CONVEGNO
EFFICIENZA ENERGETICA

Energy Efficiency Distributed Generation and CHP: Wärtsilä's way

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Vice President Wärtsilä Italia S.p.A.

Rome 5 November 2009

AGENDA

- Wärtsilä
- The Challenge
- The Science
- The Solutions
- Conclusions

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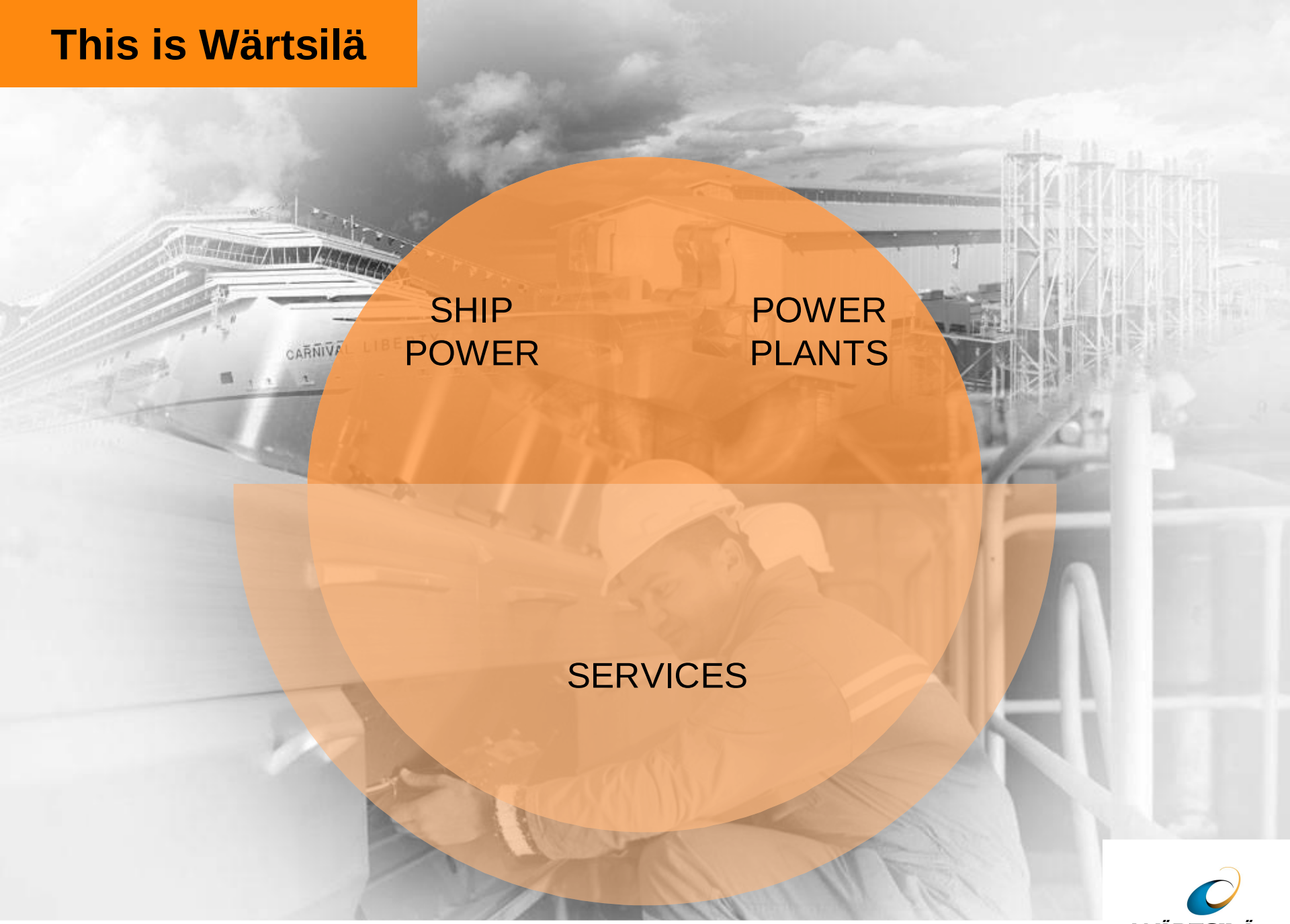
This is Wärtsilä



Our Mission and Vision

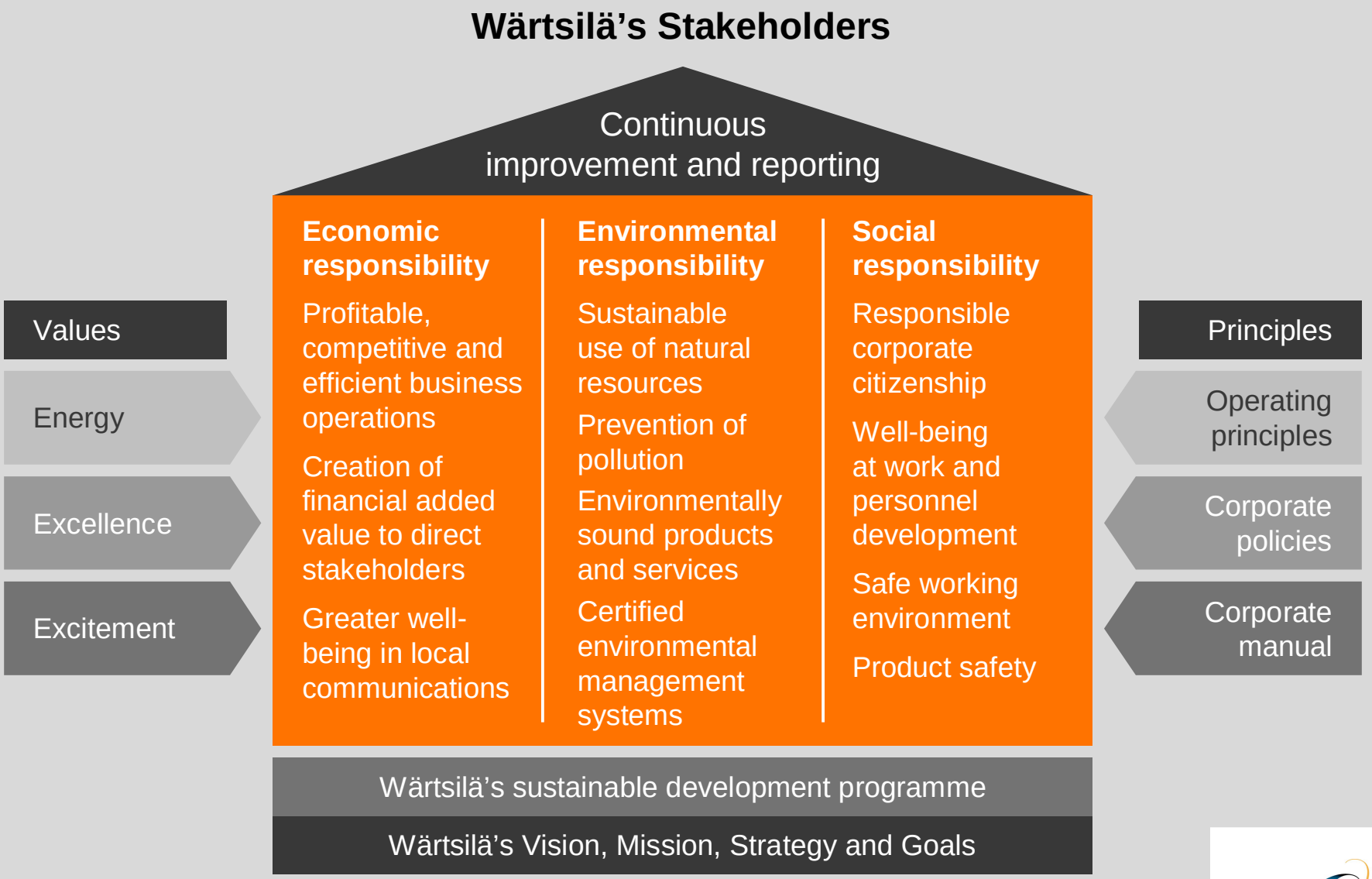
Mission

We provide lifecycle power solutions to enhance the business of our customers, whilst creating better technologies that benefit both the customer and the environment.

Vision

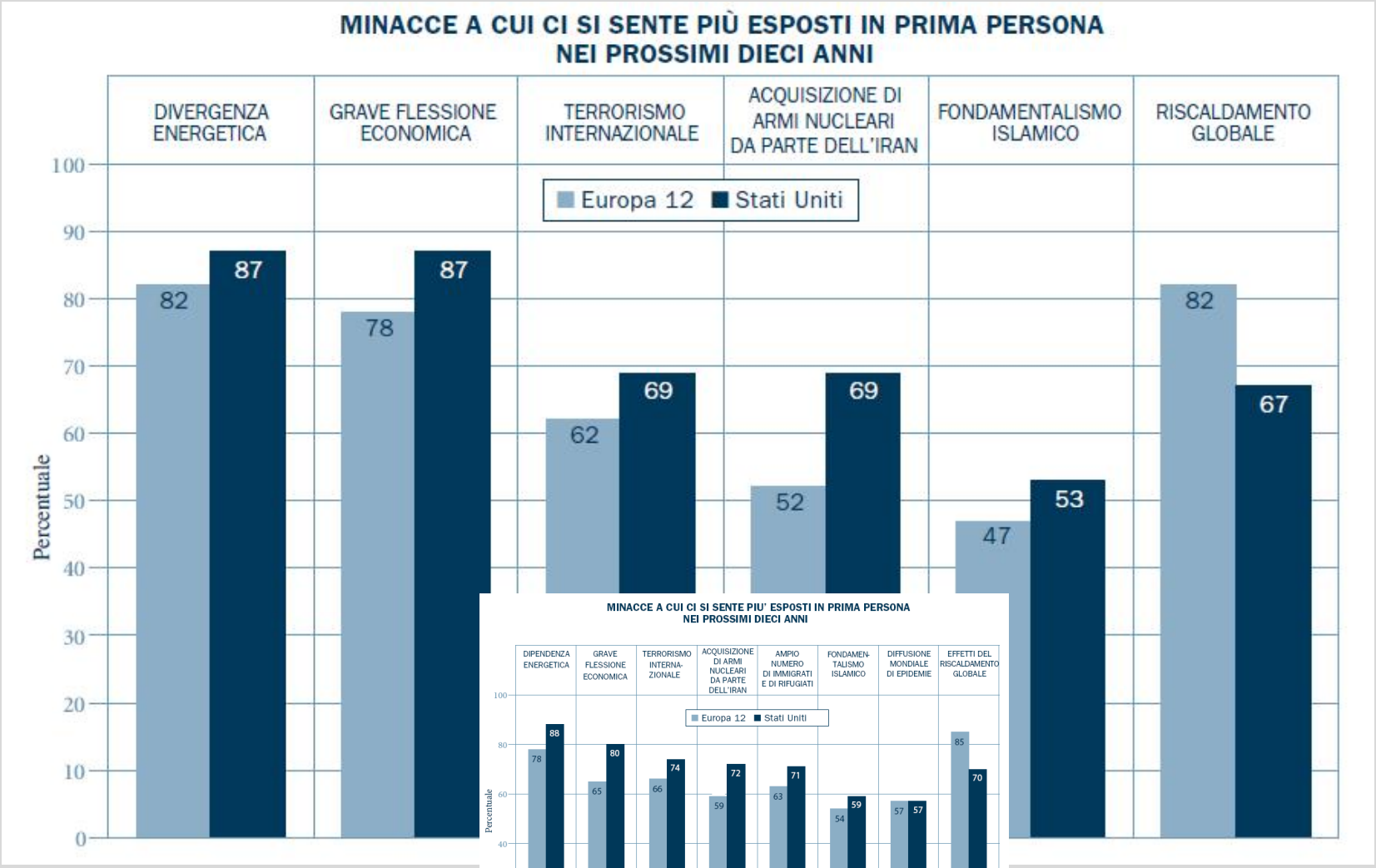
We will be the most valued business partner of all our customers.

Sustainability plays a central role in our business



The Challenge

Transatlantic trends 2008



Fonte: Transatlantic trends 2008

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Availability of fuels

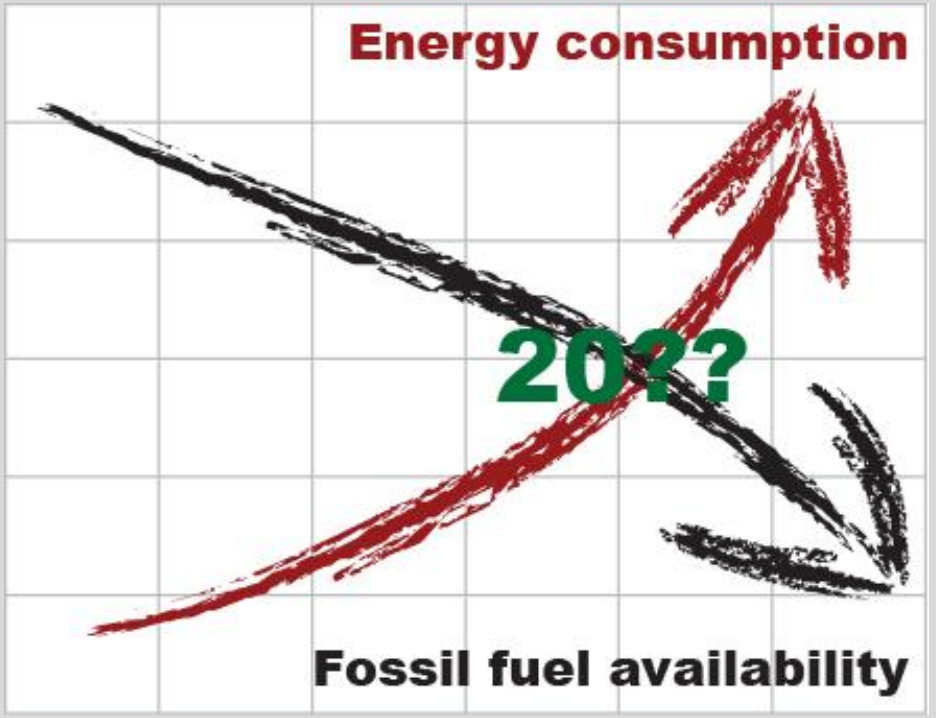
- Three hard truths – by Shell

1. Energy consumption is not only rising, but the rate of change is accelerating

2. The times for easy oil are over. Conventional resources will be soon used and non conventional resources are difficult/costly to utilise

3. The CO2 emissions are rising as a result of fossil fuels dominance as well as increased use of coal

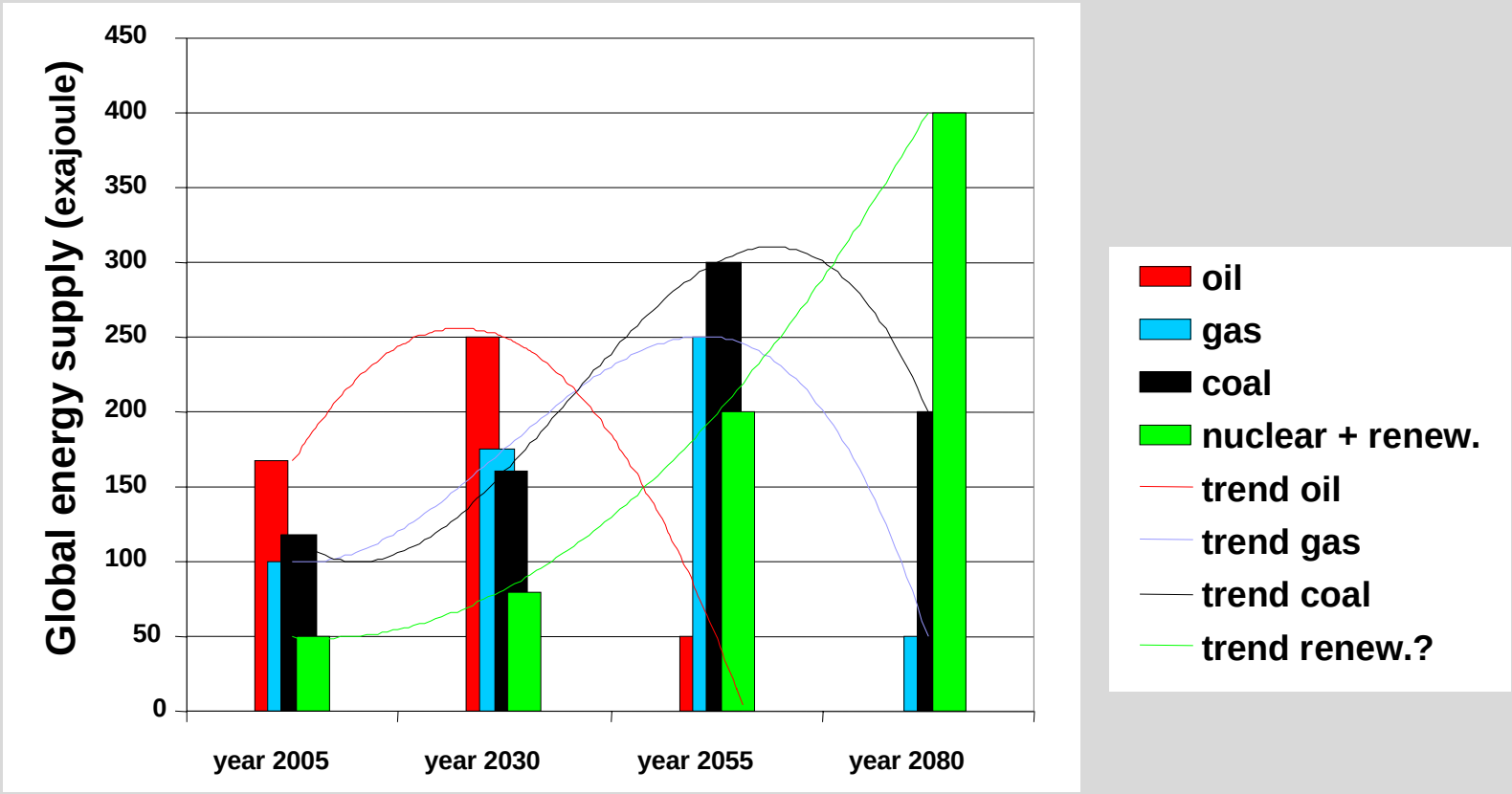
Source: Shell, CEO J vd Veer 31.5.2007 in St Gallens



Trends in Energy Use (data 2030 from IEA)

May 2, 2008: Oil production ExxonMobil 10% lower

Oil: 2.5 Mbarrels/day Gas: 1,7 Mbarrels/day eq. +



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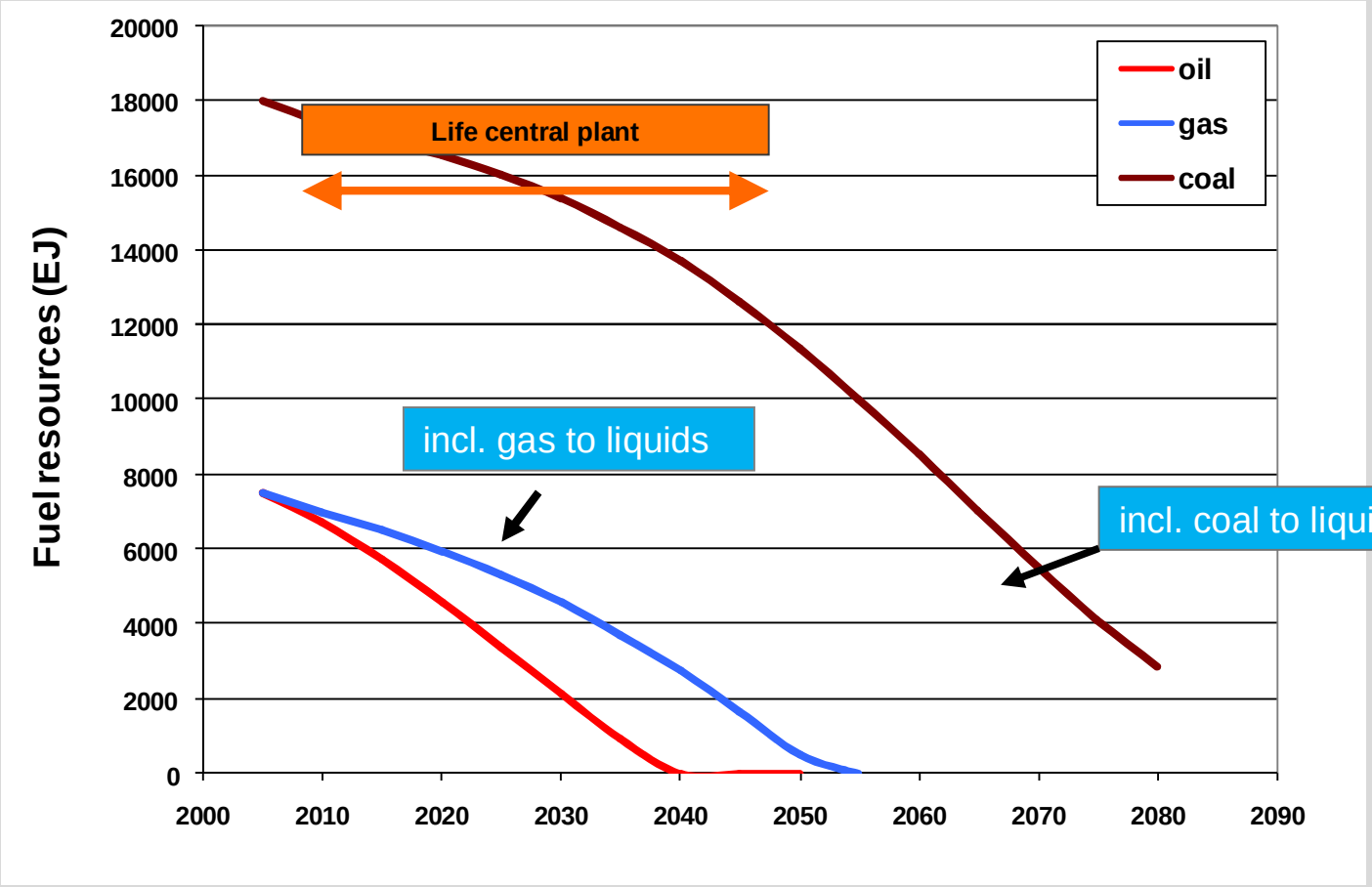
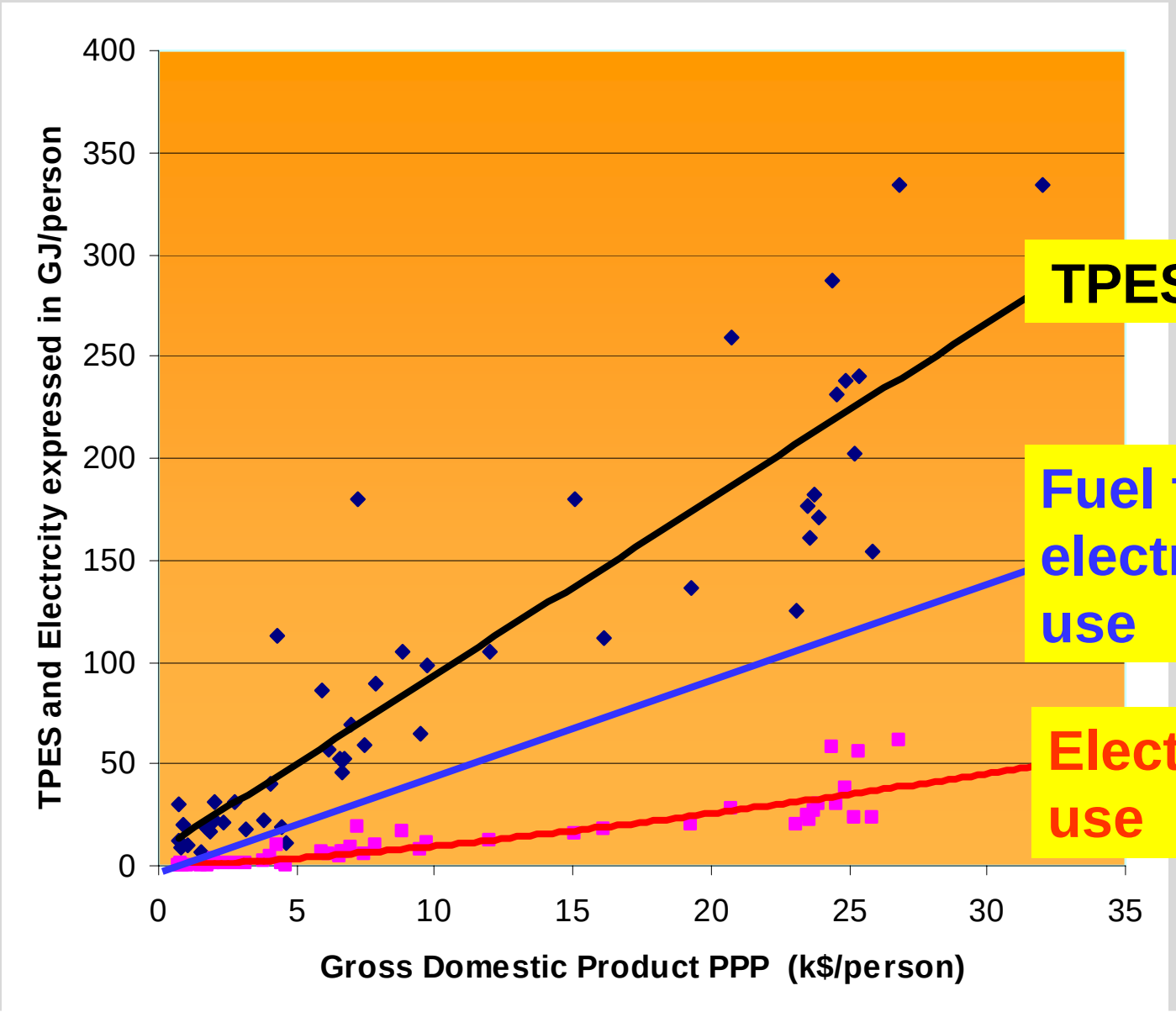
Fuel Resources: Another Way of Plotting



The Impact of Electricity Use on Fuel needs



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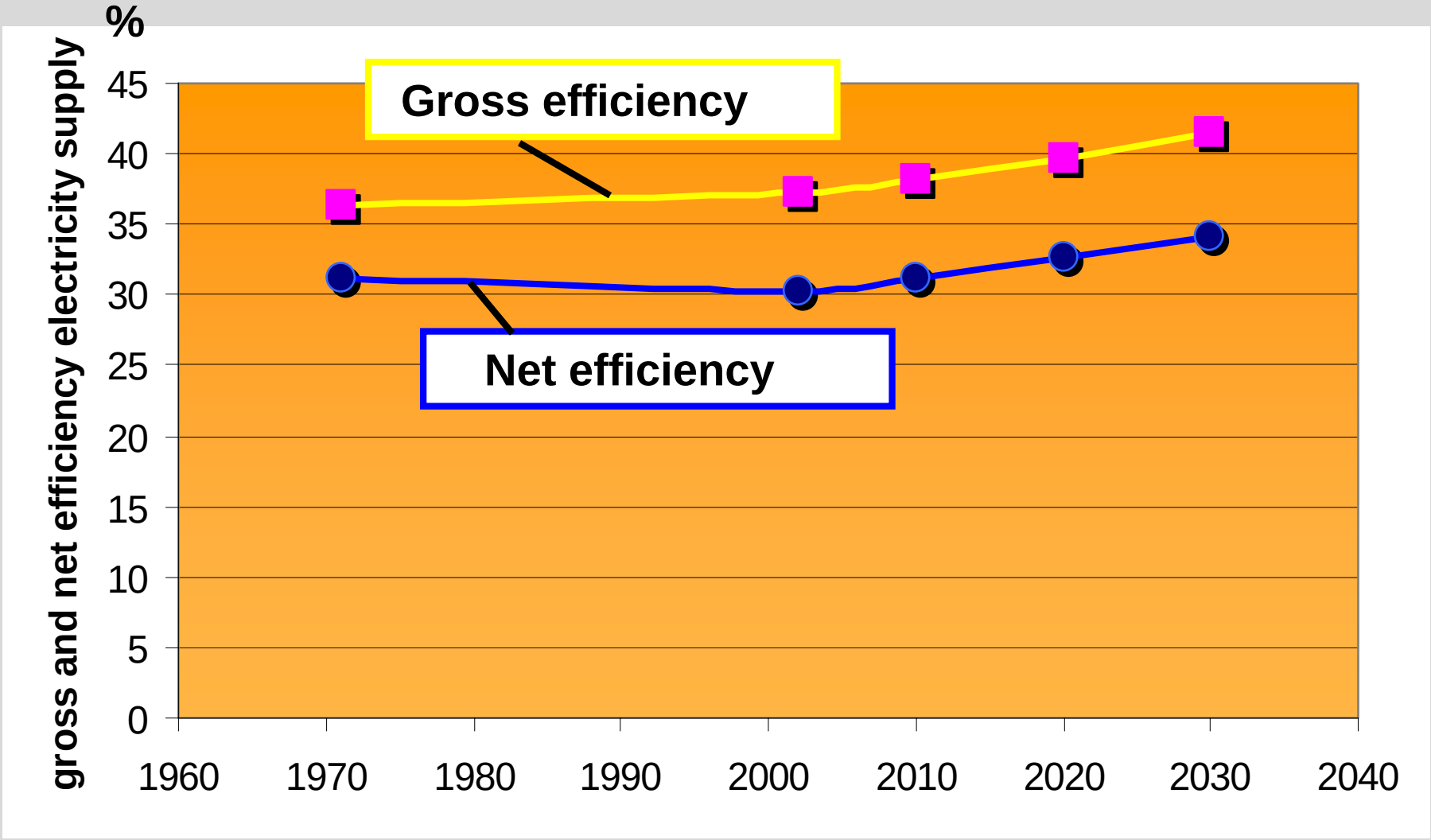
The reality: development in generation efficiency (IEA)



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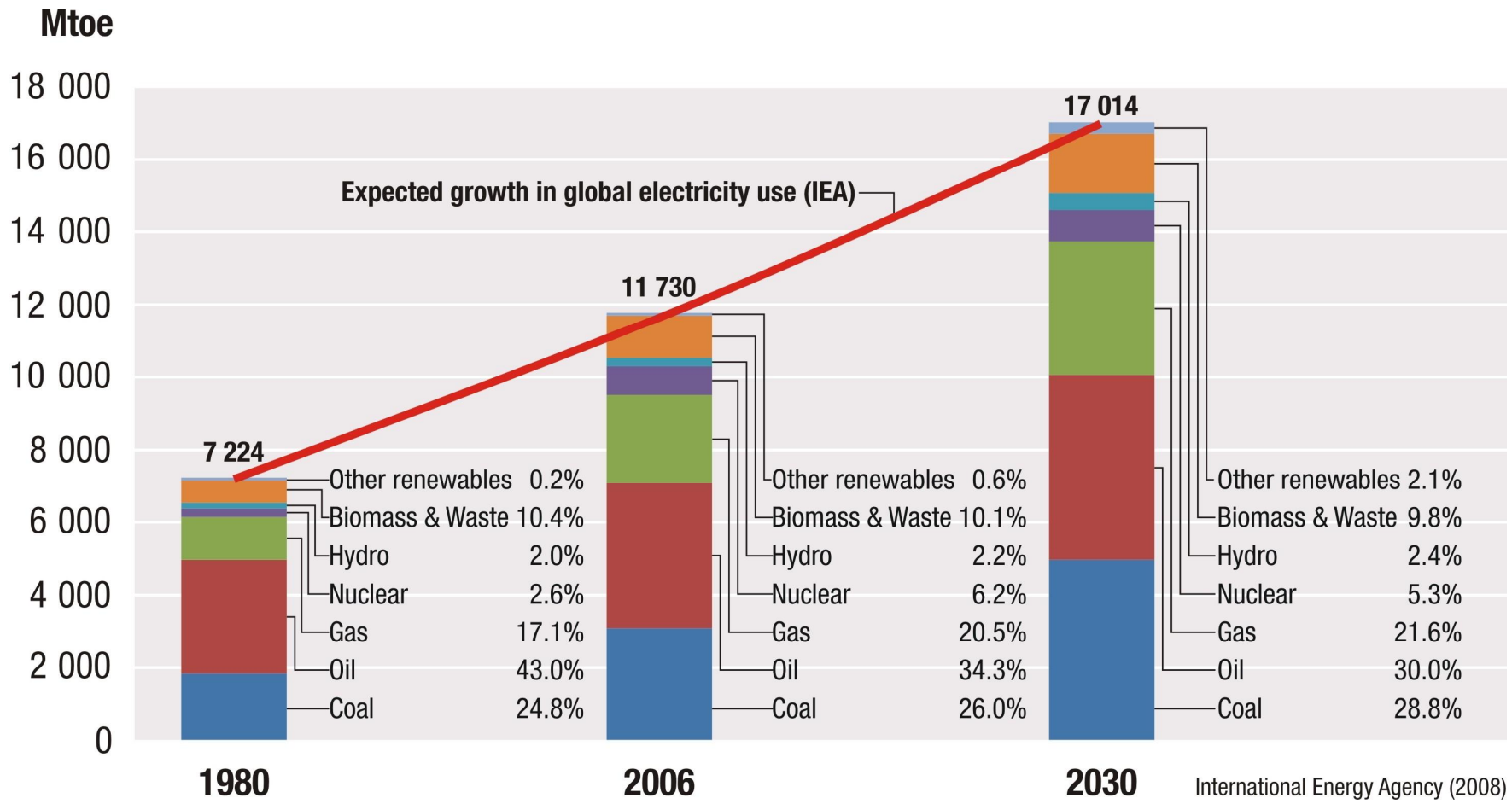
Expected Growth in Global Electricity Use 1980-2030



Prediction IEA 2007

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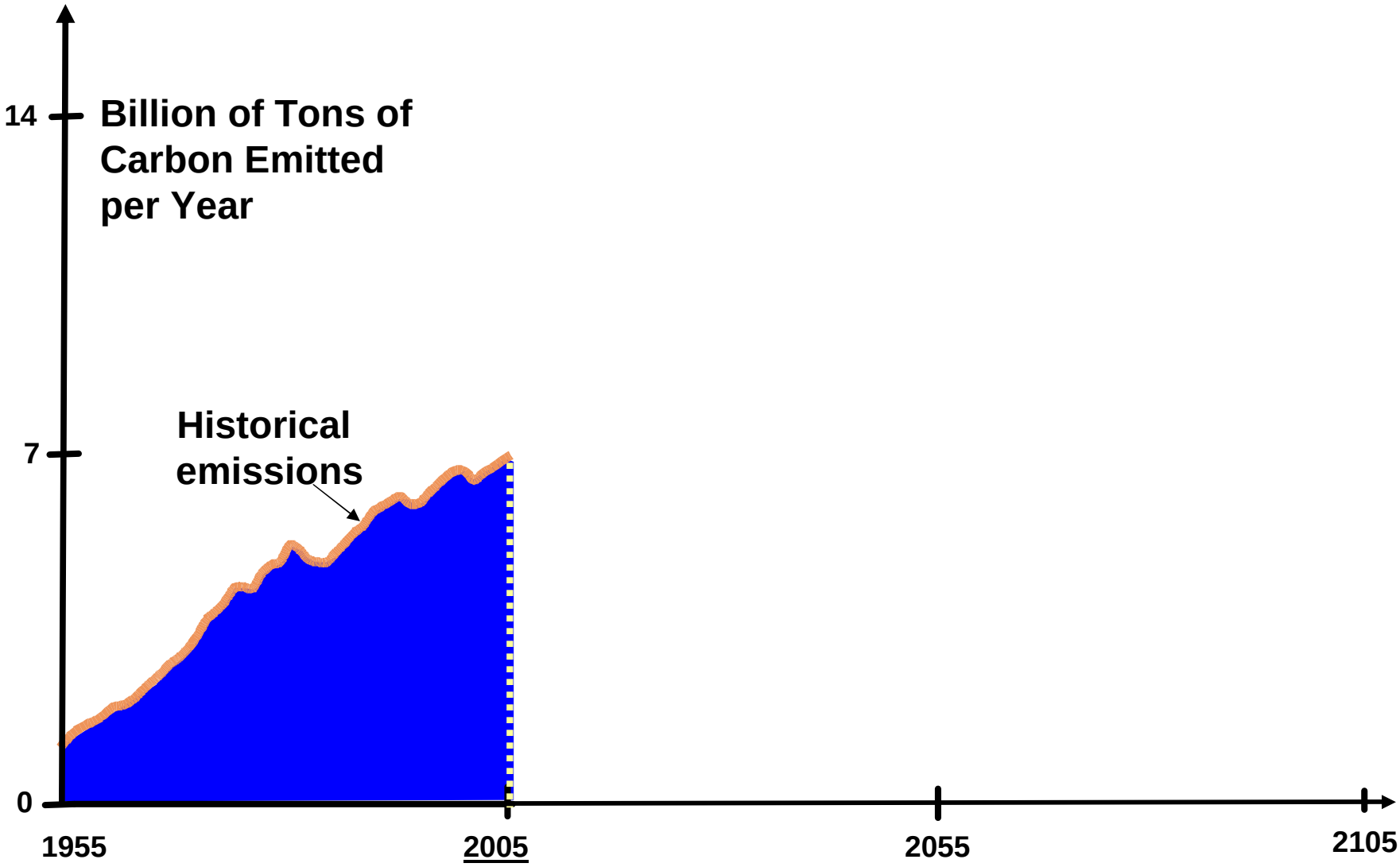
The Science


THIS IS THE SOLUTION WE'VE DEVISED FOR DEALING WITH THE FLOODING CAUSED BY CLIMATE CHANGE.

Past Emissions



Robert Socolow - Princeton University

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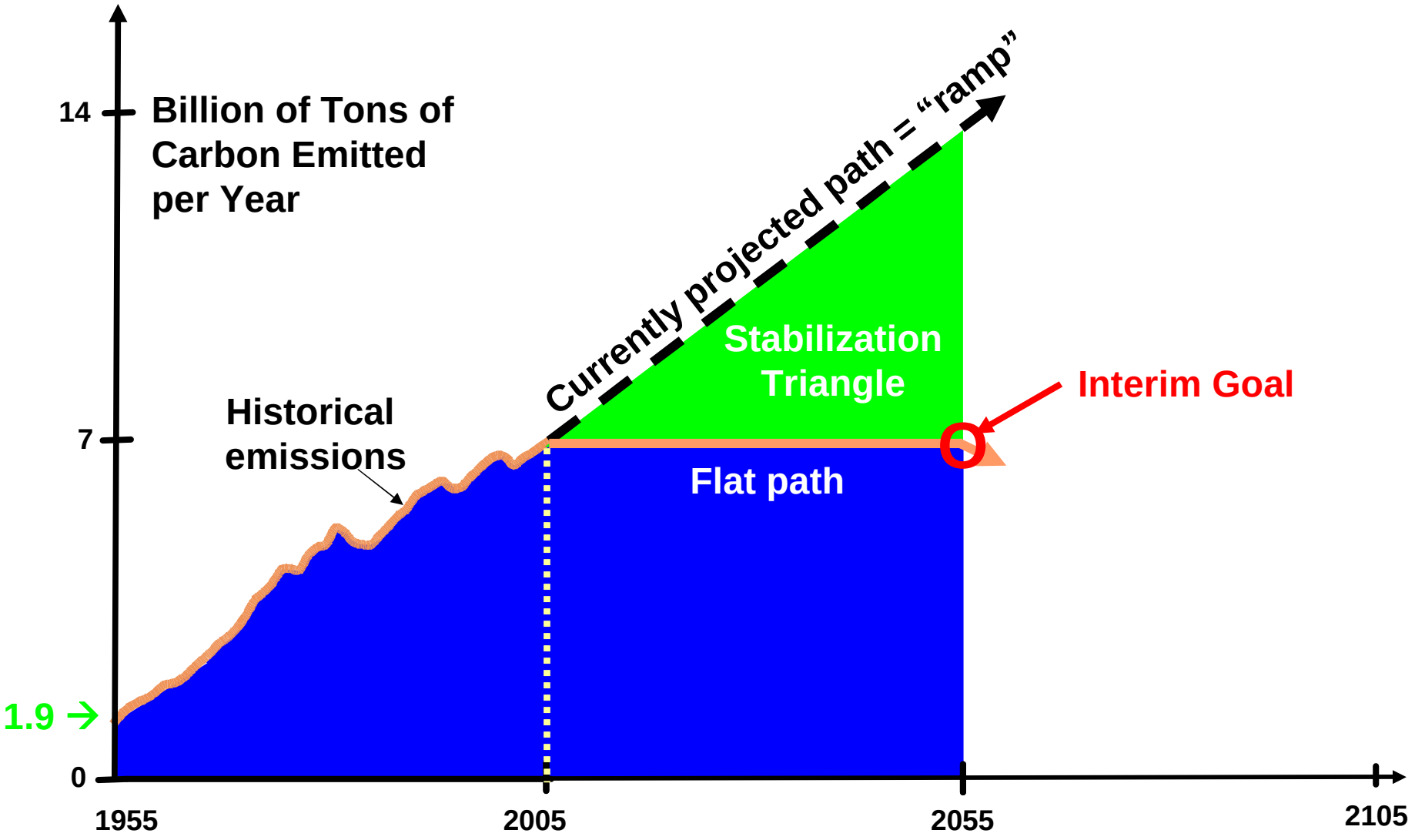
The Stabilization Triangle



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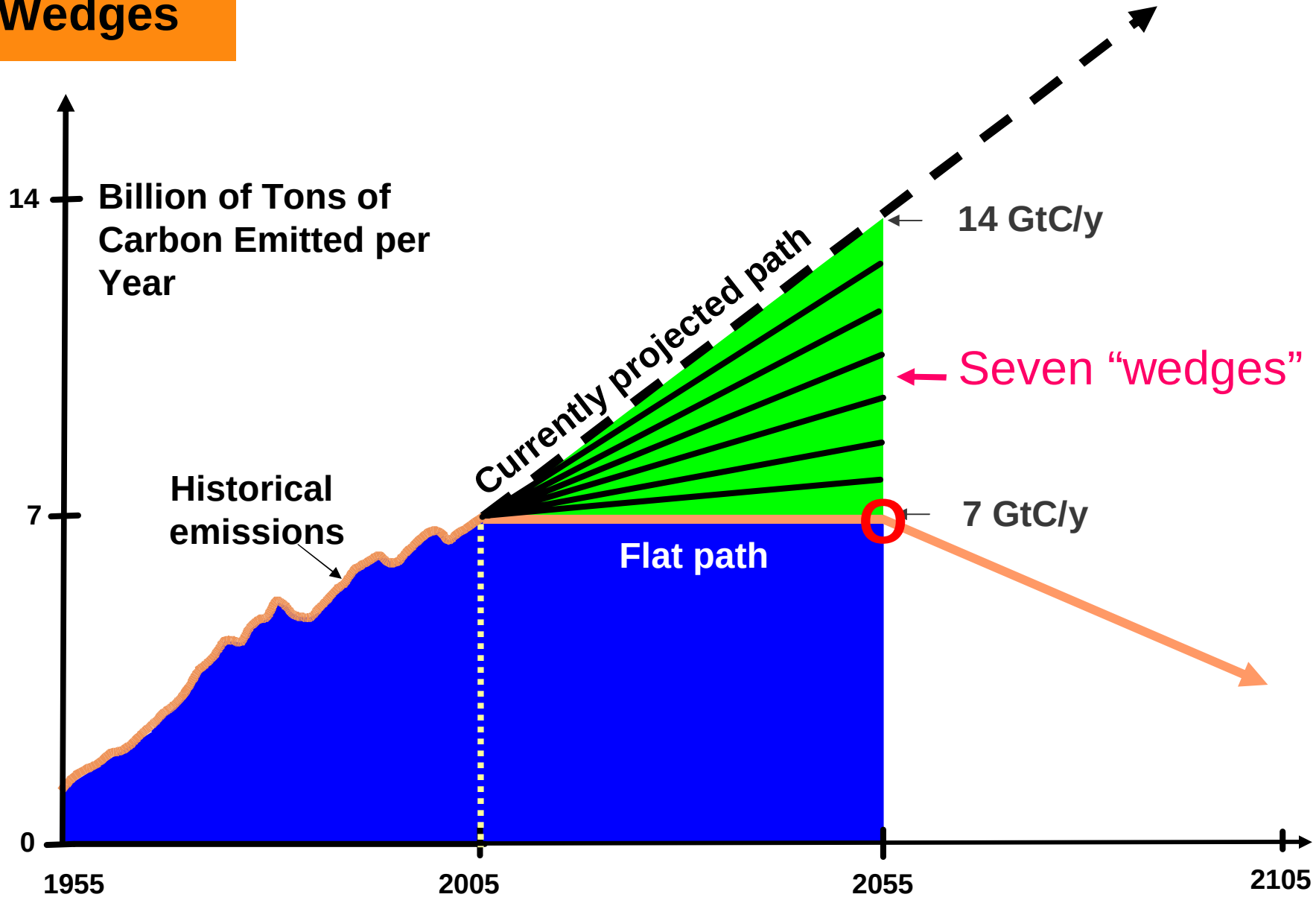
Wedges



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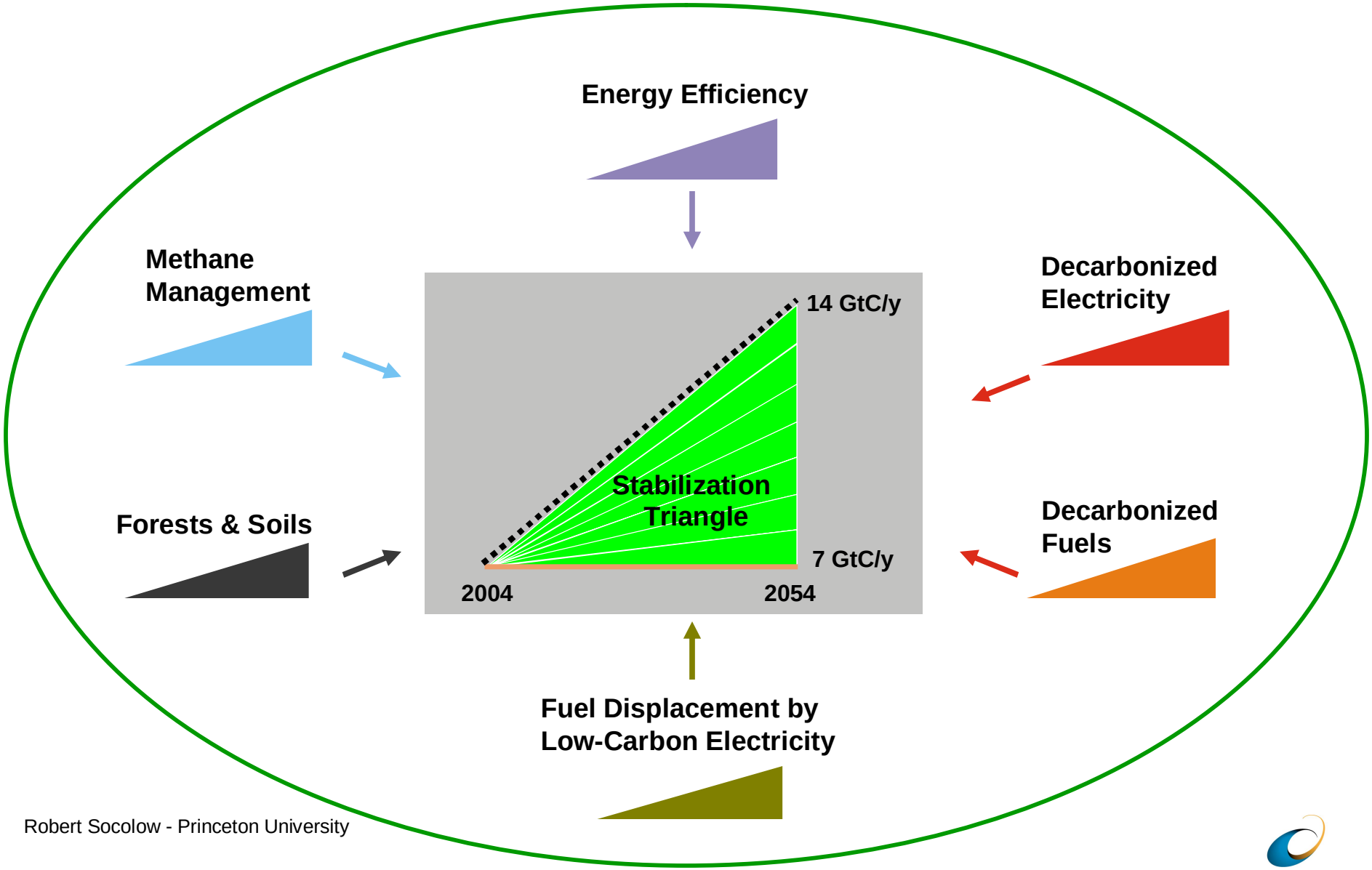
The Seven Wedges



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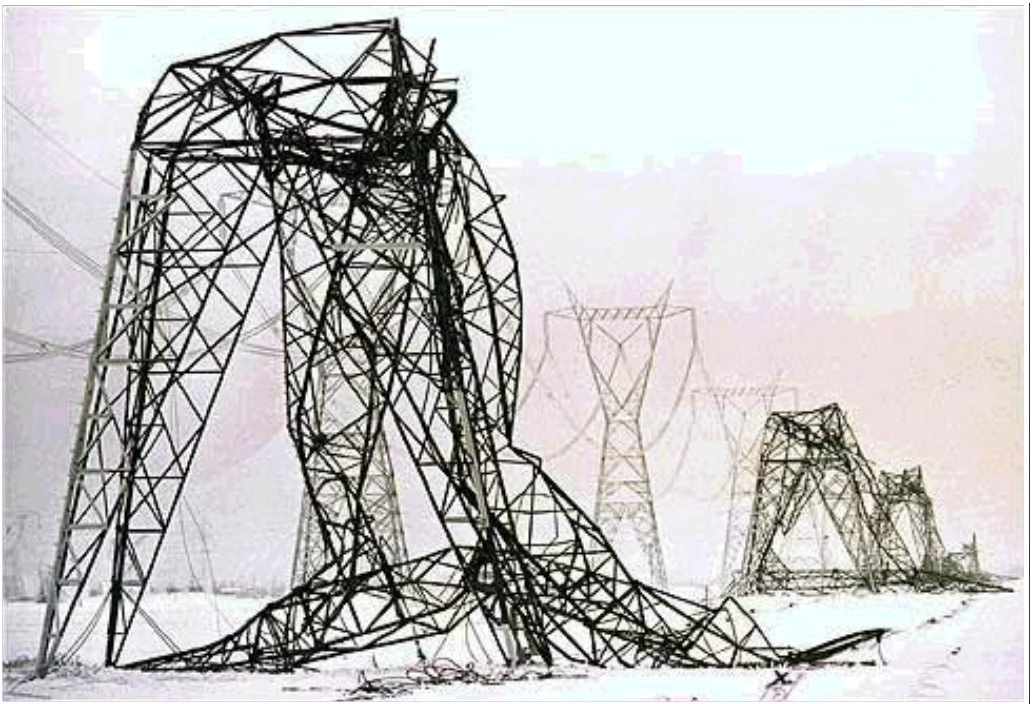
The Solutions

Decentralized power

WADE
WORLD ALLIANCE FOR DECENTRALIZED ENERGY



Capstone Turbines Corporation , USA
Centrax Gas Turbines, UK
COGEN Europe, Belgium
COGEN India, India
COGEN Portugal, Portugal
Cogeneration Study Committee, China
Cummins Power Generation, USA
Delta State Government, Nigeria
Enercon Engineering, USA
Energy Capital, Singapore
FuelCell Energy, USA
InterWorld Technologies, LLC, USA
MAN TURBO AG, Germany
Marubeni Power International, Japan
Mitcon Consultancy Services ltd., India
MTU CFC Solutions, Germany
NewEra, Canada
Peter Brotherhood Ltd, UK
Primary Energy, USA
PT. Kaltimex Energi, Indonesia
Rolls-Royce Marine Engines, Norway
Siemens, Germany
Solar Turbines, USA
Thermax, India
Turbomeca, France
US CHP Association, USA
Wärtsilä, Finland

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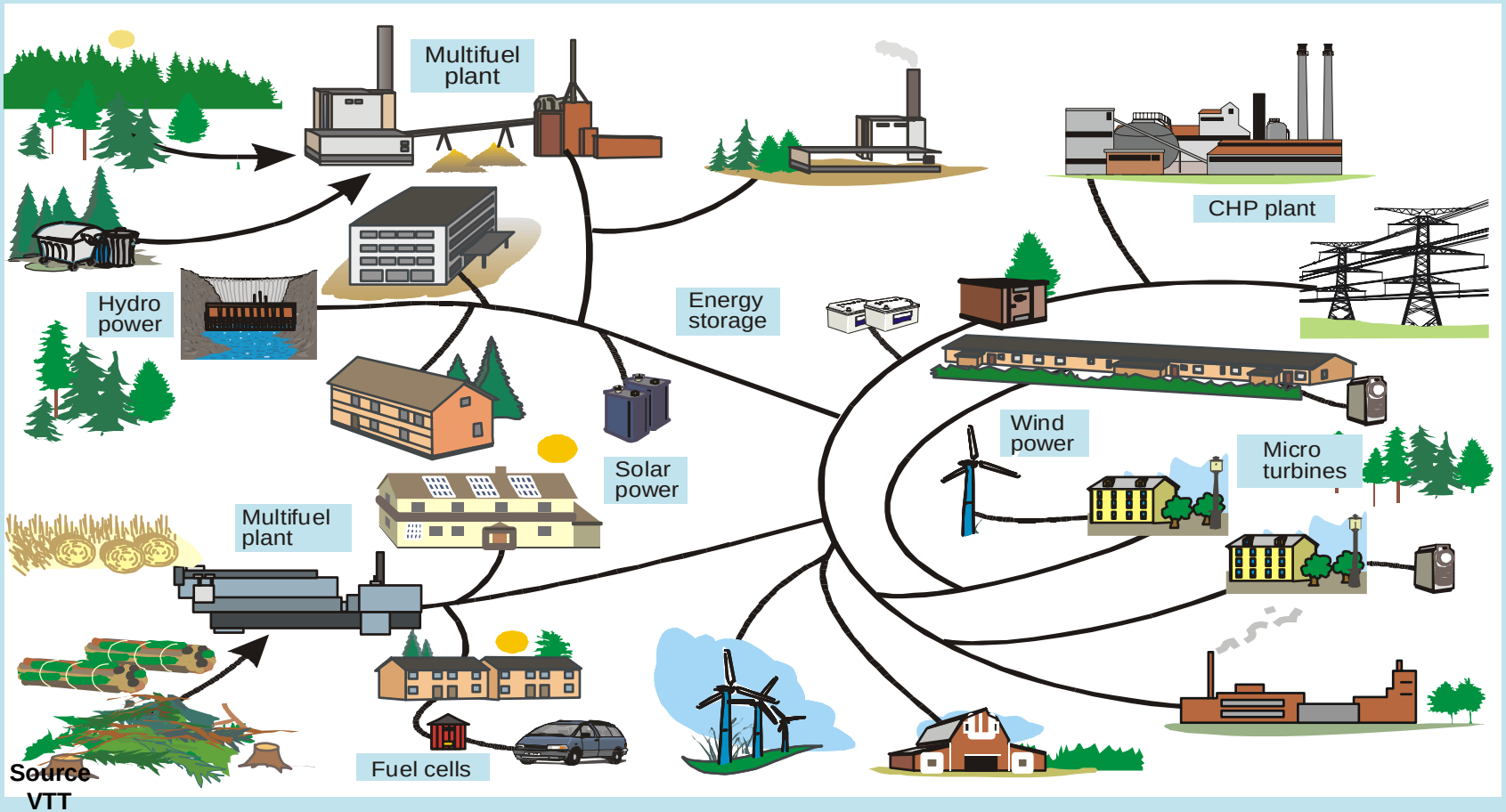
Distributed Energy production in Decentralised network

“Energy production – close to the point of consumption”



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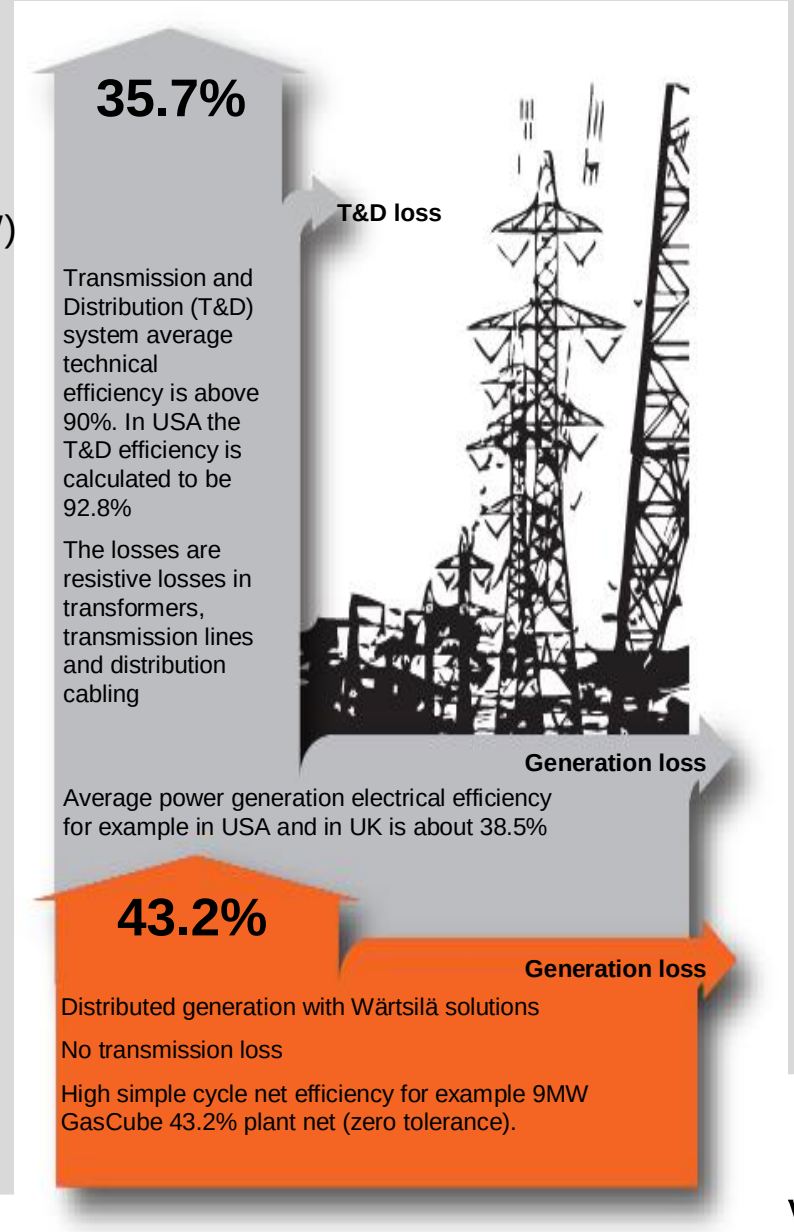
Distributed Generation

- What is Distributed Generation?
  - Relatively small plant size (typically)
    - Typical range 30kW – 15MW (…100MW)
    - Not a strict definition
  - Power is generated close to the load
    - Eliminate voltage step-up losses
    - Eliminate transmission losses
    - Eliminate step-down losses (best case, generation at same voltage as consumption)
    - Eliminate distribution losses
  - Power generation is connected to the utility (grid)
    - Normal operating mode is to run in parallel with the utility
    - Island mode operation is sometimes applied in special conditions to provide higher reliability for the consumer



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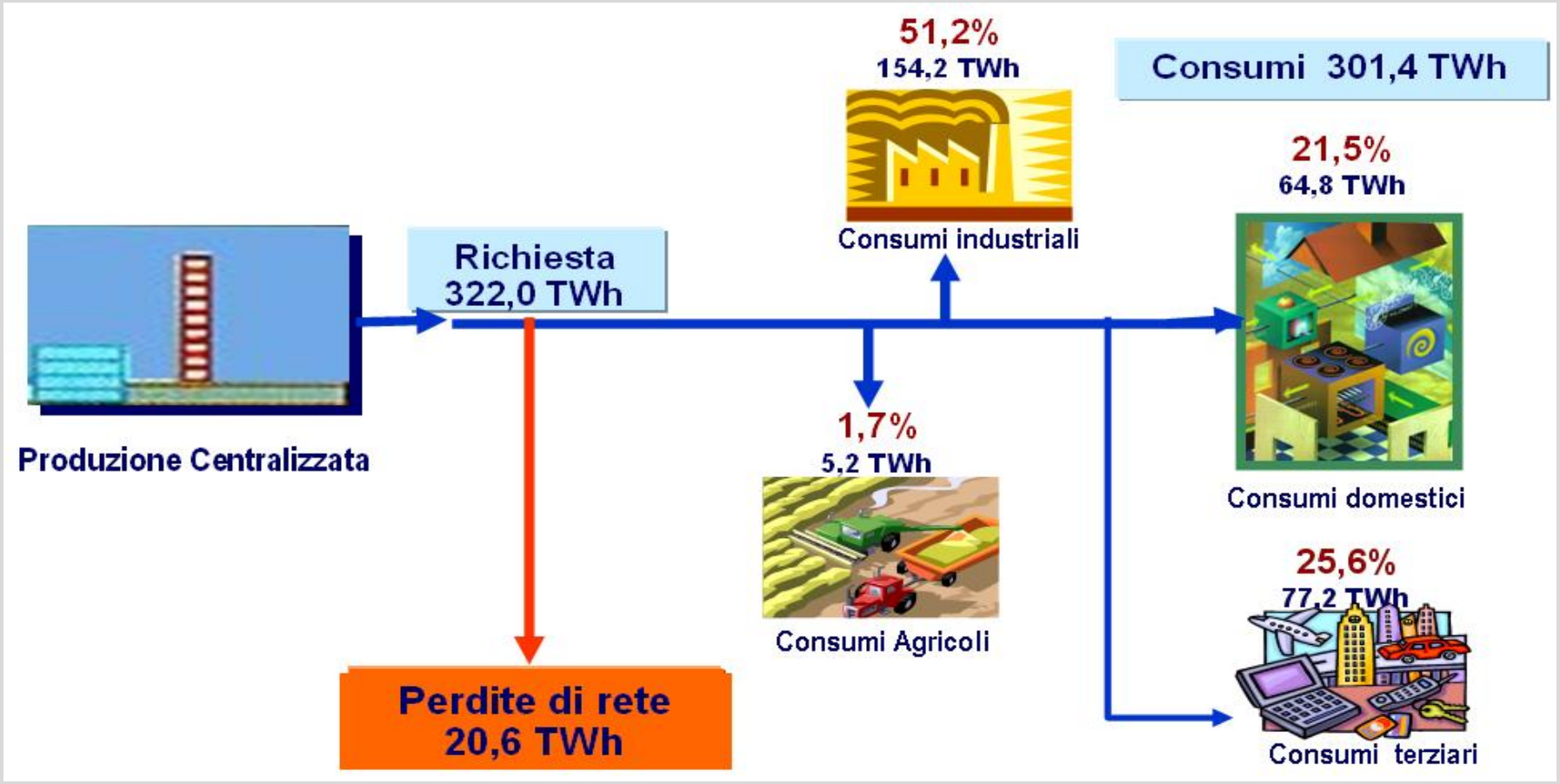
The grid



GRTN 2006

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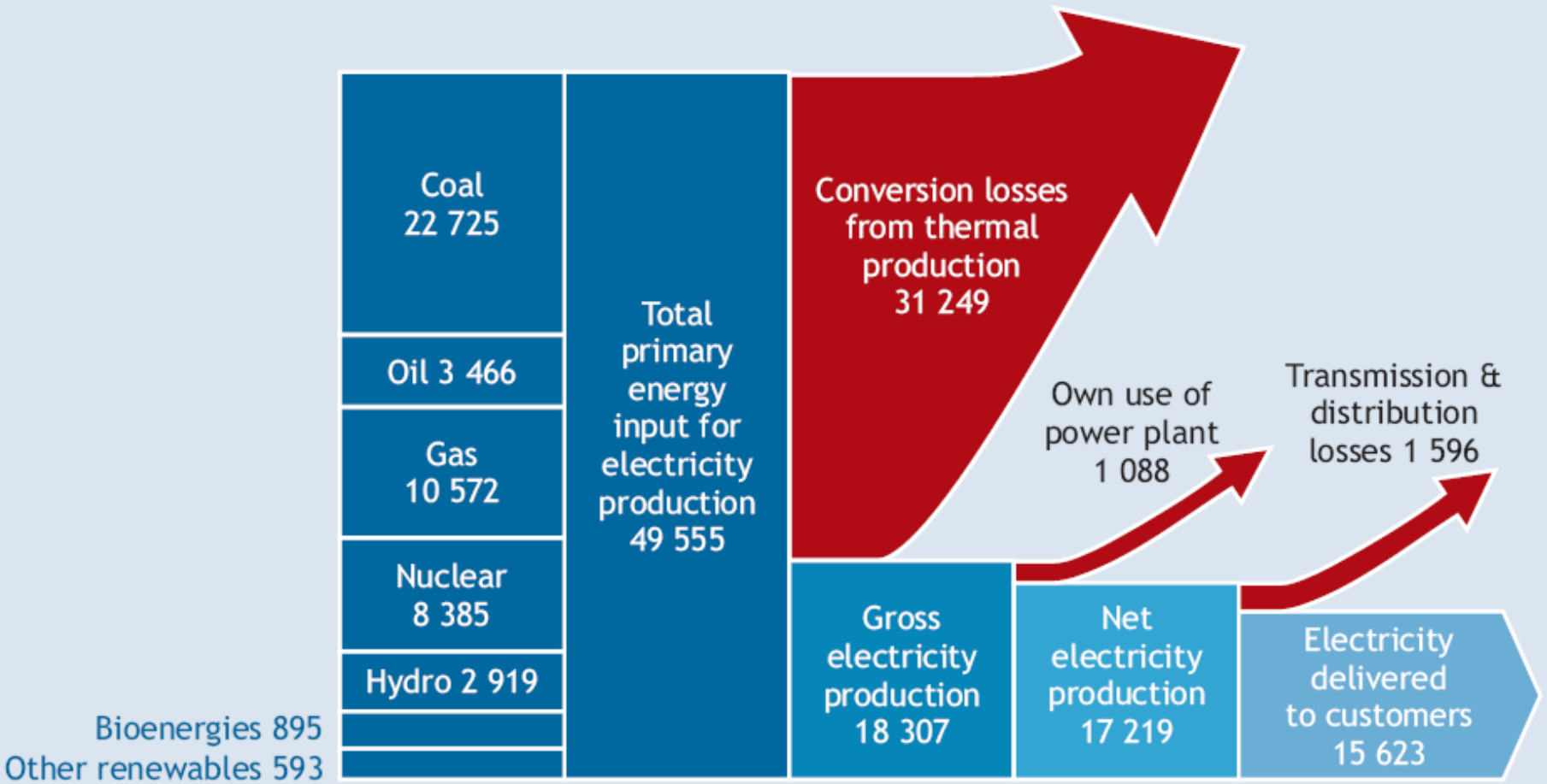
Cogeneration by IEA



Sources: IEA, 2007a; IEA, 2007d.

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IEA on CHP

- CHP can reduce CO2 emissions arising from new generation in 2015 by more than 4% (170 Mt /year), while in 2030 this saving increases to more than 10% (950 Mt / year) – equivalent to one and half times India's total annual emissions of CO2 from power generation. CHP can therefore make a meaningful contribution towards the achievement of emissions stabilisation necessary to avoid major climate disruption. Importantly, the near-term reductions from CHP can be realised starting today offering important opportunities for low- and zero-cost GHG emissions reductions.

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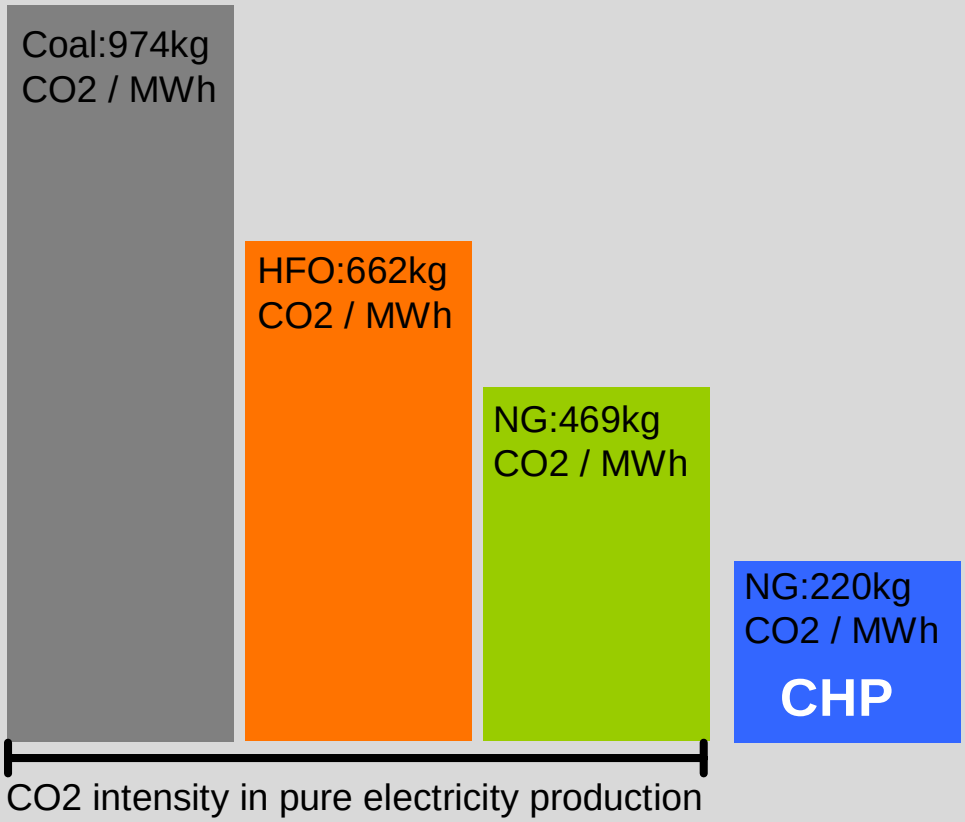
Natural gas – Oil – Coal and CHP: CO2 comparison

- Greenhouse emissions
  - Burning fuel releases energy through the breaking of chemical bonds when fuels react with oxygen.
  - In fossil fuels CO2 intensity depends on hydrogen – carbon ratio
    - The more hydrogen, the better
    - Methane (NG) C:H = 1 : 4
    - HFO C:H = 1 : 2.1
    - Coal C:H = 1 : ~1
  - Oil & Gas benefit from higher conversion efficiency in pure electricity production
    - Coal is turned to electricity through steam cycle which typically yields 36-38% efficiency
    - Reciprocating engines typically yield 43-45% net electrical efficiency with oil or gas

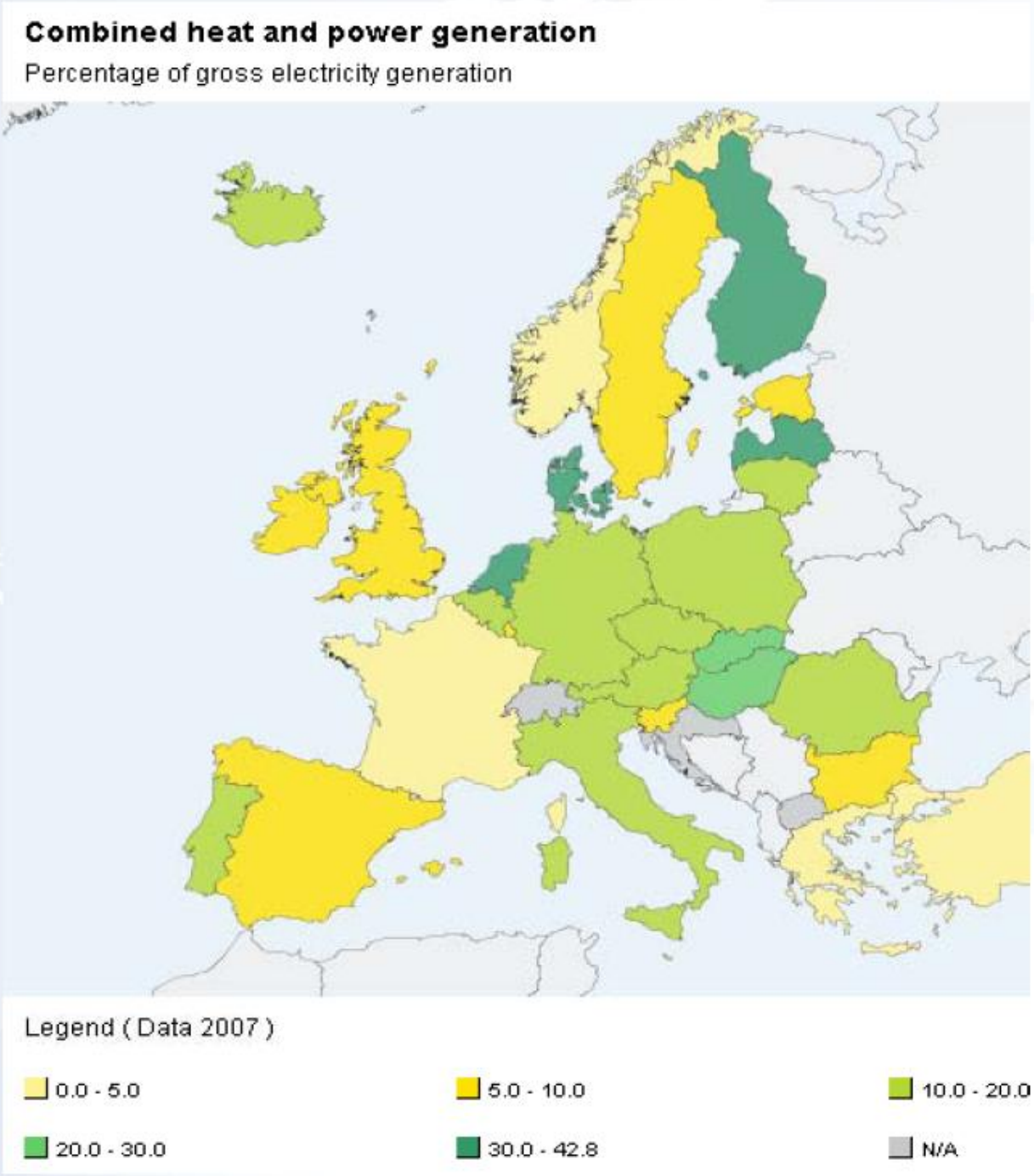


Preliminary analysis of the reports on cogeneration potential in the EU Member States

COGENERATION OBSERVATORY
AND DISSEMINATION EUROPE

COGEN
europe

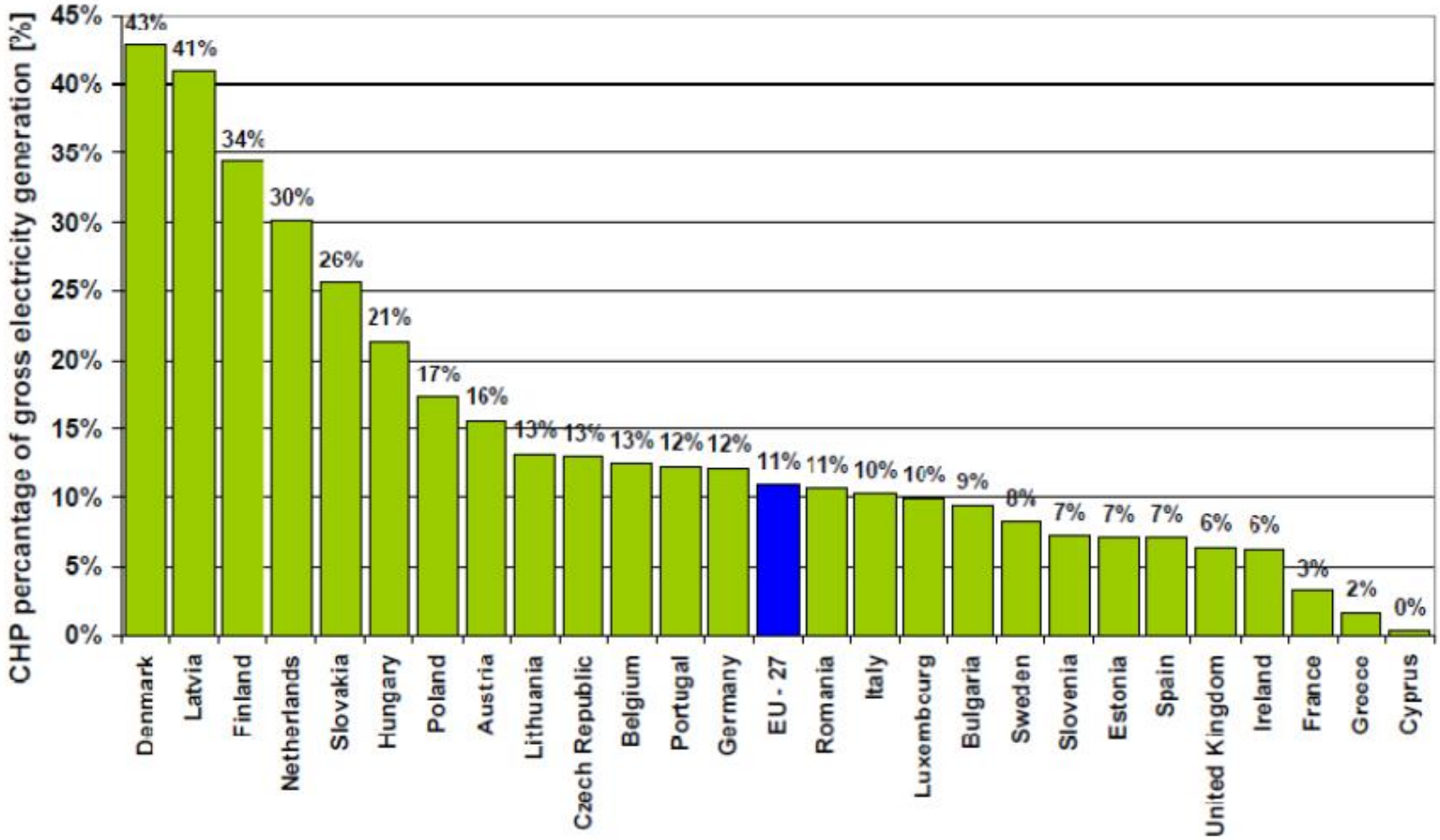
Share of CHP in total electricity generation in 2007 by Member State



COGEN europe

Electricity generated by cogeneration in 2007

- Total installed CHP electrical capacity: 97,7 GW_{el}
- Total CHP electricity production: 364,4 TWh_{el}
- Total CHP heat production: 845,1 TWh_{h}



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Cogeneration sector in Europe

Supply

Production
Development

Distribution

Operation

- Employs around100,000 people directly in the sector
- Part of Europe's innovation and knowledge economy: world experts in CHP design and delivery and leaders in micro-CHP technology

COGEN europe

Preliminary analysis of European cogeneration - additional economic potential

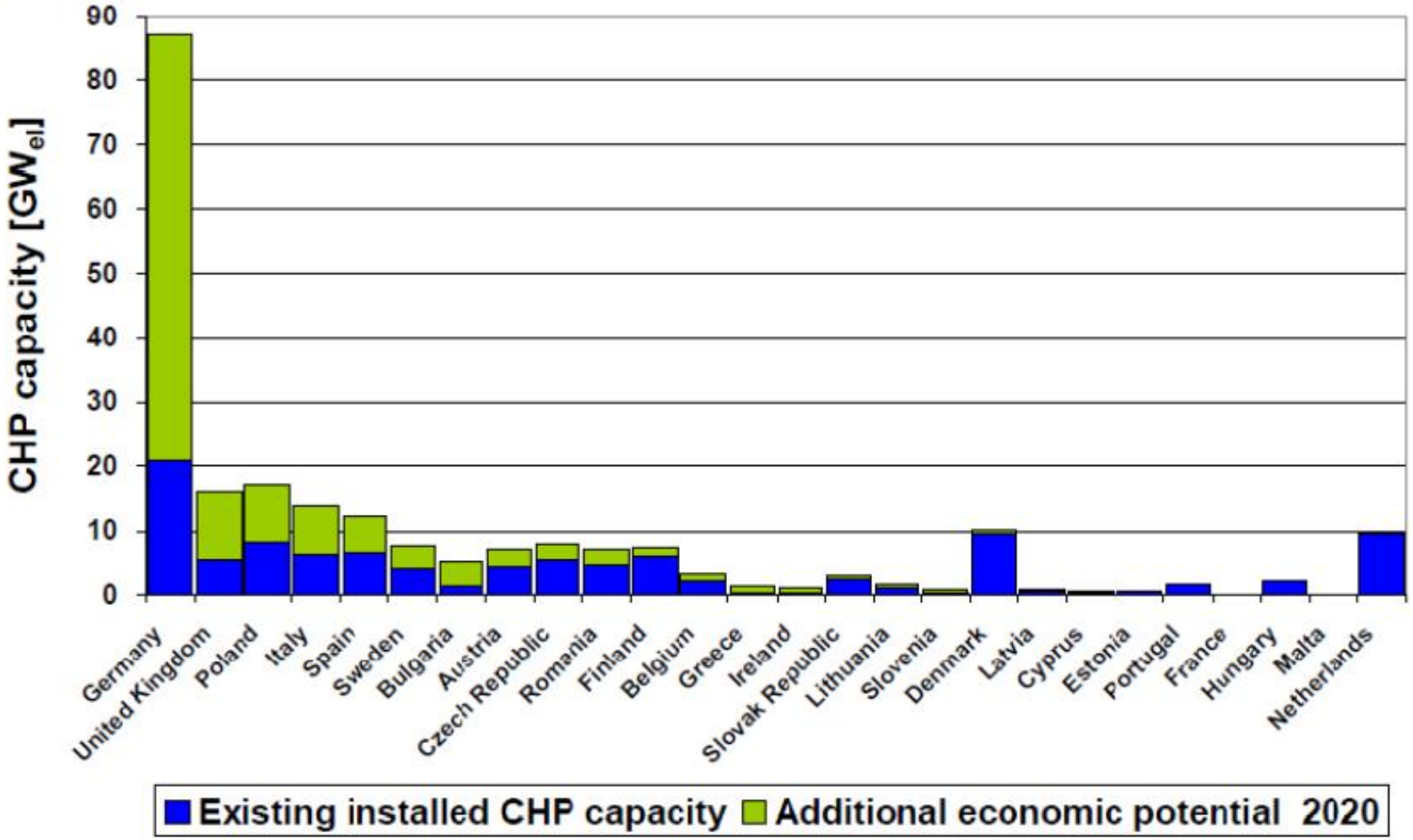
Europe's installed cogeneration capacity in 27 Member States:
97.7 GWe

Europe's additional economic potential in 23 Member States:

122 GWe

COGEN europe

European economic potential for cogeneration in 2020



COGEN europe

Interim Summary of European cogeneration additional economic potential

The additional economic potential as reported by Member States:

- Total additional Electrical Capacity: 122 GWe
- Total additional Electricity Generation: 455 TWh p.a.
- Total additional Primary Energy Saving expressed as electricity (min): 46 TWh p.a.
- Total additional CO_2 avoided (min): 20 mton p.a.
- Value of CO_2 avoided: 798 mEuro* p.a.

*Evaluated at carbon price of 39Euro/ton CO2 (ref. ETS impact study)

COGEN europe

Italy

Associazione dei costruttori e distributori
di impianti di cogenerazione

Federazione delle Associazioni Nazionali
dell'Industria Meccanica Varia ed Affine

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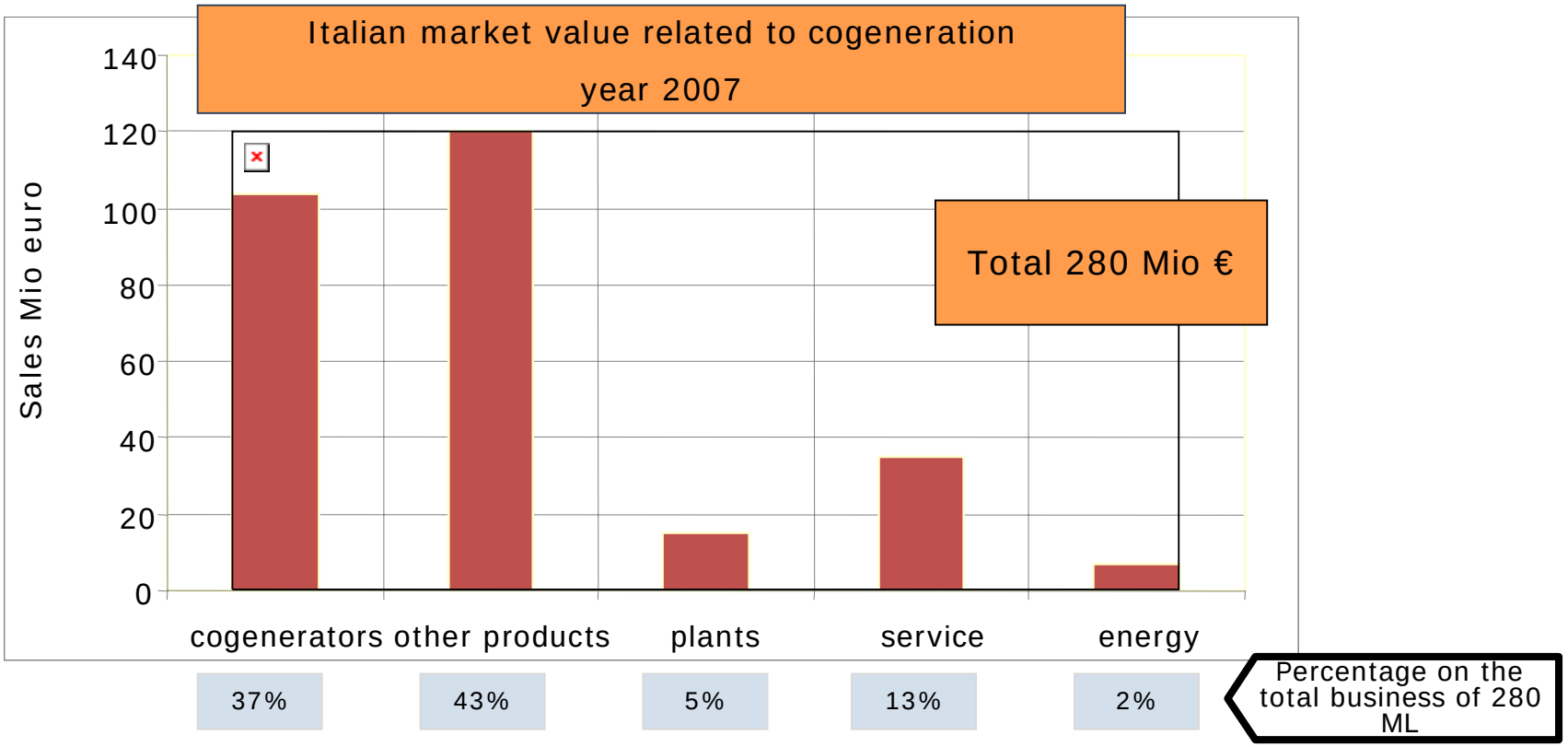

- The main companies in the cogeneration sector create a total business of 280 ML €
- More than 40% of this total business is represented by “other products”, mainly electric generators
- The third component is the “service” (as indicated in the budget); maybe there would be a not-declared part included in the component “other products”

INCREASE AT 2014	Micro and small cogeneration (< 1 MWe) – Residential and service sector	Cogeneration 1-10 MWe Industrial sector
Forecast power usage (MWe)	3200	550
Saved primary energy (Mtep/anno)	0,7	0,87
Spared Co2 emissions (Mt/year)	2,2	2,9
Incentives (M€/year)	208	87

INCREASE AT 2020	Micro and small cogeneration (< 1 MWe) – Residential and service sector	Cogeneration 1-10 MWe Industrial sector
Forecast power usage (MWe)	6200	950
Saved primary energy (Mtep/anno)	1,3	0,87
Spared Co2 emissions (Mt/year)	4,3	2,9
Incentives (M€/year)	208	87

Reference: Confindustria (Energy task-force 2007) data processing

COGENERATION IN SERVICE, RESIDENTIAL AND INDUSTRIAL SECTORS REPRESENTS THE REAL CHALLENGE/OPPORTUNITY OF COGENERATION DEVELOPMENT IN ITALY

Europe March 2007

20-20-20

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Wärtsilä for Europe

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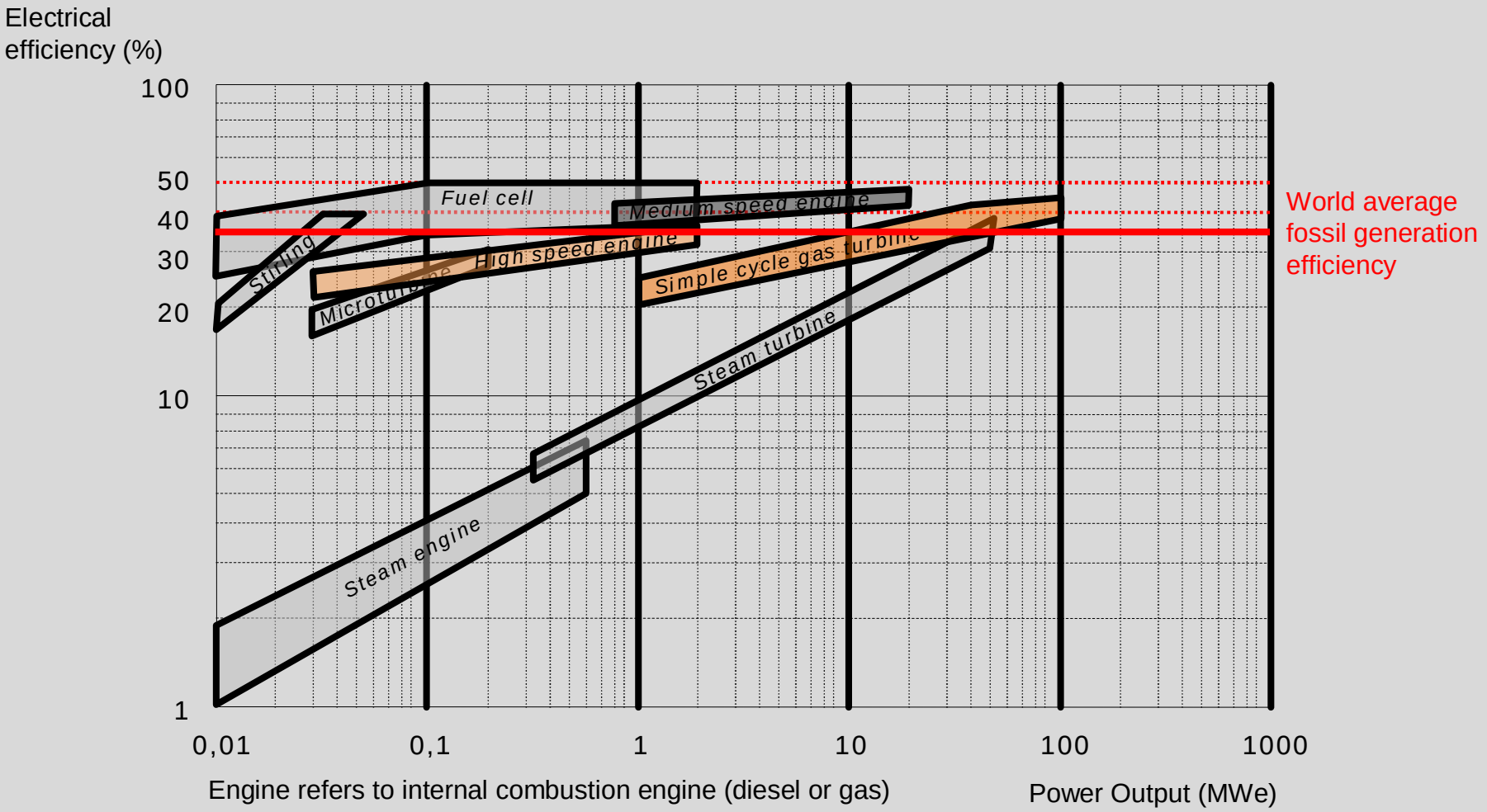
High electrical efficiency



Wärtsilä means Fuel Flexibility

Solid Biomass Wood based - steam cycle	Renewable power, Europe/Kyoto
Liquid Biofuels (LBF)	Baseload power, Europe/Kyoto
Natural gas (NG)	Baseload power, power islands, grid stability services, compressor drives
Associated gas (AG)	Oil field power, eliminates the need for flaring in oil fields
Light Fuel Oil (LFO)	Stand by & emergency power
Crude Oil (CRO)	Oil field power, Oil pipeline pumpsets
Heavy Fuel Oil (HFO)	Baseload plants, Power Islands, Back-up power
Fuel Water Emulsions (FEW)	Oil sands, Oil refinery power based on process residue

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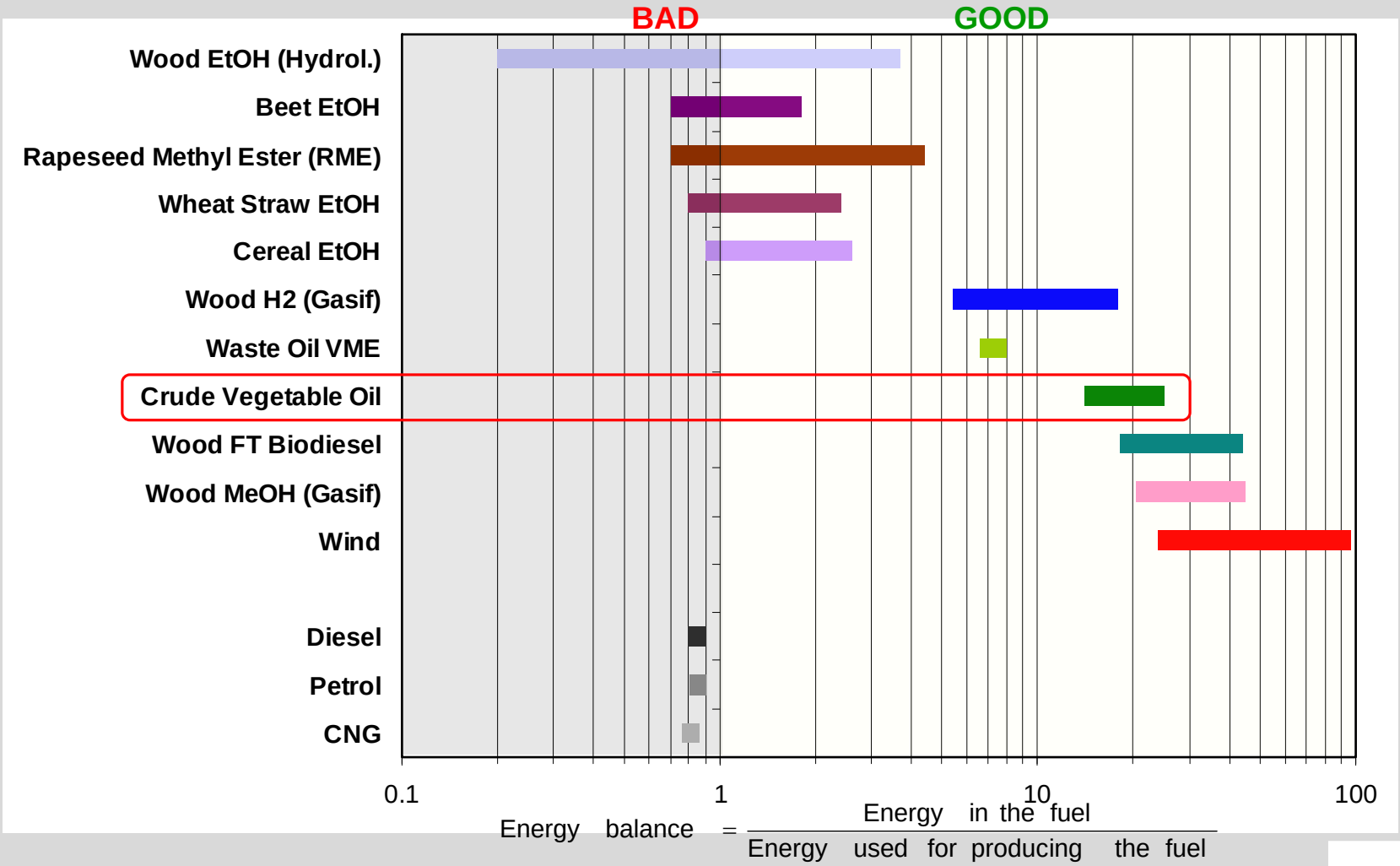
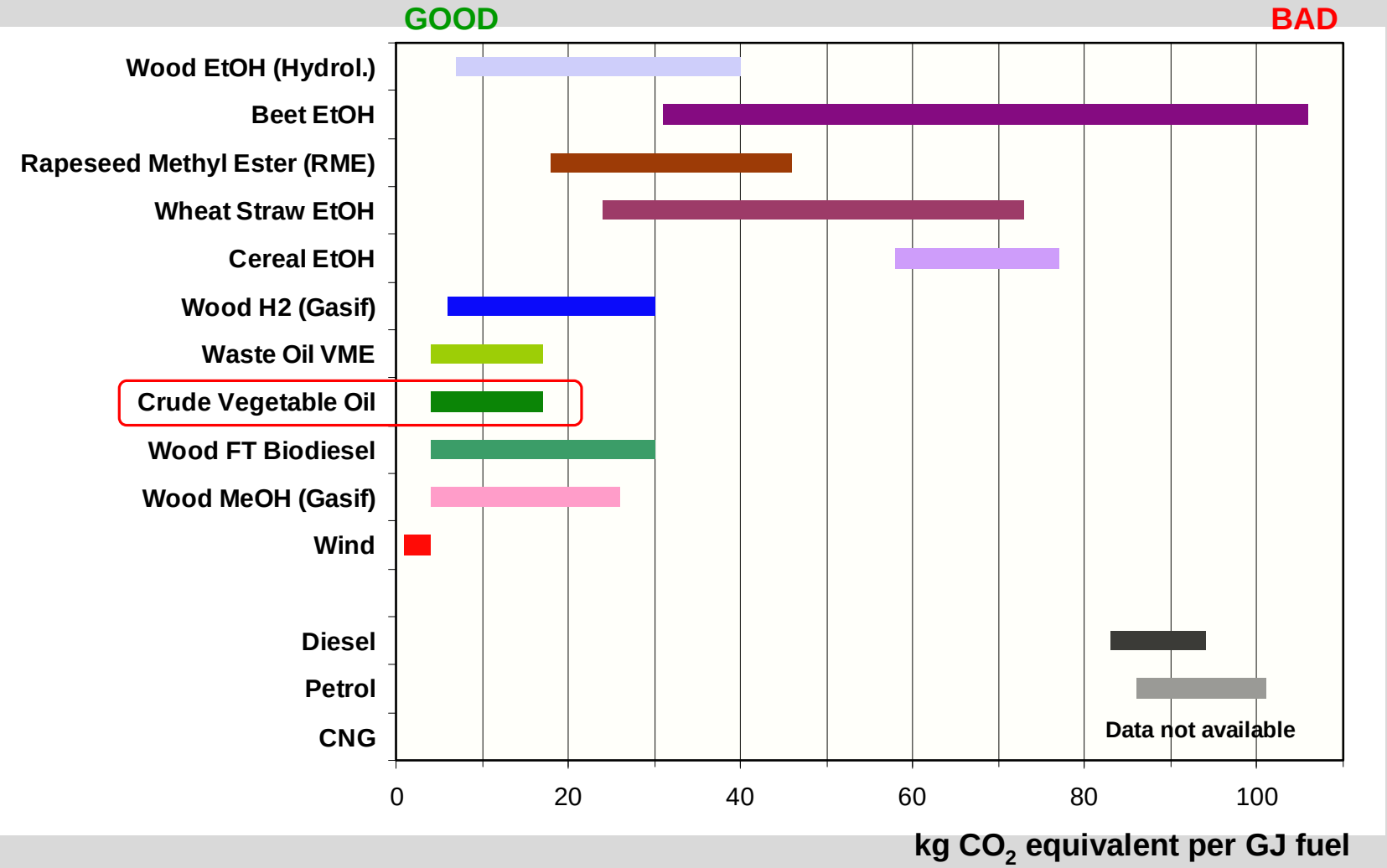
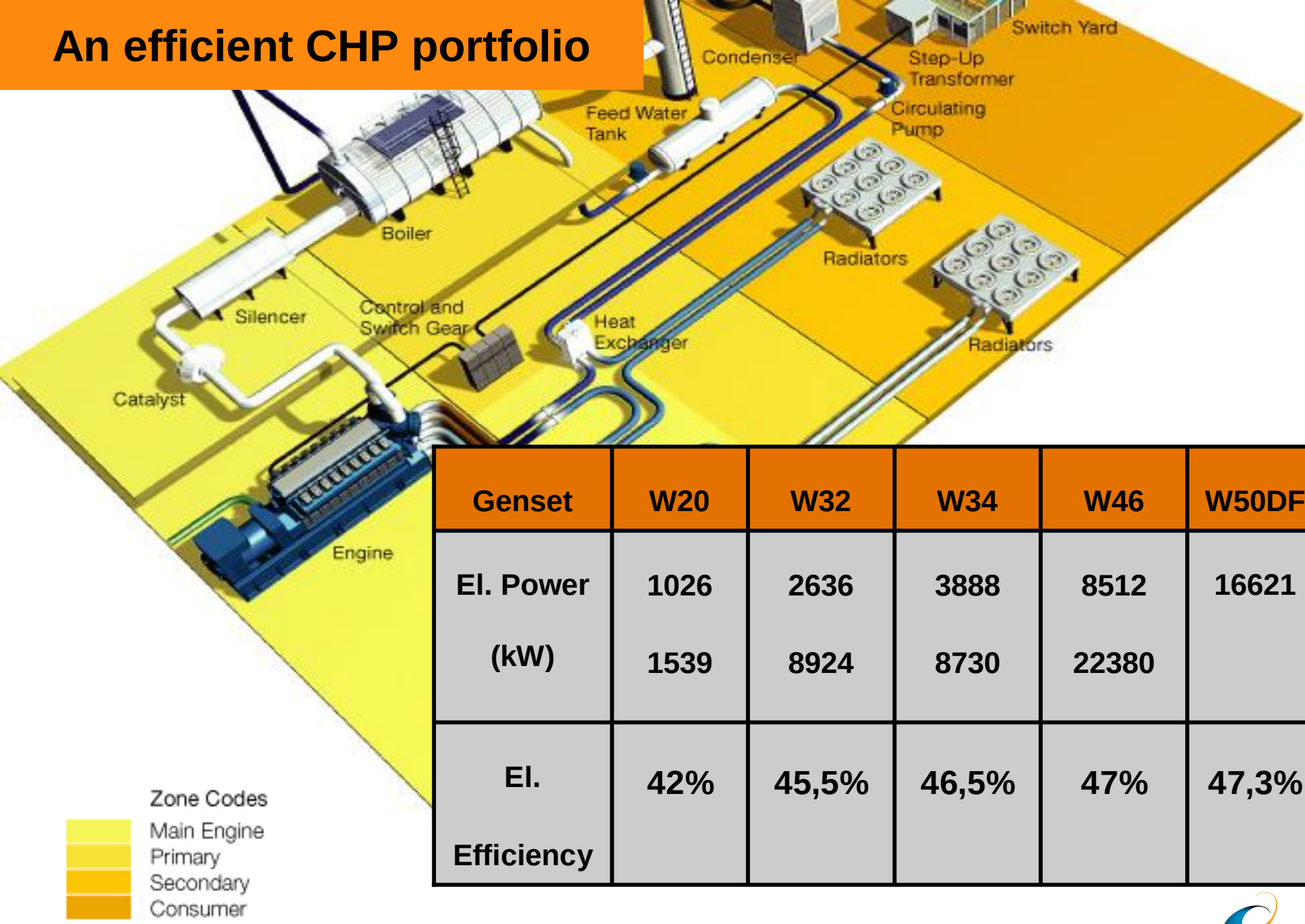
Wärtsilä means Fuel Flexibility



Wärtsilä means Fuel Flexibility



An efficient CHP portfolio



Genset	W20	W32	W34	W46	W50DF
El. Power (kW)	1026 1539	2636 8924	3888 8730	8512 22380	16621
El. Efficiency	42%	45,5%	46,5%	47%	47,3%

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Efficiency in all key power segments

Flexible Baseload Power Generation	Grid Stability and Peaking	Industrial Self-Generation	Oil and gas industry applications
			
23400 MW, 1600 plants	4900 MW, 1020 plants	12100 MW, 1740 plants	1200 MW, 80 plants

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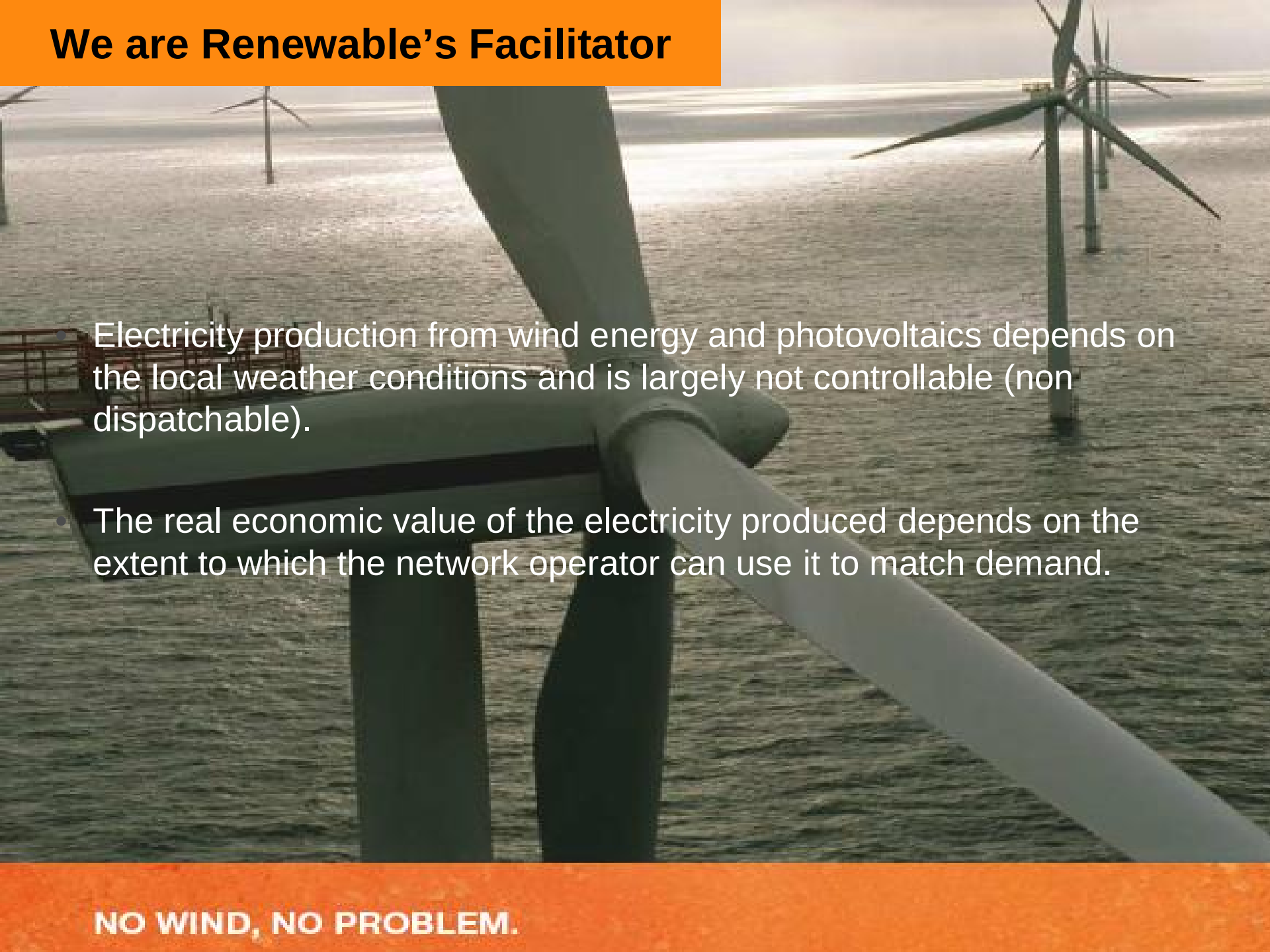
And water will be more and more precious

Typical water use of central power plants

Plant type	specific water consumption
	litres/kWh
Coal/steam	2.3
Nuclear/steam	1.9
Gas turbine combined cycle	0.95
Reciprocating engine	**< 0.00……**

We are Renewable's Facilitator

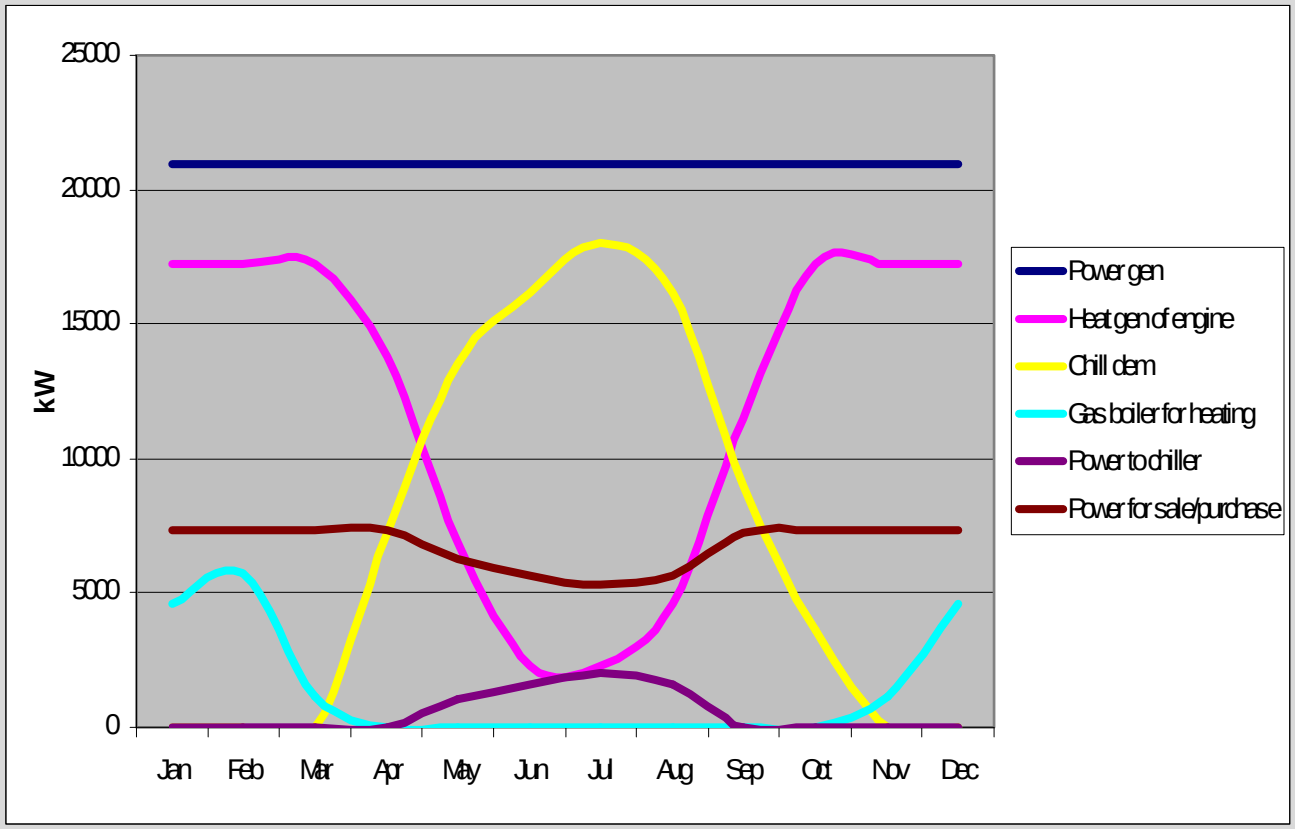


- Electricity production from wind energy and photovoltaics depends on the local weather conditions and is largely not controllable (non dispatchable).

- The real economic value of the electricity produced depends on the extent to which the network operator can use it to match demand.

Case Study: Wärtsilä's CHP solutions – Tri-Generation

Typical **Variation Curve** for Tri-Generation



Extended running hours for the plant, full CHP the year around

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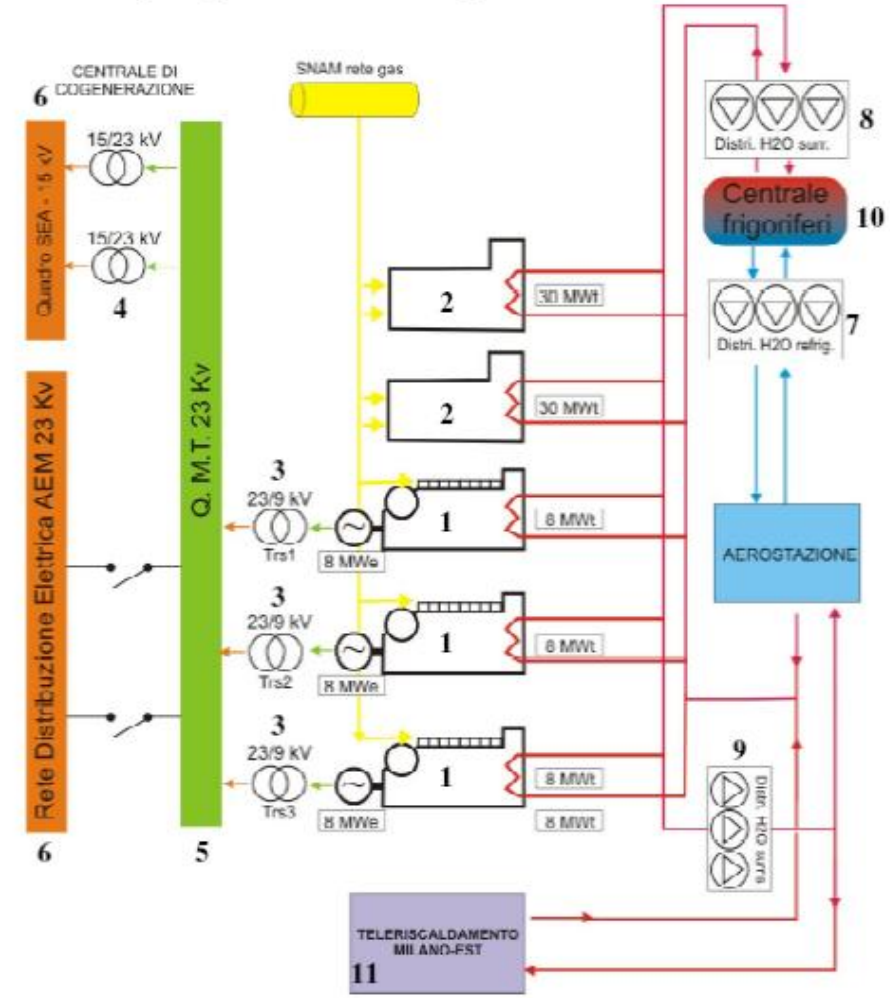
Wärtsilä's CHP solutions – Linate Airport Tri-generation

Schema di principio della centrale di cogenerazione di Linate



01	Motori WARTSILA WASA a metano	07	Sbarra 15 kV alimentazione aerostazione
02	Caldaie BONO prod. Acqua surriscaldata	08	Pompe circolaz. acqua refrigerata
03	Trasformatori elevatori 9/23 kV	09	Pompe circolaz. Acqua surris. frigoriferi
04	Trasformatori riduttori 23/15 kV	10	Pompe circolaz. Acqua surris. utenze
05	Sbarra 23 kV centrale cogenerazione	11	Centrale frigorifera
06	Sbarra 23 kV distribuzione AEM	12	Distribuzione centrale teleriscaldamento

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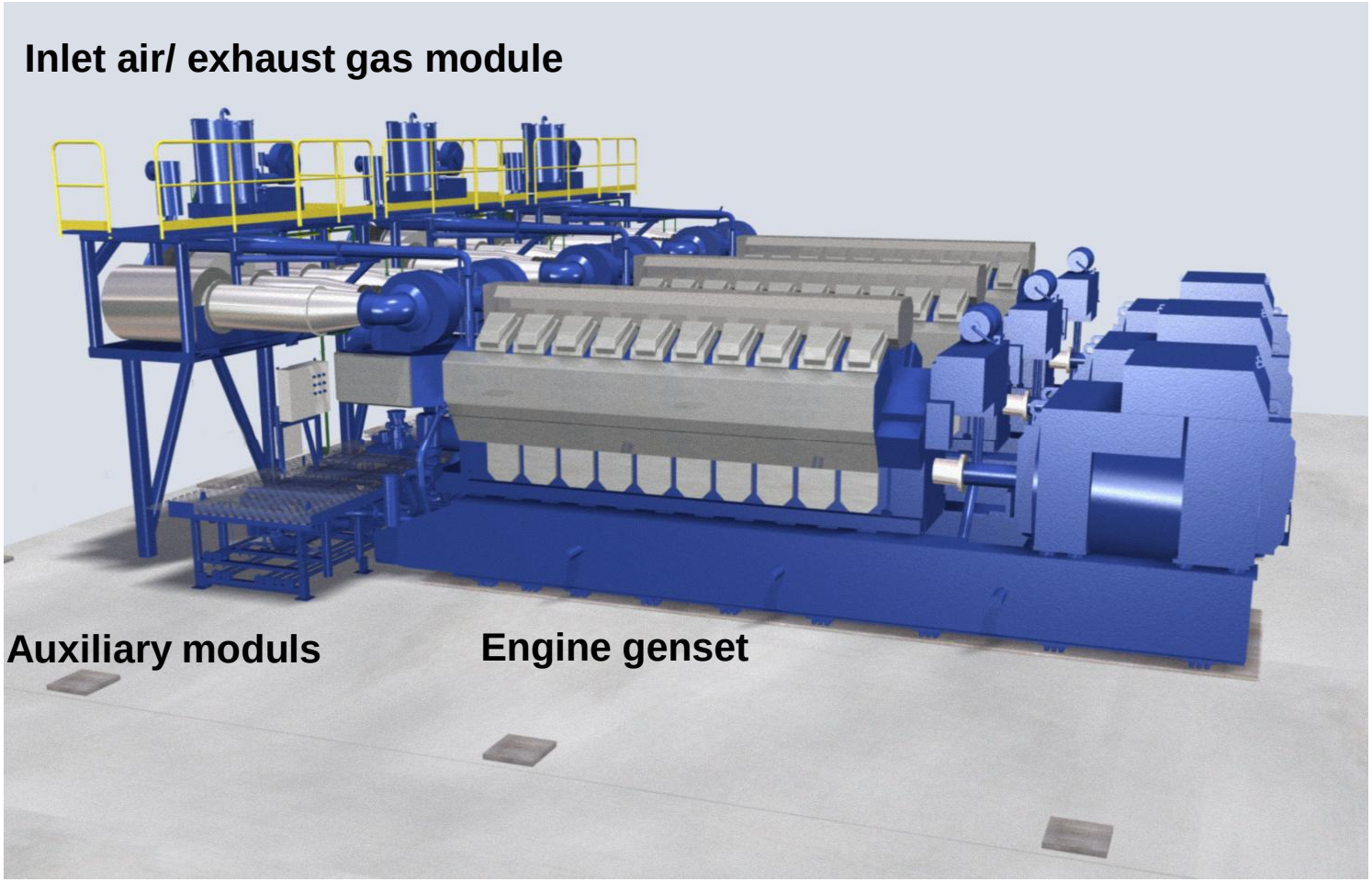
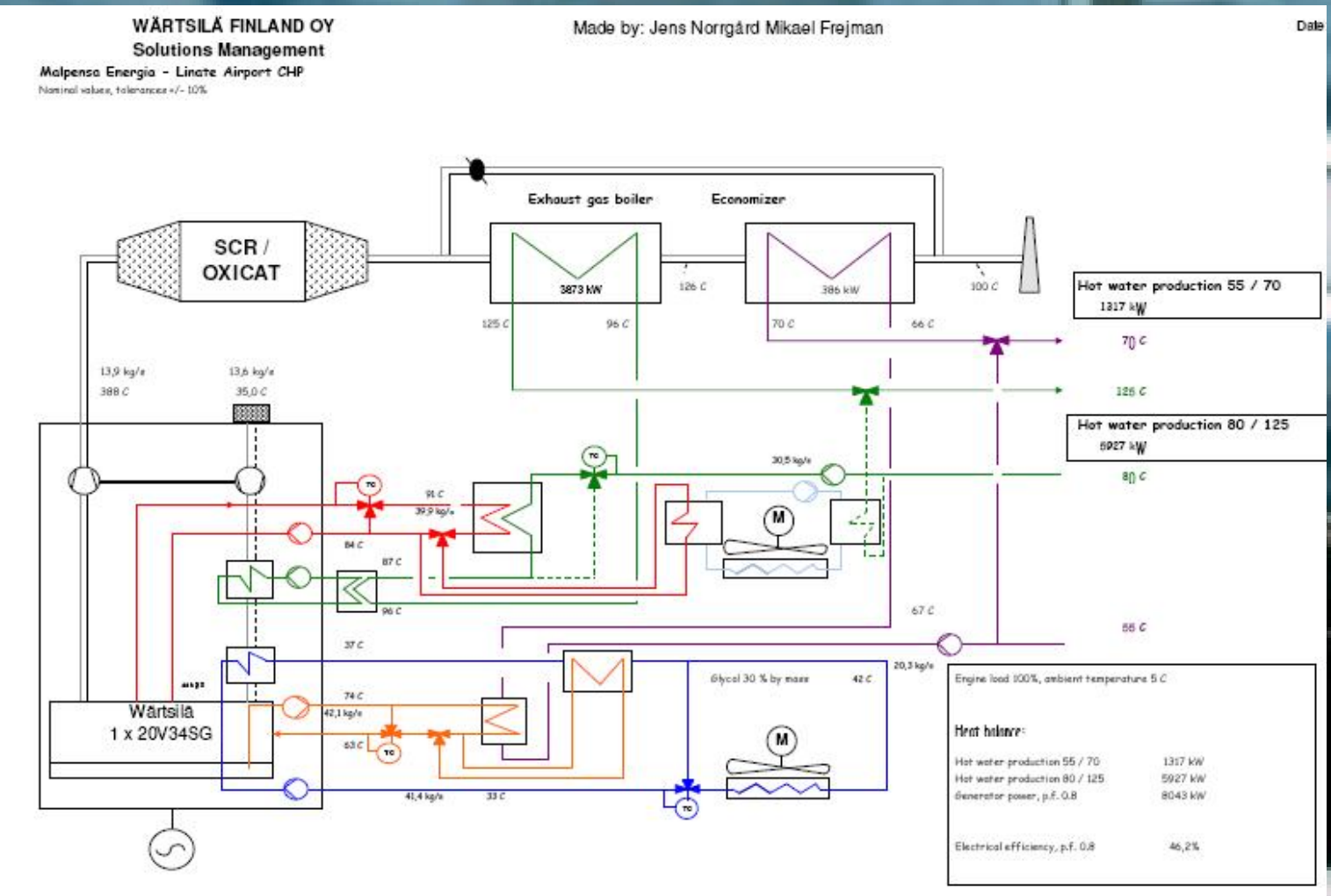
Wärtsilä 20V34SG generator set with auxiliary modules



Wärtsilä's CHP solutions – Linate Airport Tri-generation



Wärtsilä's CHP solutions – Linate Airport Tri-generation

Prime movers	3 x 20V34SG
Electrical output	24.129 kWe
Thermal Output	19.082 kWth
Electrical Efficiency	46,2%
Total Efficiency	82,7%
CO2 saved	35000 ton/yr
NOx Emission	40 mg/Nm^3 (5% O_2)

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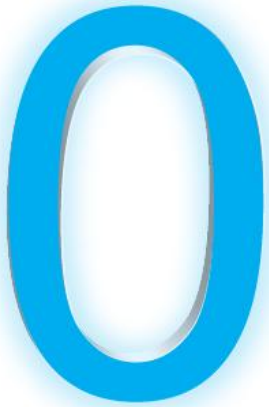
LBF Background

- **Clean Energy**
  - Energy without measurable impact locally or globally



emissions

- **Sustainable source of energy**
  - Available or Renewable source of energy
  - High efficiency

sustainable

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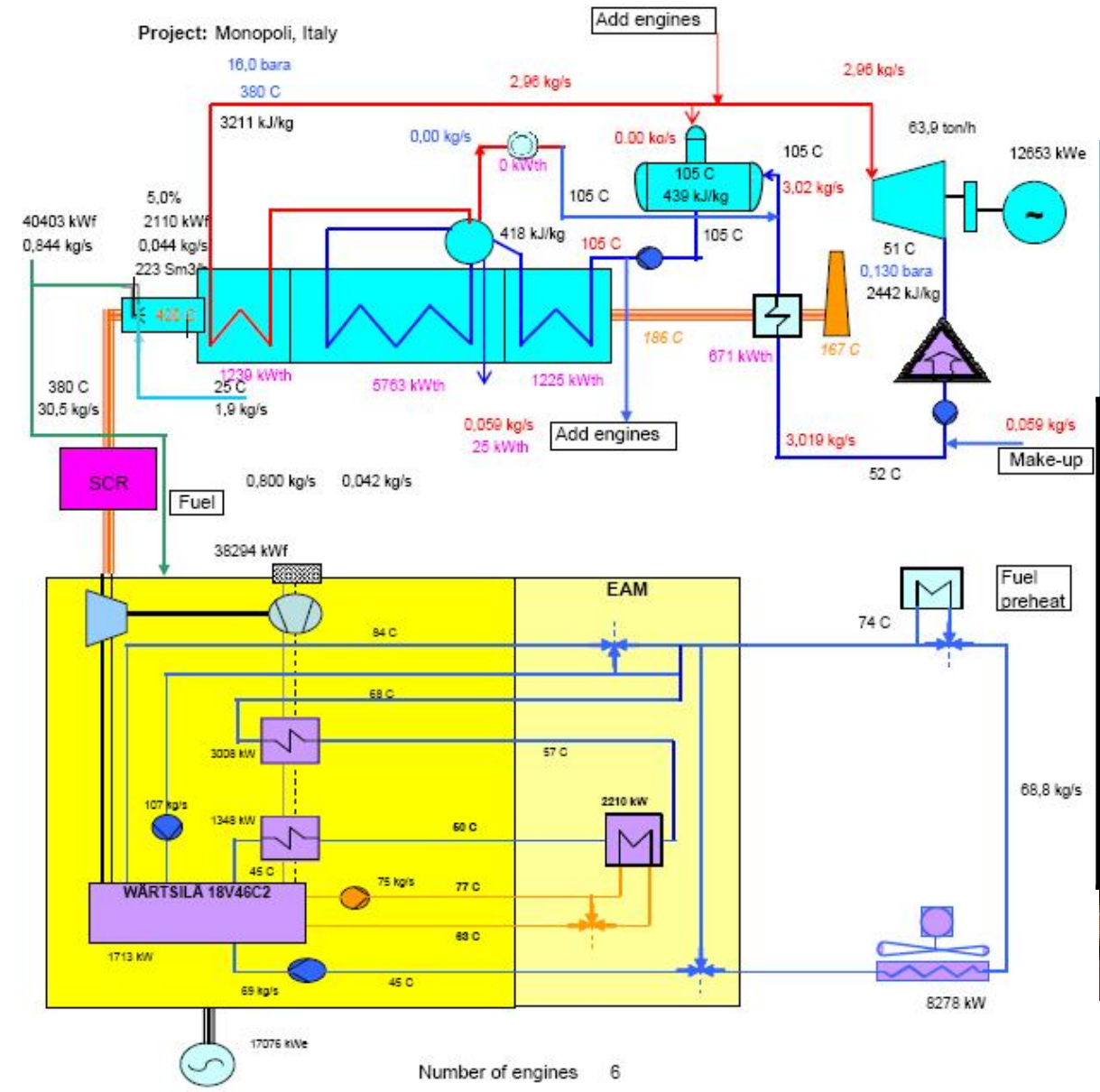
Wärtsilä's Liquid Bio Fuels (LBF) solutions - Monopoli



Prime movers	6x 18V46
Electrical output	102.457 kWe
Thermal Output	41.796 kWth
Steam turbine combined cycle	12.653 kWe
Total Efficiency	50%

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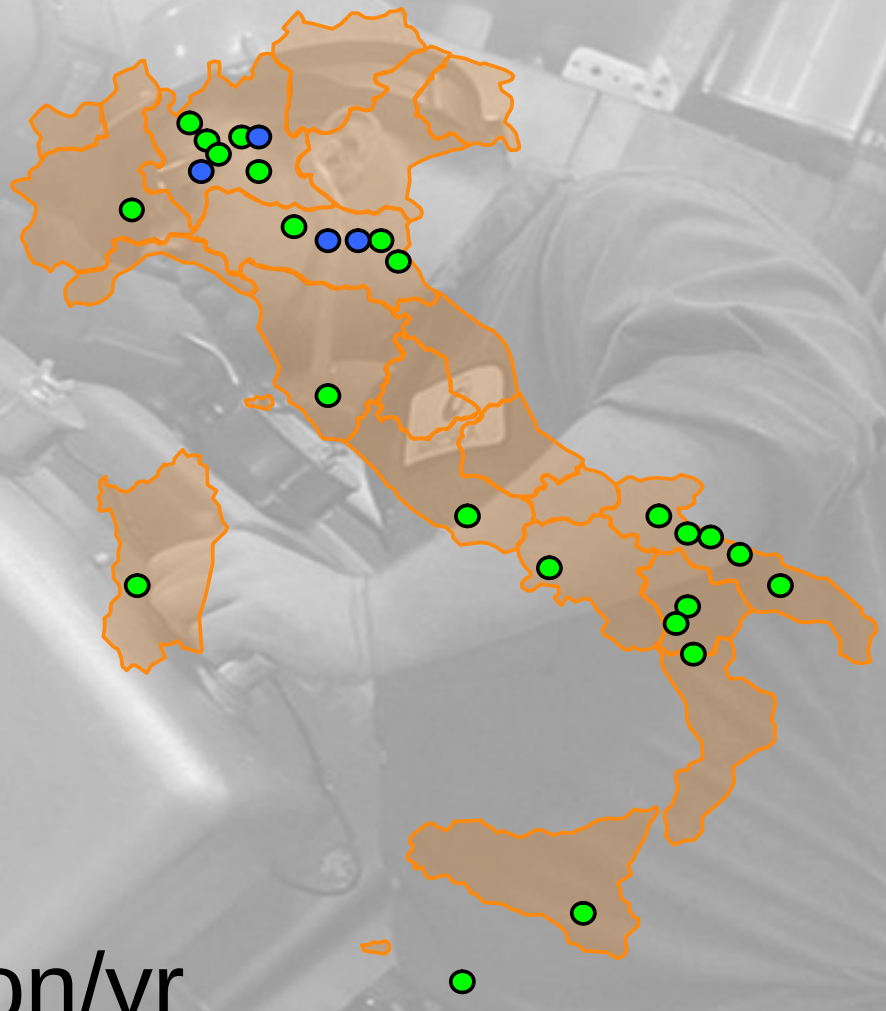
CONCLUSIONS

The Italian Job

- Distributed generation
- Cogeneration
- Trigeneration
- Peaking plants
- Renewable plants



More than 1000 MW installed in Italy

CO_2 saved >0,55 MTon/yr

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Major Challenges in Energy Business

- Public opinion recognizes climate change as a fact. Greenhouse gases perceived as the main cause. Strong political will and push for CO_2 reduction.
  - Emission limits and trading mechanisms
  - CCS (Carbon Capture System)
  - Tough targets and subsidies for renewables
  - Introduction of new renewable fuels
  - Rapid growth in wind power capacity
  - Nuclear renaissance
- Energy price volatility
  - Fuel prices vary based on demand
  - Emission costs added to electricity prices
  - Generally increasing raw material prices
- Challenging environment for new investments

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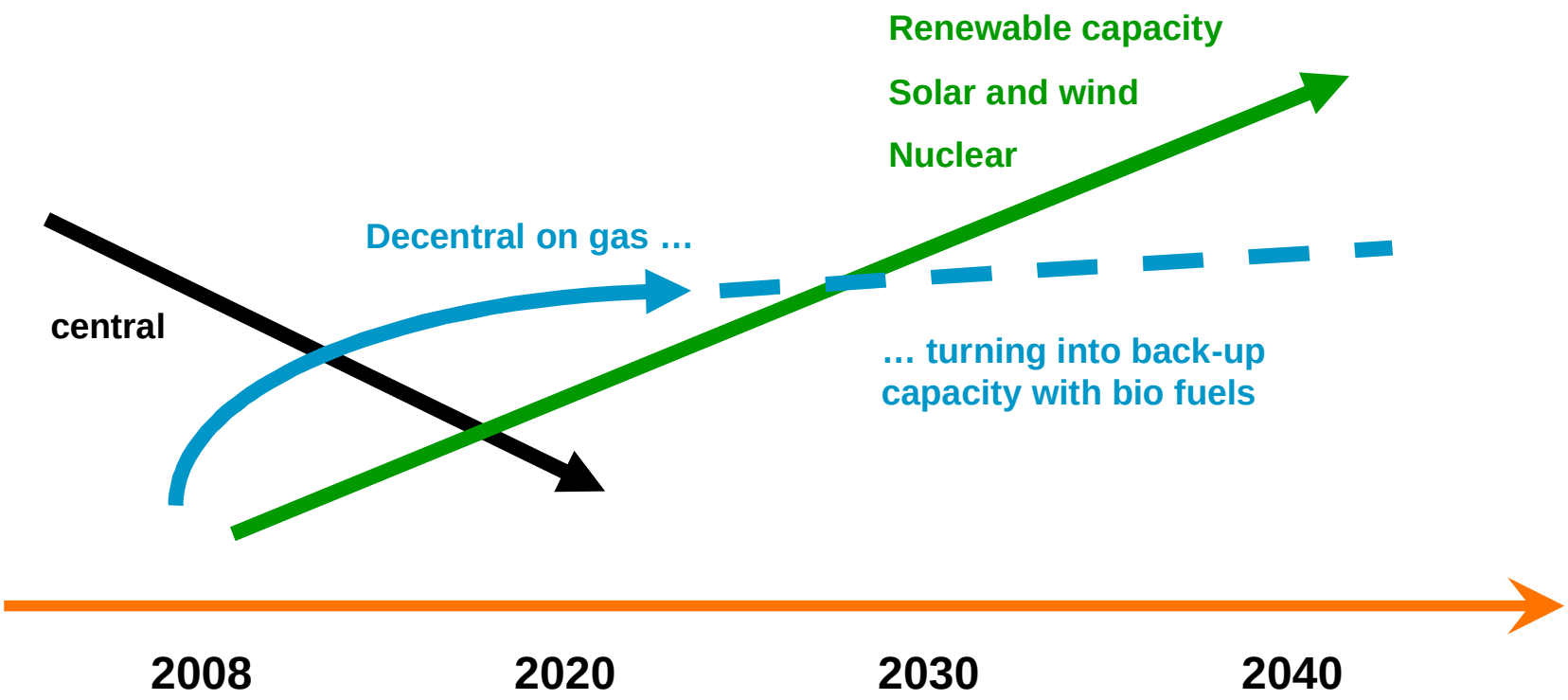
A vision based on reality…



Power Plants Mission

We provide superior value to our customers with our distributed, flexible, efficient and environmentally advanced energy solutions, which enable a global transition to a more sustainable and modern energy infrastructure.

WÄRTSILÄ

Grazie!

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