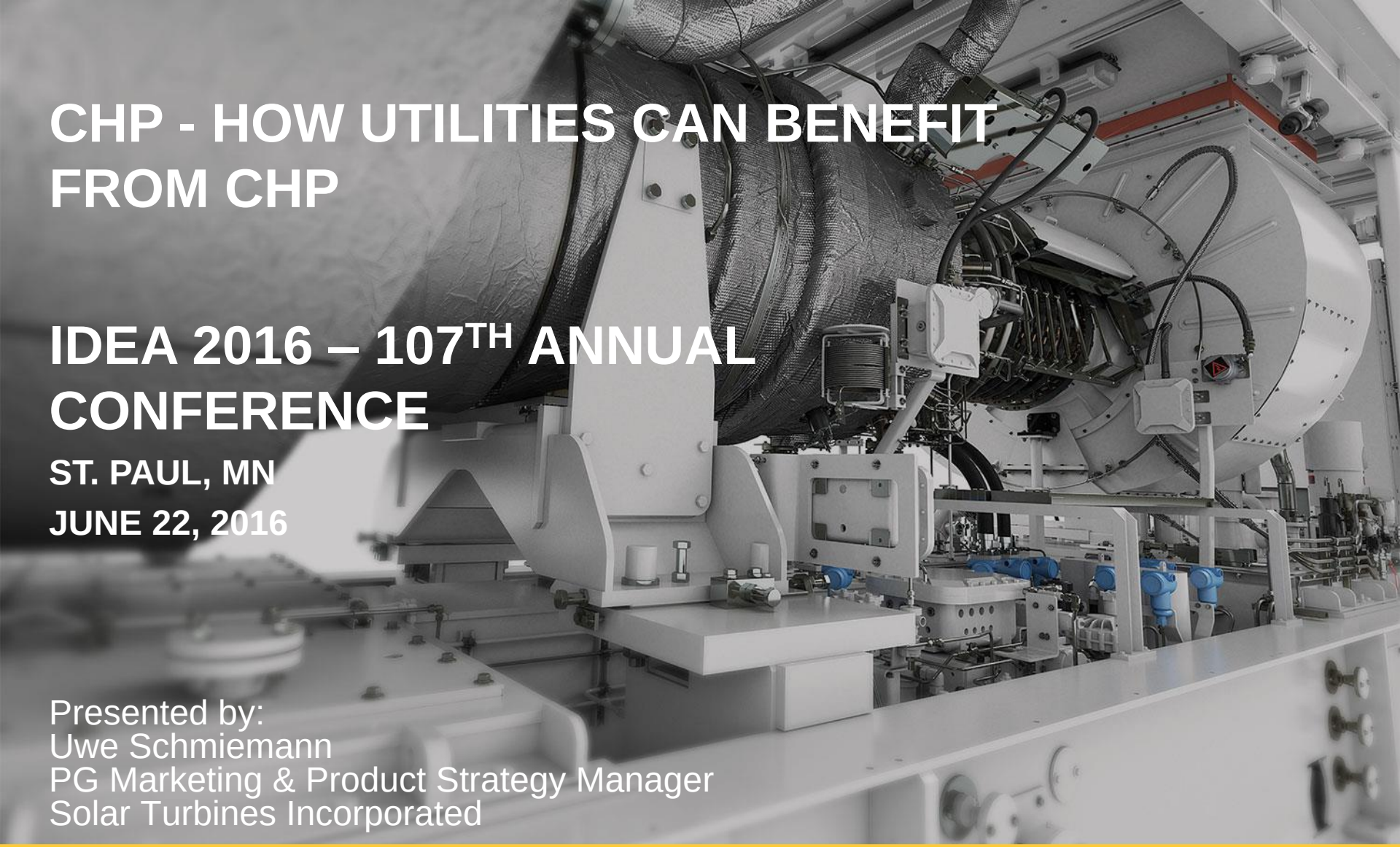

CHP - HOW UTILITIES CAN BENEFIT FROM CHP

IDEA 2016 – 107TH ANNUAL CONFERENCE

ST. PAUL, MN

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A CULTURE OF CUSTOMER CARE

Solar Turbines
A Caterpillar Company

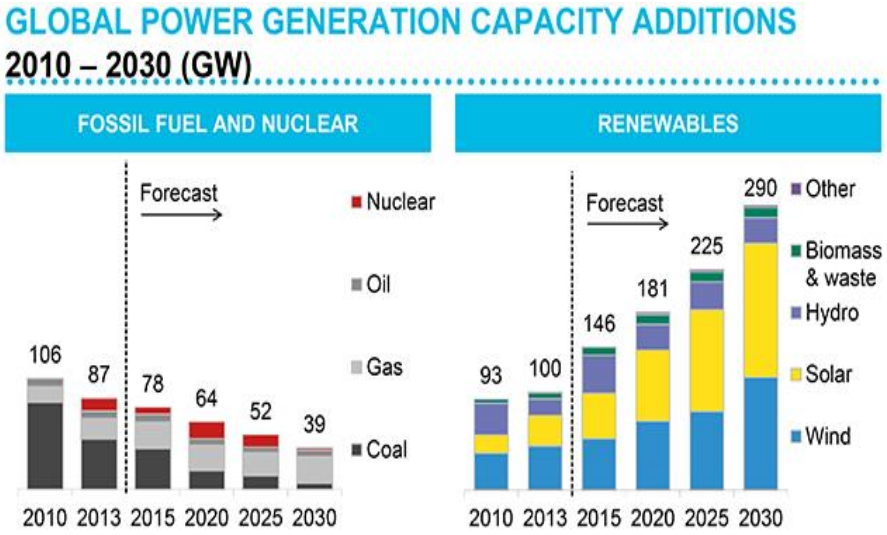
TRADITIONAL POWER GENERATION

- Centralized Power Generation
- Economy of Scale
- Reliable Power
- Environmental Impact

RENEWABLE POWER GENERATION

- Intermittent Power
- No Emissions
- Not free from Environmental Impact
- Higher Initial $/kW

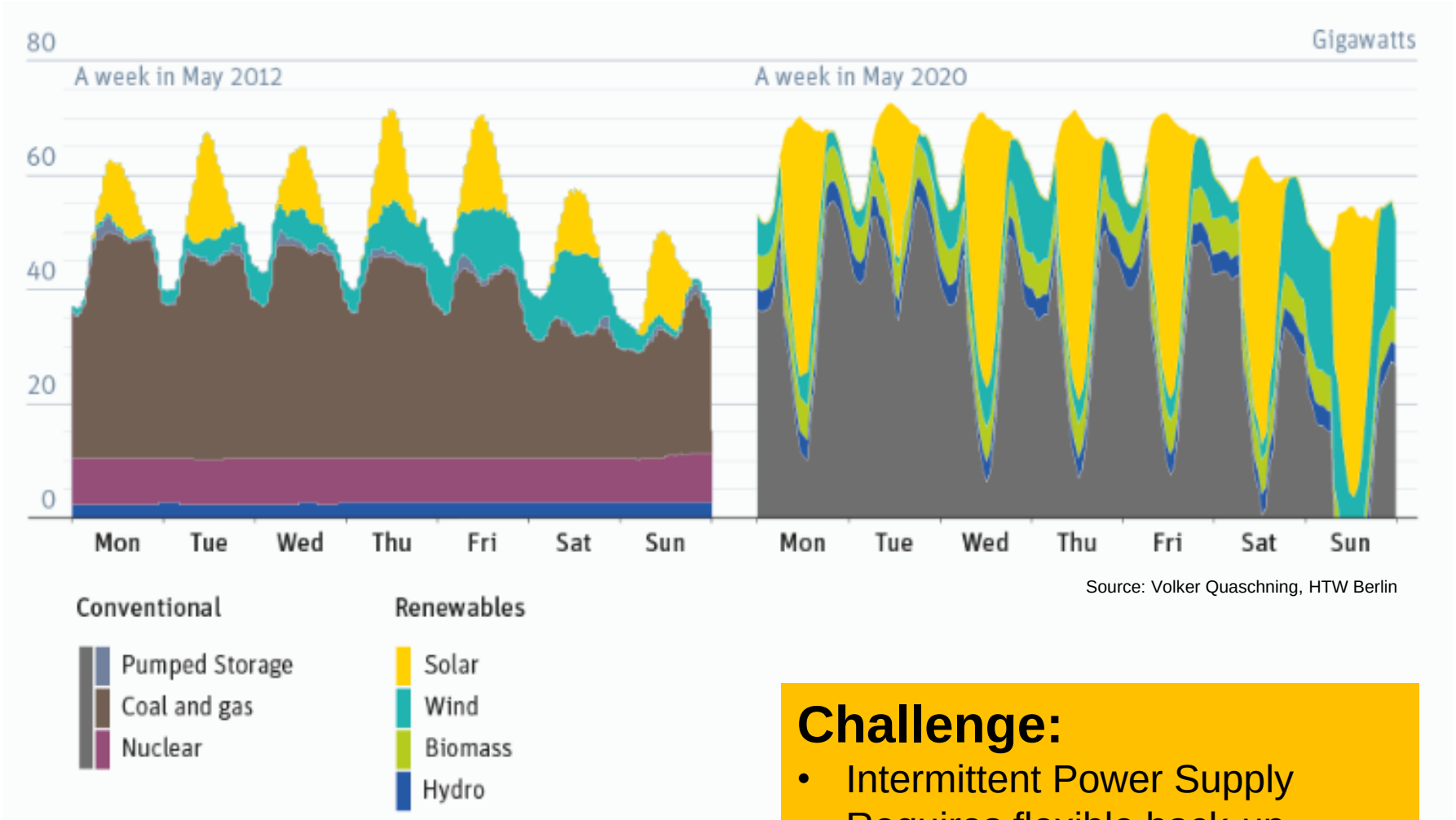
CURRENT GENERATION TRENDS



Source: Michael Liebreich/BNEFSummit 2014

- Increase in Renewable Energy – Intermittent power
- Current distribution system operates at capacity limits
- New transmission lines needed - cost intensive and long approval process
- Centralized power generation network is jeopardized by natural disasters e.g super storm Sandy

GLOBAL INSTALLED CAPACITY BY SOURCE

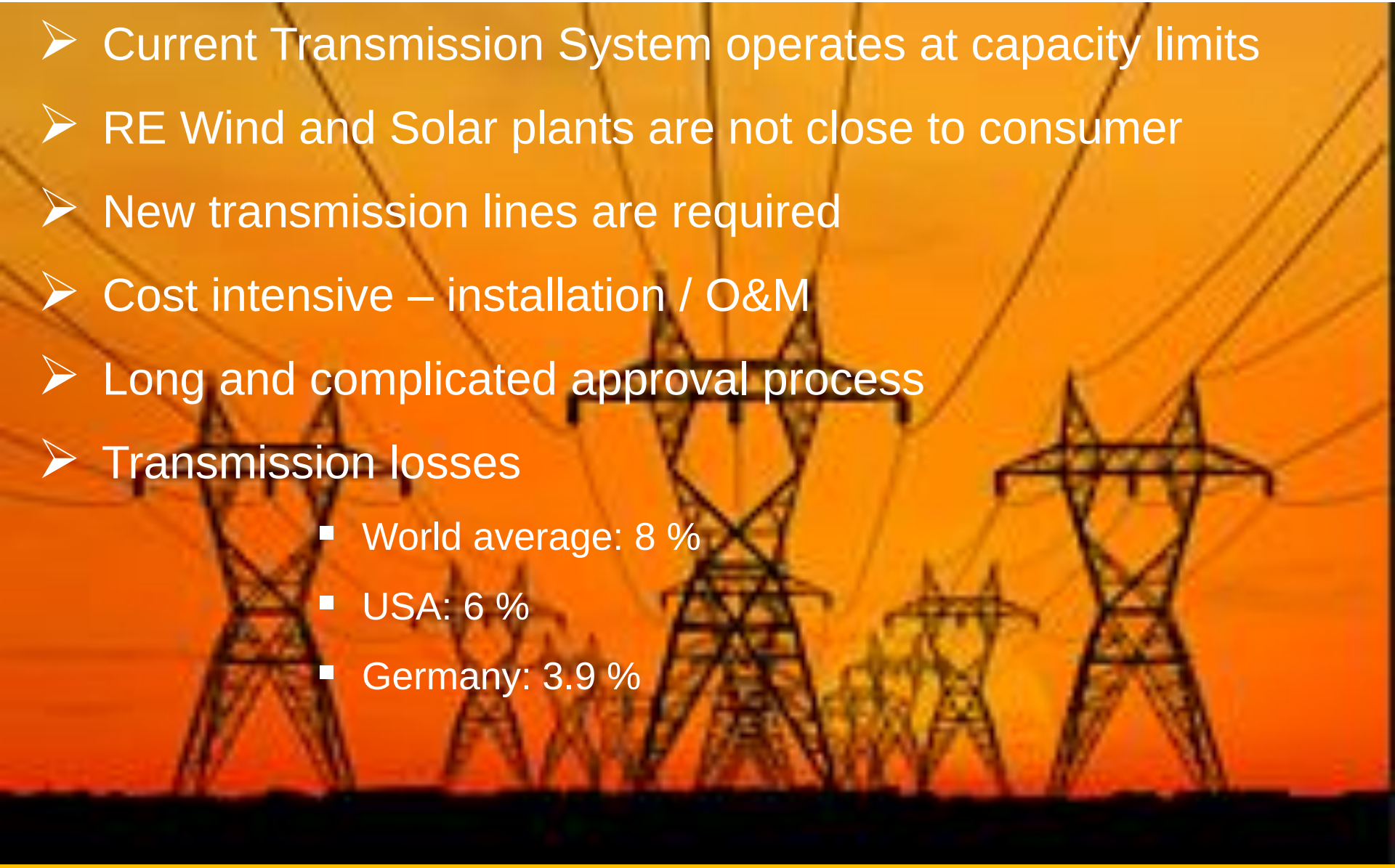


Source: Volker Quaschning, HTW Berlin

Challenge:

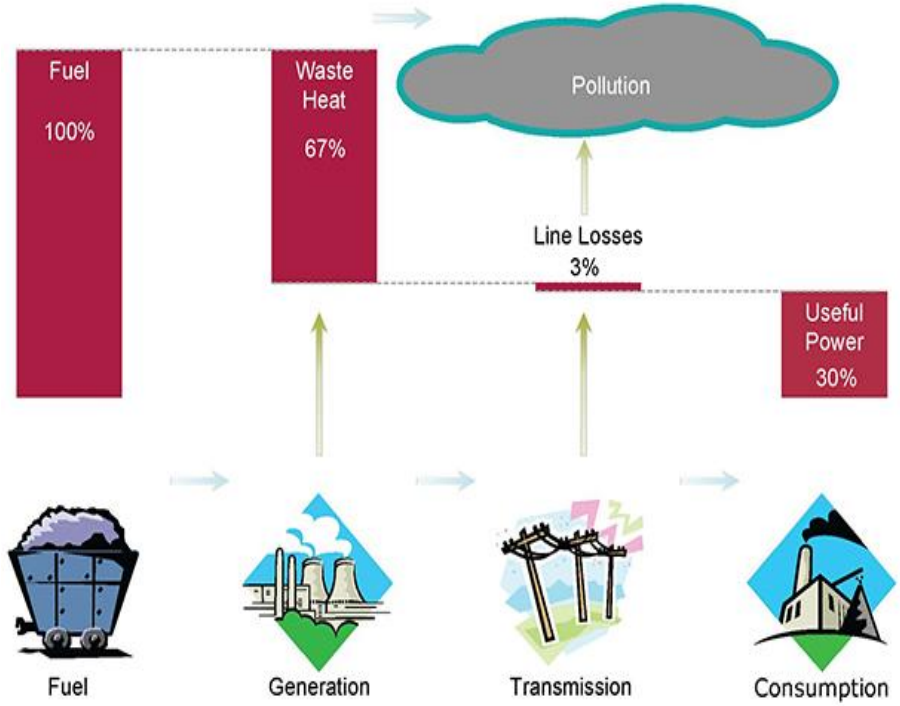
- Intermittent Power Supply
- Requires flexible back-up

TRANSMISSION / DISTRIBUTION



- Current Transmission System operates at capacity limits
- RE Wind and Solar plants are not close to consumer
- New transmission lines are required
- Cost intensive – installation / O&M
- Long and complicated approval process
- Transmission losses
  - World average: 8 %
  - USA: 6 %
  - Germany: 3.9 %

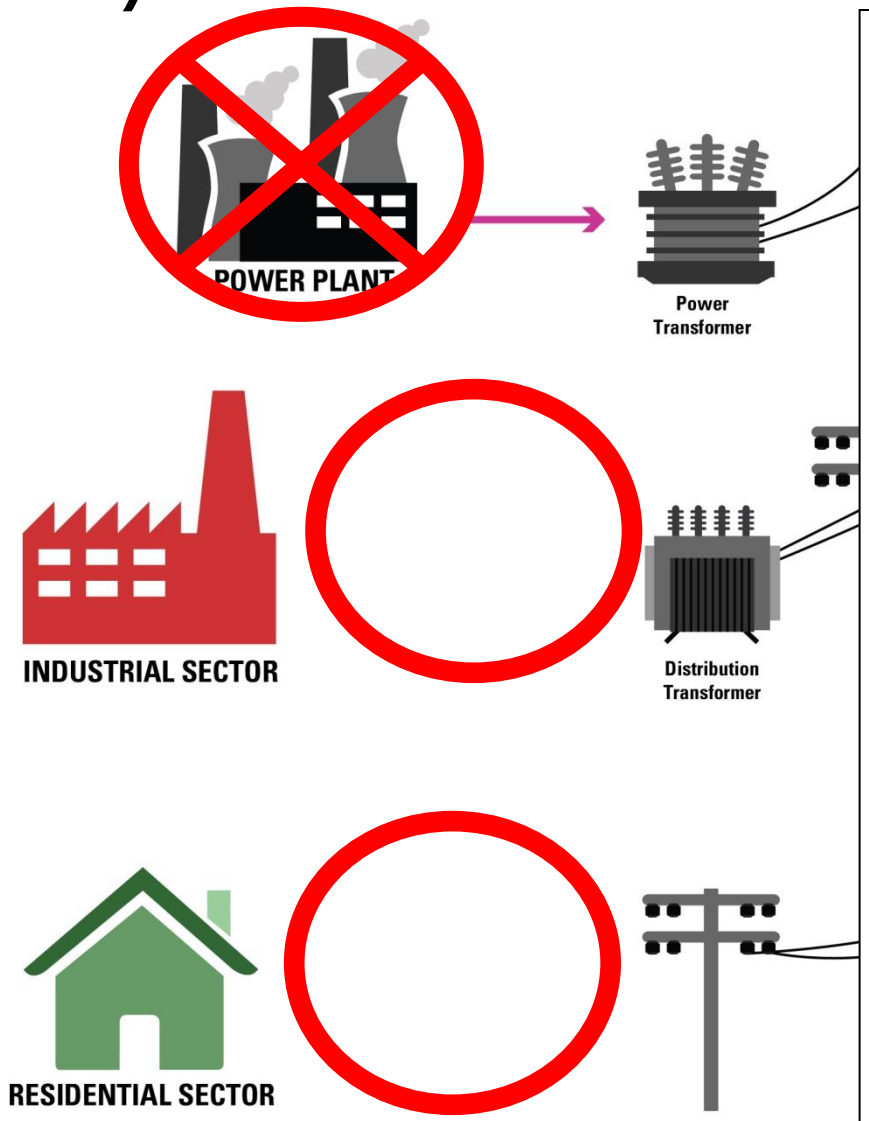
PROBLEM STATEMENT



Source: Recycled Energy Development

- About two-thirds of fuel used by traditional power plants gets lost as waste
- Further losses due to transmission losses – current transmission and distribution losses in the USA is around 6%.
- More and More RE being added to the system
- Adding RE doesn't guarantee stable power
- Right power mix is necessary – ensure stable power w/o price increase
- New Transmission lines needed
- Grid disruption due to Major RE sources are Wind and Solar – intermittent power supply
- Grid disruption due to equipment failure / natural disasters or cyber attacks can compromise broad populations or sensitive facilities

POTENTIAL SOLUTION – COMBINED HEAT & POWER (CHP) DECENTRALIZED POWER

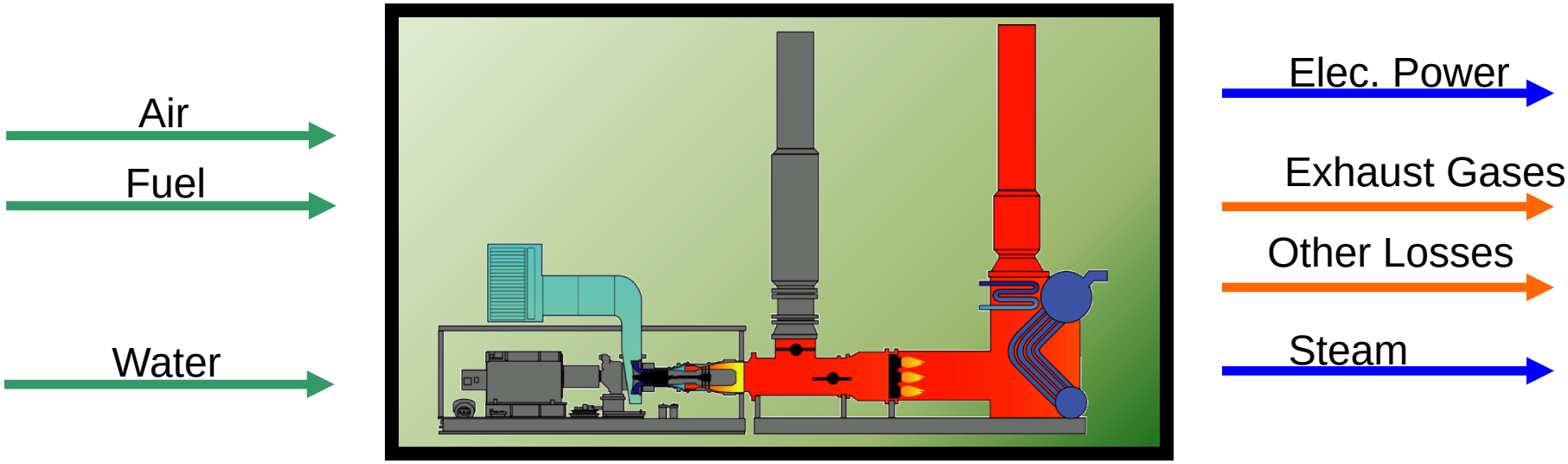


- ✓ Support Grid Stability
- ✓ Allows decentralized PG
  - ✓ Island Mode / Parallel Operation
  - ✓ Increase Reliability
  - ✓ Increase Resiliency
- ✓ Minimize Investment compared to centralized power generation
- ✓ Reduce transmission losses – placed closer to consumer
- ✓ Quick start-up
- ✓ Flexible load following
- ✓ Low Emissions
- ✓ High Efficient when CHP is used

CHP CHARACTERISTICS

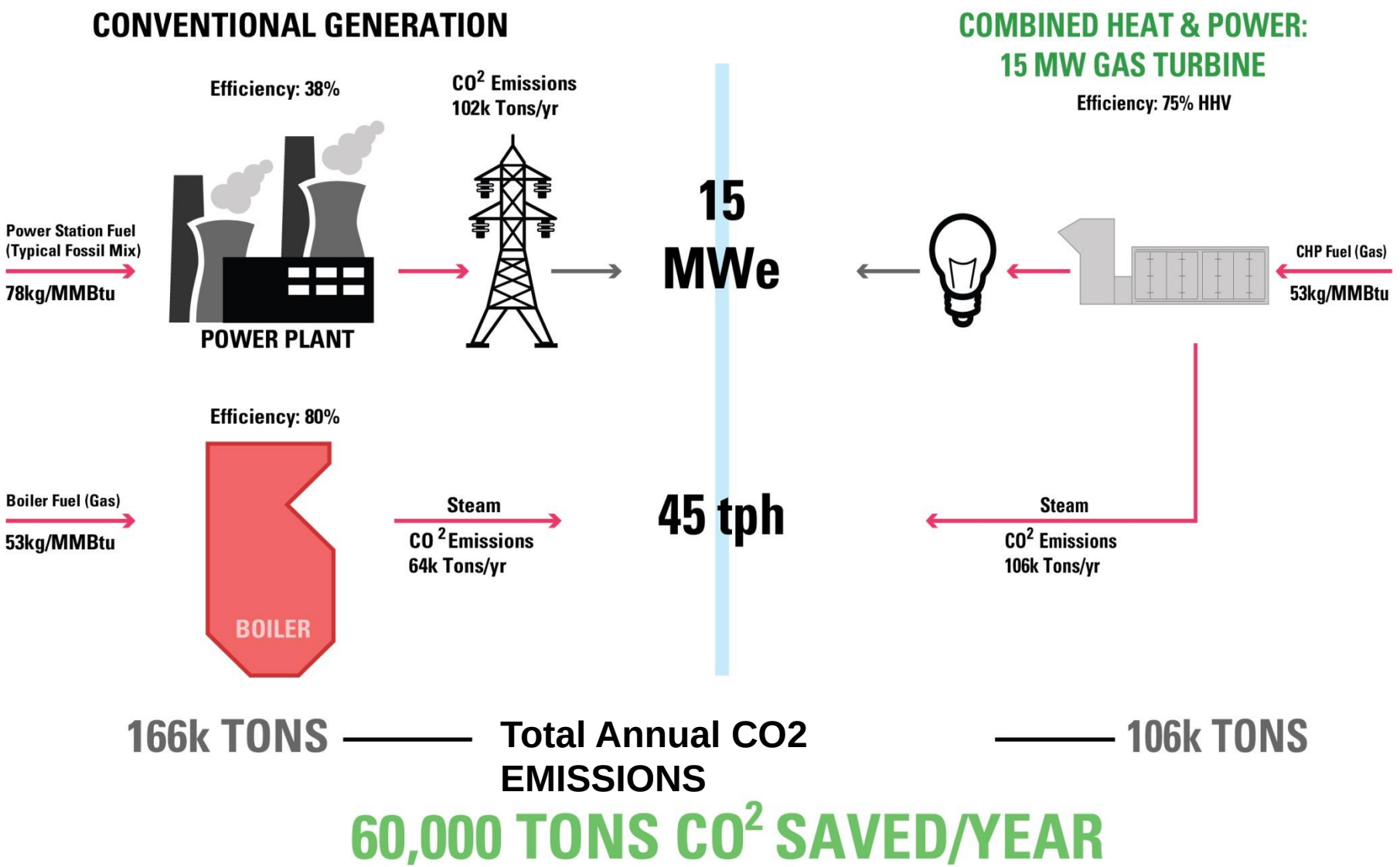
"Simultaneous Production of Two Useful Forms of Energy from Same Source"

- Provides both Electrical and Thermal Energy
  - Steam, Dry Heat and/or Chilling
- Extremely High Efficiency and Availability
- Lowest Greenhouse Gas Footprint
- Continuous Operation



$$\text{CHP Efficiency} = \frac{\text{Elec. Power + Steam}}{\text{Fuel Input}}$$

CO2 EMISSIONS REDUCTIONS FROM CHP



ENVIRONMENT

Federal & State Support

- White Executive Order: “Coordinate and strongly encourage efforts to achieve a national goal of deploying 40 gigawatts of new, cost effective industrial CHP in the United States by the end of 2020.”
- EPA recognizes CHP as an efficiency measure leading to greenhouse gas emission reduction
- Multiple Federal and State Tax Incentive for CHP project

Electricity Outlook

- “Utility MACT causes compliance costs and/or drive closings of some coal capacity”
  - Estimates of shutdown coal capacity range from 20 to 50 GW
- Price impacts will be regional
  - EPA estimated up to 7% increase in electric rates in the few coming years
  - Greater price impacts in regulated markets
- Closings could result in localized reliability concerns providing opportunities for CHP

EIGHT FLAGS ENERGY, LLC SUMMARY

- Eight Flags Energy, LLC – Created as an unregulated subsidiary of Chesapeake Utilities Corporation, Complete by April 2016, Can provide black start generation to Amelia Island in response to disasters

- Solar Turbines, A Caterpillar Company - 21 MW Natural Gas Fired Turbine Generator, >80% System Efficiency,

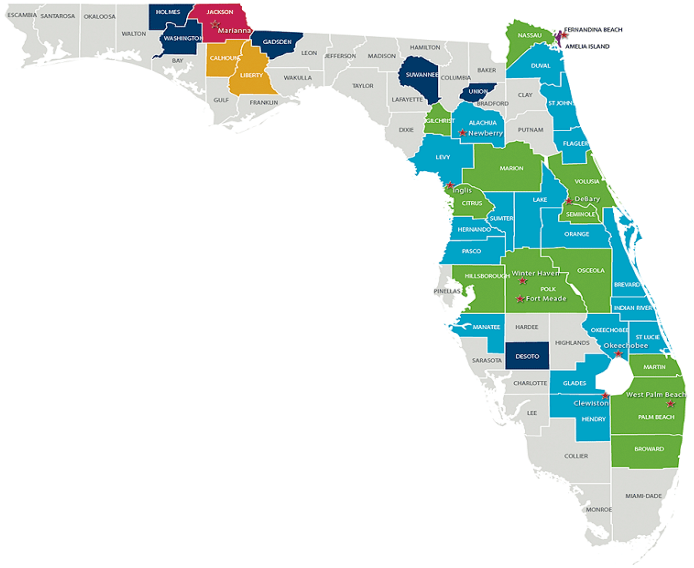
- Rentech Boiler Systems – Heat Recovery Steam Generator capable of producing 75K lbs/hr unfired steam and up to 200K lbs/hr fired steam

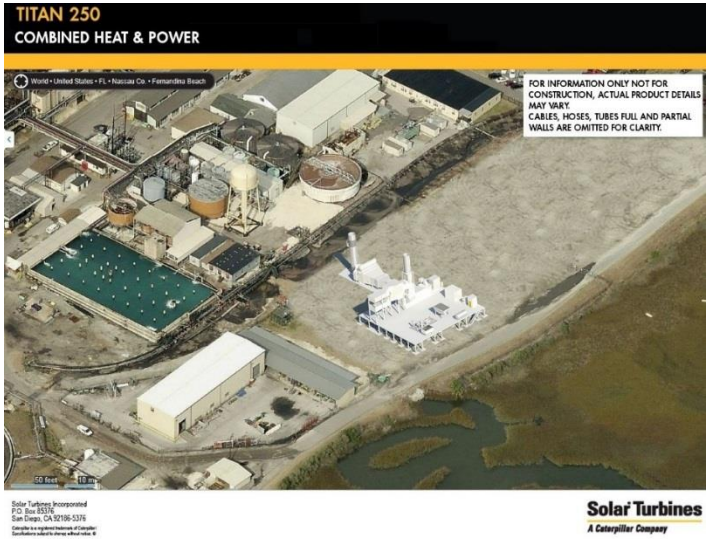
- Florida Public Utilities Company – Electric transmission interconnection and natural gas provider, 50K tons/year emission reduction

- Rayonier Advanced Materials – Property owner, thermal host, increased production days, operational flexibility

EIGHT FLAGS ENERGY, LLC

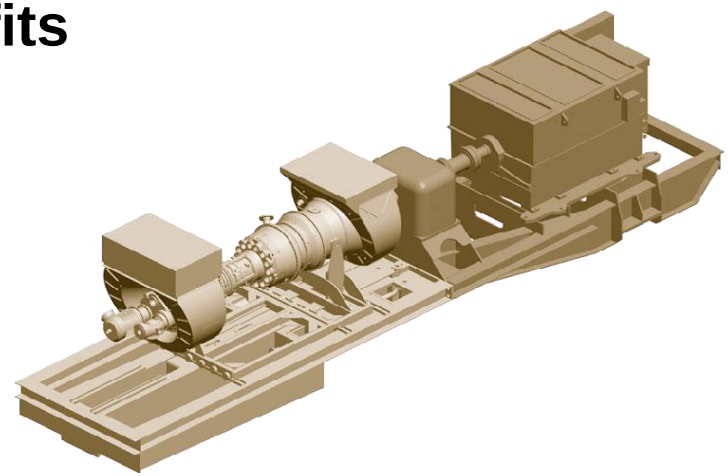
- Installation in April 2016
- FPU and Rayonier Fibers
- Distributed Power in response to disaster
- 21 MW, >80% cycle efficiency
- Additional steam production available to the mill
  - means more production days for mill
  - HRSG upsized by FPU from 75k pph unfired to 200kpph fired at no cost to Rayonier
- Reduction of CO2 emissions of 110,000 tons/year





WHY CHP WORKS ON AMELIA ISLAND

- **Electric Customer Benefits**
  - Electric Rate Reduction
  - Electric Reliability Improvements
  - Produces Positive Environmental Impact
- **FPU Benefits**
  - Purchased Power Cost Reduced
  - Allows Use of Natural Gas Assets
  - Increase Natural Gas Sales
- **Existing Industrial Customer Benefits**
  - Reduction of Overall Energy Cost
  - Additional Steam Production Capability
  - Increased Efficiency and Flexibility
- **CHP Factors**
  - Electrical and Thermal Energy Match
  - Investment Opportunity



WHAT INFORMATION IS NEEDED FOR EVALUATION?

- Electrical Load Profile
- Thermal Load Profile
  - Steam, Hot water, Hot Air
- Gas Availability
- Other Factors Based on the Situation

CHP PROJECT DEVELOPMENT

- Assemble an experienced team of professionals to review the engineering, financial and environmental aspects
  - Determine Objectives
  - Gather Information
  - Identify Projects
- Review of all CHP Technology – One size does “NOT” fit all
  - Turbine – lower efficiency, higher electrical and thermal output
  - Reciprocating Machine - higher efficiency, lower electrical and thermal output
- Analyze the electrical and thermal loads and match with the appropriate CHP technology
  - Electrical Load
  - Steam and Waste Heat Requirements
  - Electrical and Thermal Load Profiles
  - Offsite Sales

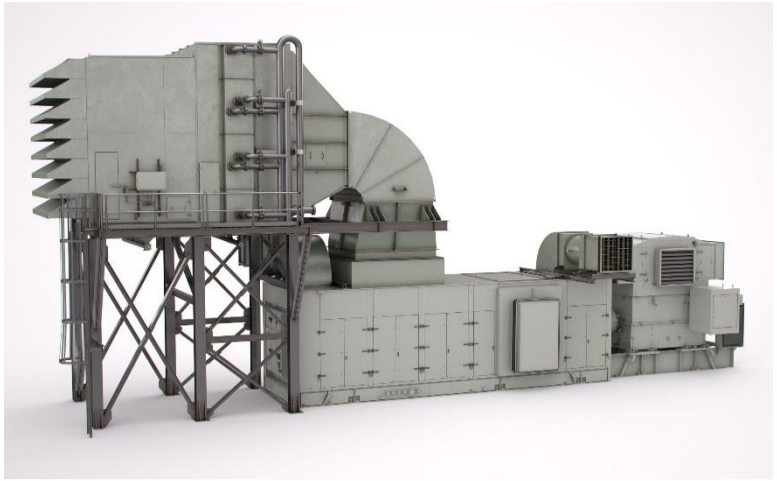
OTHER CONSIDERATIONS

- Electrical Interconnections
- Water Supply
- State Regulatory Approvals
- Qualifying Facility Certification - FERC
- Power Export
- Standby Charges
- Air Permits
- Other local permits

SUMMARY

CHP CAN WORK FOR UTILITIES AND THEIR CUSTOMERS

- Benefits the Customer with Lower Rates
- Grows Natural Gas Usage
- Reduces Carbon Emissions
- Can Be Used Productively By Electric Utilities
- Provides Returns to Stockholders



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