. Questions regarding crediting CHP**

# *Impacts of Policy Options*

- **Market penetration beyond Business as Usual (Base Case)**
- **Cost-Benefit tests**
  - Participant cost test (PCT)
  - Societal cost test (SCT)

# Impacts of Policy Options

## Market Penetration





# ***Impacts of Policy Options***

## ***Cost-Benefit Tests***

<b>1.1</b>	Most CHP installations do not meet both the PCT and SCT
<b>1.2</b>	
<b>1.3</b>	Improves PCT results, but most CHP installations not meet both the PCT and the SCT
<b>2.1</b>	Most CHP installations do not meet both the PCT and SCT
<b>2.2</b>	
<b>2.3</b>	Improves PCT results, but most CHP installations not meet both the PCT and the SCT
<b>3.1</b>	Positive results for both cost-benefit tests for a wide range of CHP installations.
<b>3.2</b>	
<b>4</b>	Not analyzed
<b>5.1</b>	Positive results for both cost-benefit tests for a wide range of CHP installations.
<b>5.2</b>	

Questions and Answers?

# *Agenda*

## *Conclusions and Recommendations*

- **Conclusions**
- **Recommendations**
  - **Near-term**
  - **Legislation**
  - **Implementation**

# *Conclusions*

- **Significant increases in implementation of CHP will require investment by utilities in CHP because:**
  - Utilities have a sufficiently low WACC to make many CHP projects cost-effective
  - Implementation of CHP will be facilitated if electric utilities are motivated and incented
  - CHP has the potential to help utilities comply with upcoming regulations on GHG emissions from power plants
- **CIP has a significant advantage**
  - Established program for reductions in electricity and natural gas consumption that is familiar to all players
  - Provides opportunities for incentives (“carrots”) for utility adoption of CHP, in contrast to the APS, which relies solely on a “stick” approach

# *CIP Compared with APS*

	<b>CIP</b>	<b>APS</b>
<b>Advantages</b>	CIP is an established program for reductions in electricity and natural gas consumption that is familiar to utilities, stakeholders and state agencies.	As a new program can avoid some of the complexities related to adapting the CIP to include CHP.
	Provides opportunities for both "carrots" and "sticks" for utility adoption CHP.	
<b>Disadvantages</b>	There are disparities in CHP opportunities between utilities, particularly limitations in the service territories of municipal utilities and cooperatives. (Potential solution: system of tradable credits.)	Legislation would be required to create a new program and related implementation mechanisms. Creation of a new program will likely face greater political challenges in comparison to expanding an existing program.
	Lack of statutory clarity regarding applicability of CHP in CIP. (Solution: clarifying legislation.)	Primarily a "stick" approach.
	Less clear path to enforceability than a portfolio standard. (Solution: clear enforcement provisions in legislation.)	
	High level of opt-out and the fact that the opt-outs tend to be the larger energy users who are generally the best candidates for CHP. (Largely mitigated if utility investments in CHP are in rate base.)	

# *Conclusions*

- **Must examine issues relating to utility investment in CHP:**
  - Ratepayer risks if CHP host goes out of business
  - Risk profiles of potential thermal hosts vary dramatically
  - Consider CHP risks in context of existing risks to ratepayers
  - Potential ratepayer risks could be addressed through range of mechanisms
- **Integrated Resource Planning (IRP) provides a context for:**
  - Consideration of potential benefits of CHP that currently do not have a market value
  - Analysis of CHP opportunities in the utility service area in comparison with other resources

# ***Recommendations***

## **Near-term Steps**

- **Stakeholder feedback**
- **Interagency working group to integrate potential CHP policy with Minnesota's plan to comply with the EPA's Clean Power Plan**
- **Develop a draft "Minnesota CHP Policy Act" for consideration by the legislature in 2015**



# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act**

- **Set goal of doubling CHP capacity from the current 962 MegaWatts (MW) by the year 2030**
- **Add new CHP tier to CIP for electric utilities**
  - IOUs 0.45% of sales
  - Munis and coops 0.18% of sales
- **Electric utilities may own CHP facilities on customer premises**

# *Recommendations*

## Minnesota Combined Heat and Power Policy Act

### Standards for Crediting CHP Output for New CHP

Non-Renewable Fuels		
Tier	Efficiency (HHV)	% of Power Output Credited
	<60%	0%
Tier 1	>60<70%	80%
Tier 2	>70<80%	90%
Tier 3	>80%	100%

Renewable Fuels		
Tier	Efficiency (HHV)	% of Power Output Credited
	<50%	0%
Tier R1	>50<60%	80%
Tier R2	>60<70%	90%
Tier R3	>70%	100%

# *Recommendations*

## Minnesota Combined Heat and Power Policy Act

### Standards for Crediting CHP Output for

- **Retrofit of Existing Power Plant; or**
- **Retrofit of Existing Heating or Process Energy Plant:**

IEE = Incremental Electrical Energy

IUTE = Incremental Useful Thermal Energy

IF = Incremental Fuel

CHP Credit =  $(IEE / 40\%) + (IUTE / 80\%) - IF$

# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act Definitions**

- **Process Waste Heat.** Heat contained in gases or liquids exhausted from a boiler plant, industrial process or municipal process that is currently and/or conventionally not recovered for useful purposes.
- **Qualifying CHP Plant.** Any CHP Retrofit of Existing Power Plant, any CHP Plant CHP Retrofit of Existing Heating or Process Energy Plant, or a new CHP Plant with:
  - Minimum annual efficiency of 60% (if using non-renewable fuels) or 50% (if using renewable fuels); and
  - Produces at least 20% of its total useful energy in the form of thermal energy and at least 20% in the form of electrical or mechanical power.
- **Renewable CHP Plant.** A Qualifying CHP Plant for which at least 90% of the annual fuel input is composed of energy sources other than natural gas, coal, oil, propane, other fossil fuels, or nuclear energy.

# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act CIP Incentives**

- **Operating Incentives for Customer- or Third Party-Owned CHP**
  - **Duration of Incentive: 15 years**
  - **Incentive calculated as follows:**
    - CIPE = Statewide average total CIP expenditures by electric utilities for non-CHP incentives and programs over the prior 3 years, inclusive of administrative costs
    - CIPS = Statewide average total first year CIP savings (MWh) by electric utilities for non-CHP incentives and programs over the prior 3 years
    - Level of Incentive =  $CIPE / (CIPS \times 15 \text{ years})$
- **Utility-Owned CHP.** If the electric utility finances a CHP plant, it may include as a CIP expenditure the amount which would otherwise be provided to a CHP Plant financed by a customer or third party

# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act**

- **Alternative Compliance**

- A utility may instead make an Alternative Compliance Payment (ACP) to the Minnesota Department of Commerce (COMM)
- ACP Rate, in \$ per MWh CHPC, and provisions for modifying the rate, shall be established in rulemaking
- COMM will oversee the use of ACP funds so as to further the implementation of CHP, district energy systems and other energy efficiency and renewable energy systems

- **Tradable Credits**

- System of tradable CHP credits (CHPCs) will be established
- CHPS Credits will have a trading lifetime of 4 years according to the year of generation

# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act Integrated Resource Planning**

### **Require utilities to demonstrate that:**

- Opportunities for new combined heat and power plants within their service territory have been thoroughly assessed to determine the GHG, grid resiliency and other benefits;
- The potential for converting existing power plants to combined heat and power, with distribution of recovered energy through district energy systems, has been thoroughly assessed to determine the GHG, grid resiliency and other benefits; and
- A CHP facility is not in the public interest.

# *Recommendations*

## **Minnesota Combined Heat and Power Policy Act Standby Rates**

### **Standby rates charged by public utilities must conform to the following principles:**

- Standby rates should be transparent, concise and easily understandable.
- Standby energy usage fee should reflect both demand and time-of-use cost drivers.
- Forced Outage Rate should be used in the calculation of a customer's reservation charge.
- Standby demand usage fees should only apply during on-peak hours and be charged on a daily basis.
- Grace periods exempting demand usage fees should be removed where they exist.



# ***Recommendations***

## ***Implementation and Rulemaking***

### **Following passage of legislation:**

- Conduct a study to quantify the “Value of CHP” relative to total energy efficiency, GHG emissions, power grid resiliency, peak demand management, risk management and other potential values of CHP.
- Establish clear policies regarding inclusion of CHP costs in electric utility rates, including mechanisms for addressing ratepayer risks associated with utility investment in CHP.
- Initiate a high-level dialog with the Midwest Independent System Operator to create rules that encourage maximum dispatch of CHP units.

# Thanks for your attention!

## Questions?

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