

Asia Clean Energy Forum 2016  
ADB, Manila, The Philippines

Track: Innovations in Renewable Energy  
9 June 2016

## ***Scenario Development for a 100% Renewable Future***

**Dr.-Ing. Werner Siemers**  
**Energy System Analysis**



- ◆ CUTEC
  - Applied research in resources (material) and energy
  - Sustainable industrial society with 100% renewable energy and 100% recycling\*
  - 4 departments, 100 employees
- ◆ Energy System Analysis
  - Scenarios, system approach, renewable energy, industrial efficiency
- ◆ Presenter (Siemens)
  - Realisation of energy systems, energy parks, cogeneration
  - Bioenergy (Biomass, Biogas, Biofuel) in South East Asia (e.g. Thailand, Vietnam, The Philippines)

## *Project description*

- ◆ Project initiated by the state of Lower Saxony
- ◆ Substantial reduction of greenhouse gas (GHG) emissions
  - Scenarios for 100% renewable energies
  - Scenarios for at least 80% GHG reduction
- ◆ Time horizon 2050
- ◆ Conditions for local solutions
- ◆ Including all energy demands



Power



Heat



Transport



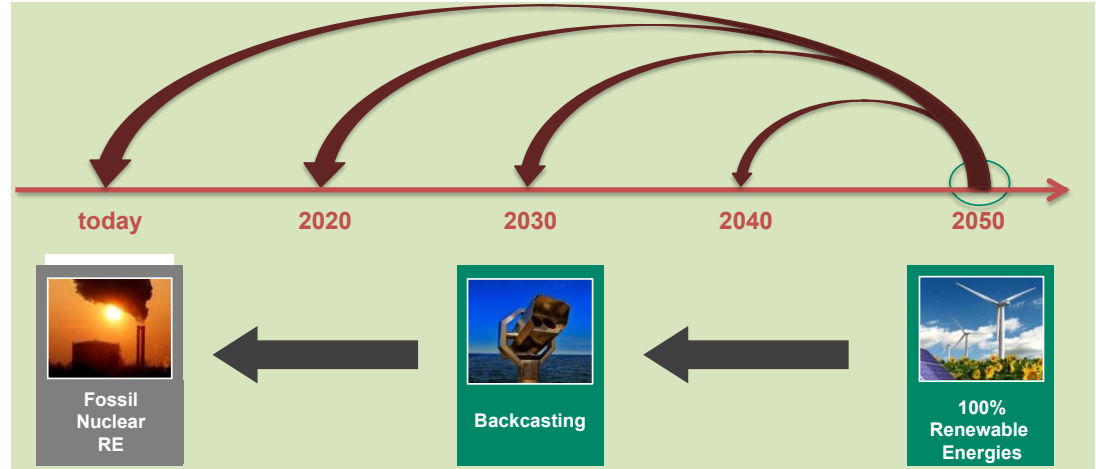
Materials

## Framework

### ◆ Backcasting



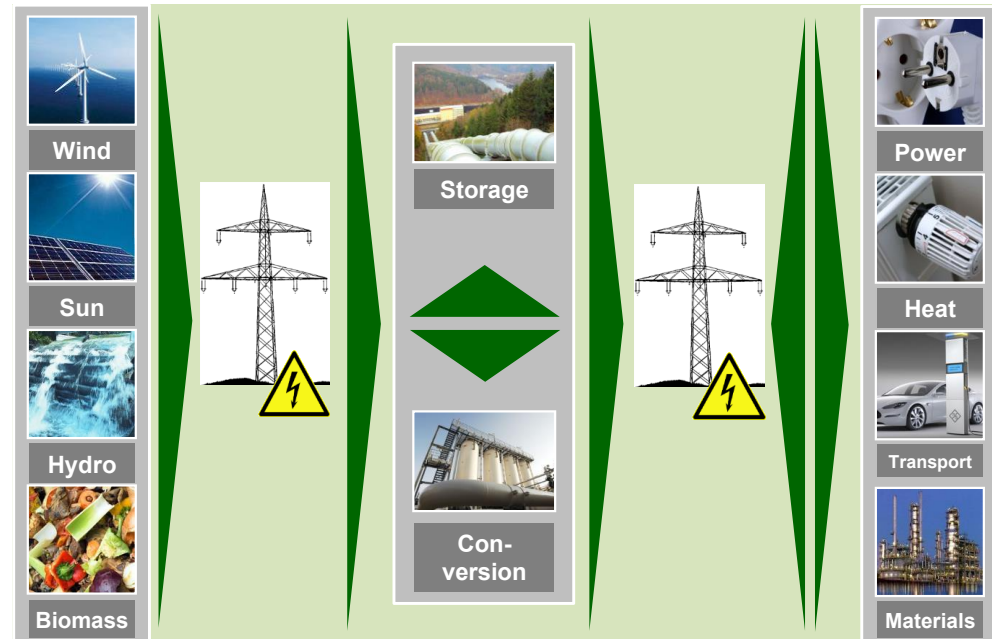
- Area based balance:  
agriculture  
forestry  
buildings etc.



### ◆ Dominance of electricity infrastructure



- Solidarity principle:  
goods import  
energy export



## *Energy demand in 2050*

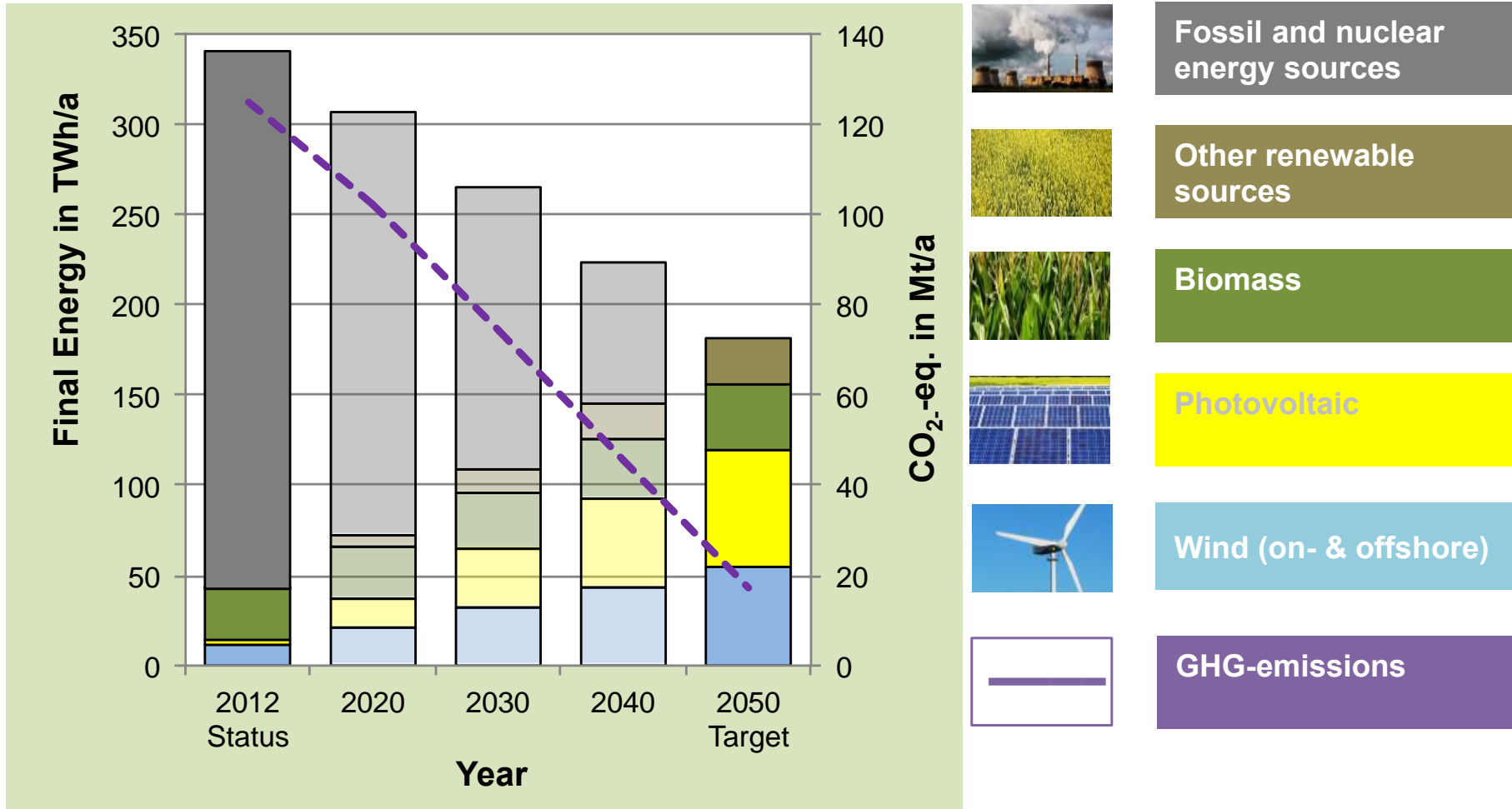
- ◆ Economic growth + 0.7 %
  - Higher energy productivity
- ◆ Degression of population - 12%
- ◆ Increasing efficiency resp. reducing demand
  - Power demand: all sectors - 18%
  - Residential heat: low energy buildings with 2.6% renovation rate, use of electrical heat pumps, efficient hot water production - 66%
  - Process heat: efficiency and shift to power use - 24%
  - Transport: electrification of individual and goods transport - 53%

 Reduction of demand from 340 TWh in 2012 to 182 TWh in 2050

 Minus 47%

## Energy supply in 2050

### ◆ Summary for the 100% RE scenario



- ◆ Model and projections for non-energetic GHG emissions

### Energy based GHG



Lignite power plant



Coal power plant



NG-/combined cycle

### Non-energy based GHG



Industry process



Solvents



Agriculture

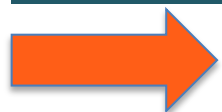


Waste



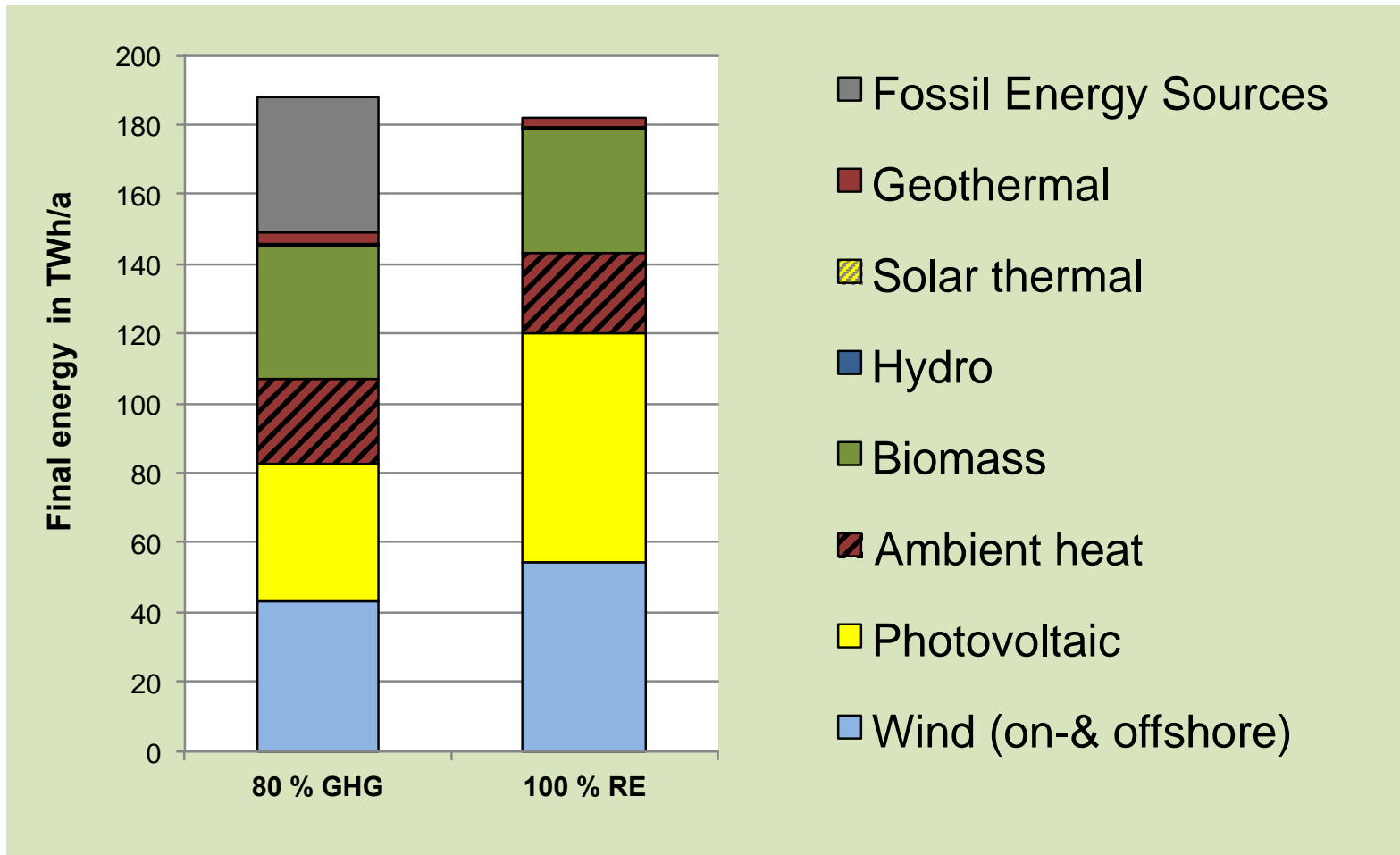
Waste Water

Not calculated: Land use, land use change and forestry



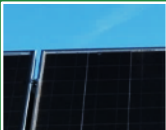




12,5% of GHG for non-energy GHG

- ◆ Allows limited use of fossil resources
  - Materials, transport, process heat, peak power plants





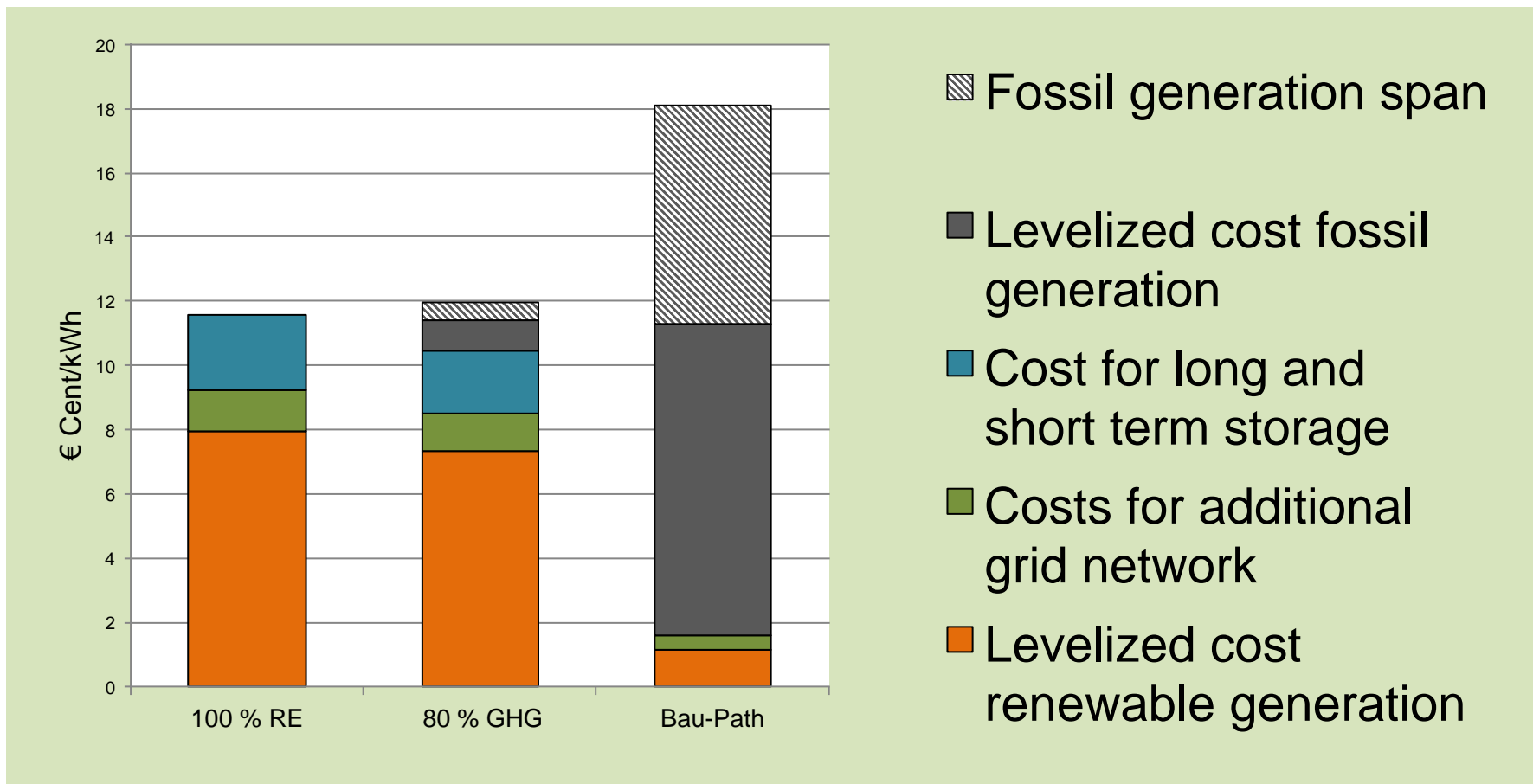
## Demand on natural resources (area)

		2012	2050 80% GHG	2050 100% RE
	<b>Solar roof area</b> Base: Building and open area	0.5 %	7 %	7 %
	<b>Solar park</b> Base: Agricultural area	0.08 %	0.08 %	4.5 %
	<b>Wind onshore</b> Base: Land area	0.6 %	1.4 %	2.1 %
	<b>Wind offshore*</b> Base: Land area	0.006 %*	0.5 %*	1.07 %*
	<b>Energy crops</b> Base: Agricultural area	13.3 %	13.1 %	10.8 %

\*Onshore equivalent through Offshore

## Cost comparison

- ◆ On long term view the renewable option seems to be more attractive



*....many more aspects*

- ◆ Storage options
  - ◆ Technology development
  - ◆ Optimisation of systems and individual solutions
  - ◆ Materials demand
  - ◆ Non-energetic GHG
  - ◆ .....
- 
- ◆ Contact: [werner.siemers@cutec.de](mailto:werner.siemers@cutec.de)



**Thank You  
for  
Your Attention**