



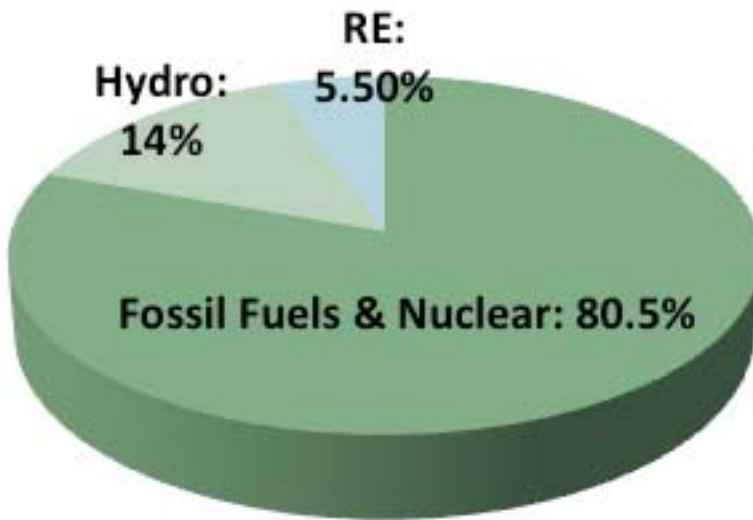
# Renewable energy: Policy and practice

Chandra Bhushan

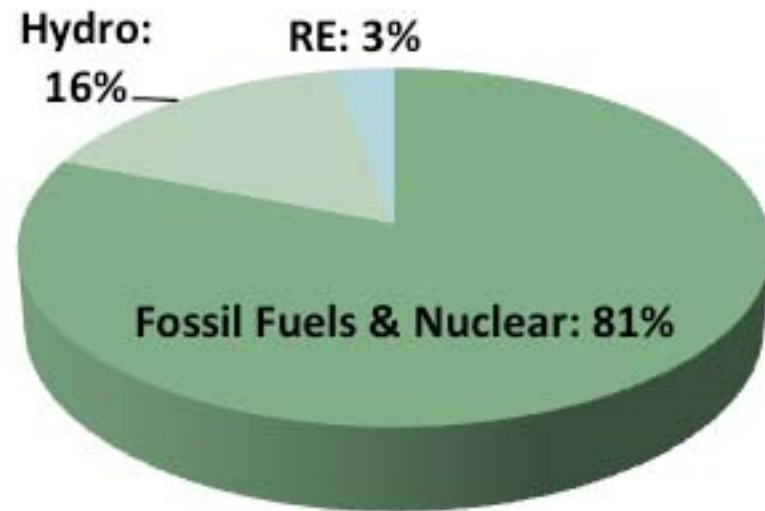


# Electricity mix

INDIA

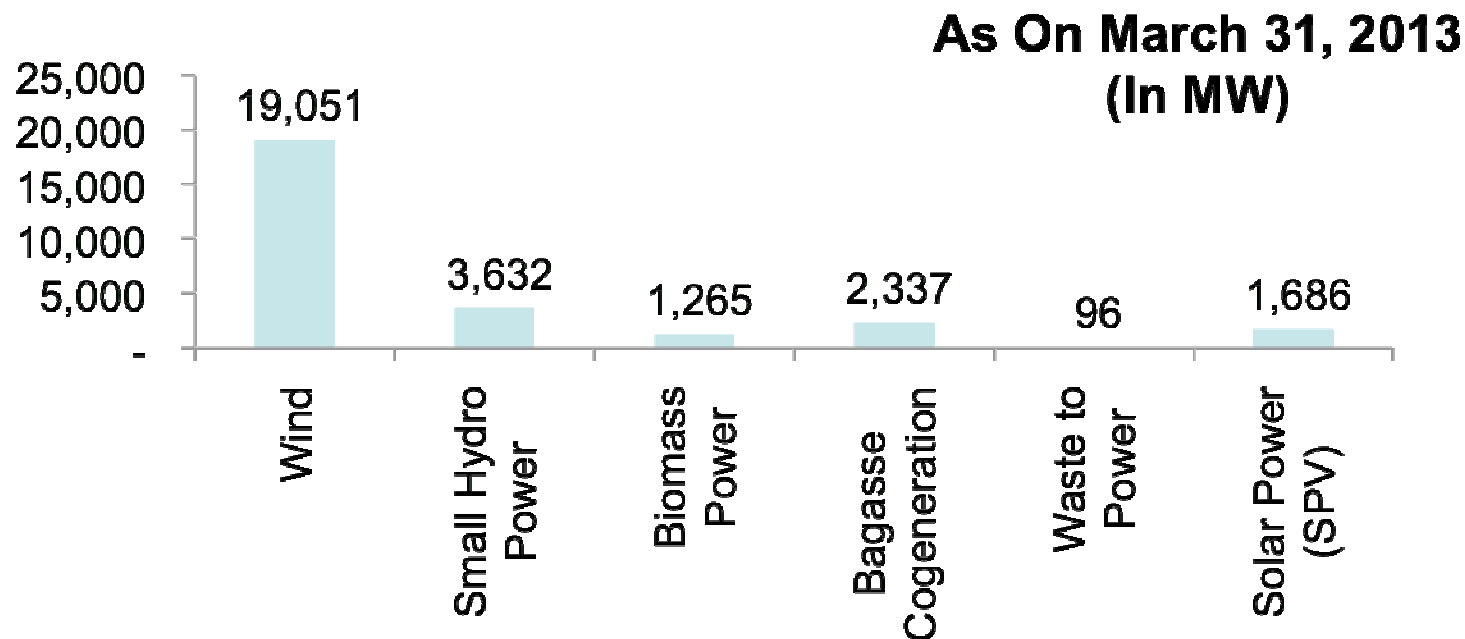


WORLD





# Grid connected renewable power



- The installation of grid connected RE (excluding large hydro) in India has grown from 3.5 GW in March 2002 to 28 GW in March 2013 – **annual growth rate of 23%**
- As of March 2012, **RE (excluding large hydro) constituted 12.3%** of installed capacity
- **51.23 billion kWh** of electricity generated in 2011-12 – annual requirement of **about 60 million people**



# India's clean energy programme

- **15% electricity from renewable sources (excluding large hydro) by 2020**
- **Preferential tariff for wind, biomass, small hydro and solar energy**
- **22,000 MW solar power by 2022: National Solar Mission**
- **Tax on coal (US\$ 1.0/tonne) to fund clean energy**



# India's clean energy programme

- **National Renewable Purchase Obligation (RPO)** of 5% by 2010 and 1% additional each year till 2020.
- States have set different RPOs for Discoms and captive users: 2-6% by 2010. **Major non-compliance**
- Mandatory to source 0.25% electricity from solar power by 2013 and 3% by 2022 by all discoms and captive users. **Major non-compliance**
- Market created for **Renewable Energy Certificates (RECs)**; sold at two stock exchanges – **market has crashed because of lack of demand**



# Challenges

- How to upscale renewable power?
  - Funding
  - Grid capacity and technology
- Environmental norms for renewable power (wind and small hydropower)?



# Energiewende



- Energy transition in Germany



# Energiewende

## Germany's targets for 2050

Tackling climate change through renewables and energy efficiency

		2020 (%)	2030 (%)	2040 (%)	2050 (%)	
Climate	Greenhouse gases*	-40	-55	-70	-80 to -95	
Renewable energy	Share in electricity	35	50	65	80	
	Share in gross final energy consumption	18	30	45	60	
Efficiency	Primary energy consumption	-20	→		-50	
	Electricity consumption	-10				-25
	Energy consumption in buildings	-20	heat demand			-80 primary energy

Source: Agora Energiewende; \*Against 1990 levels

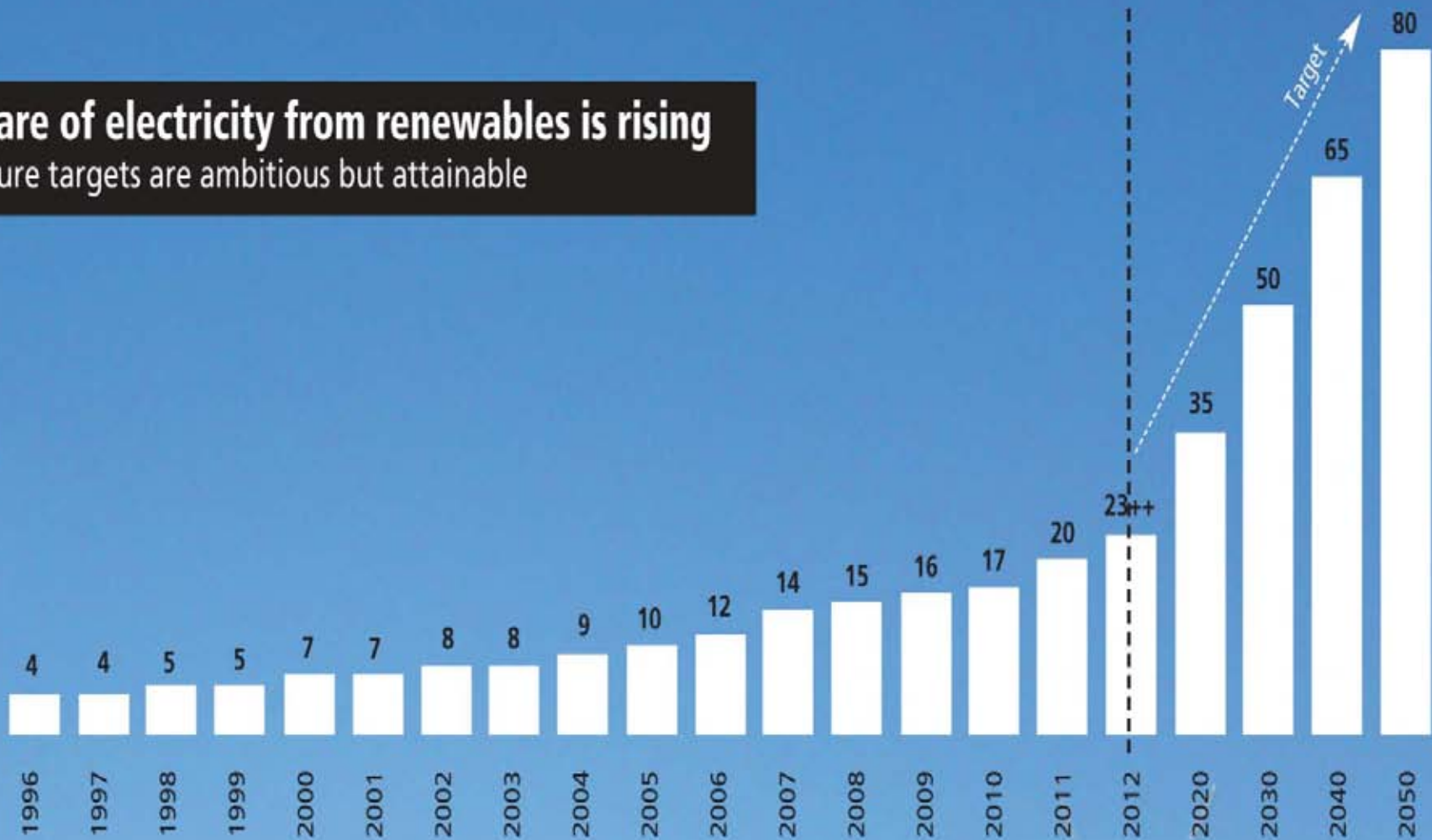




# Energiewende

## Share of electricity from renewables is rising

Future targets are ambitious but attainable



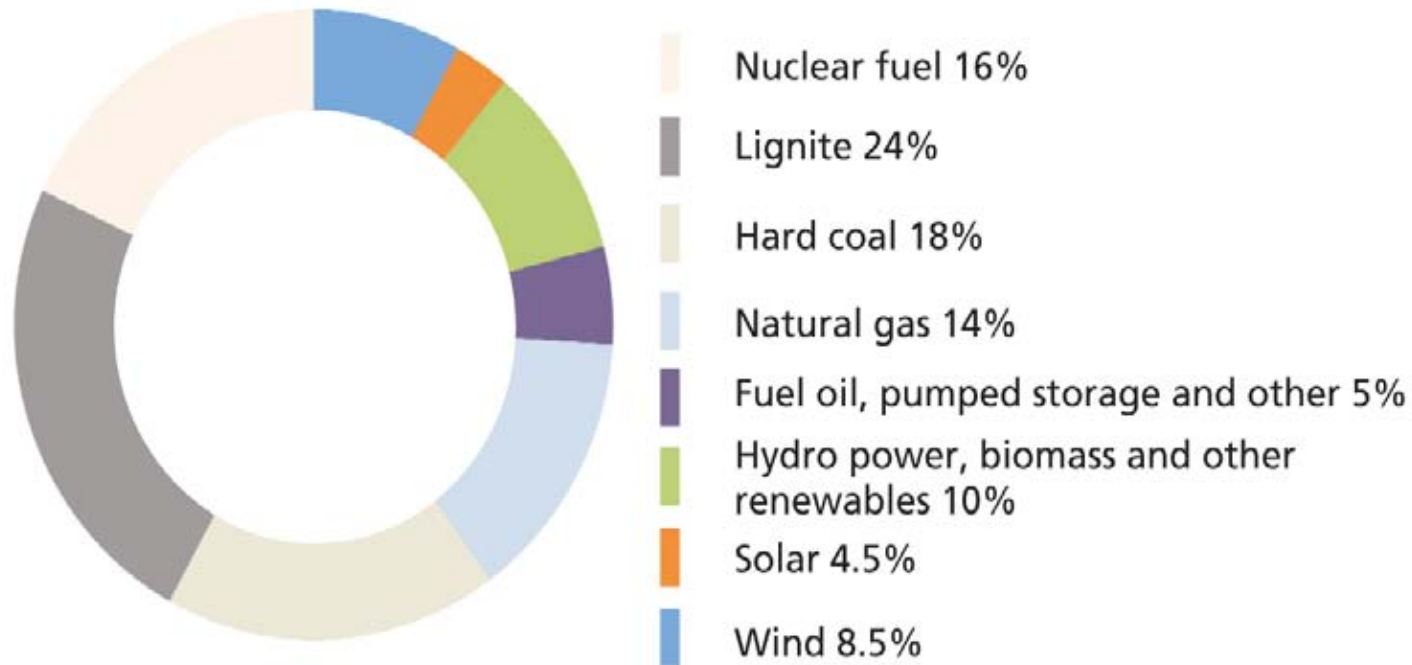
Source: Agora Energiewende



# Energiewende

## Share of energy sources in electricity generation

Nearly a fourth of electricity comes from renewables



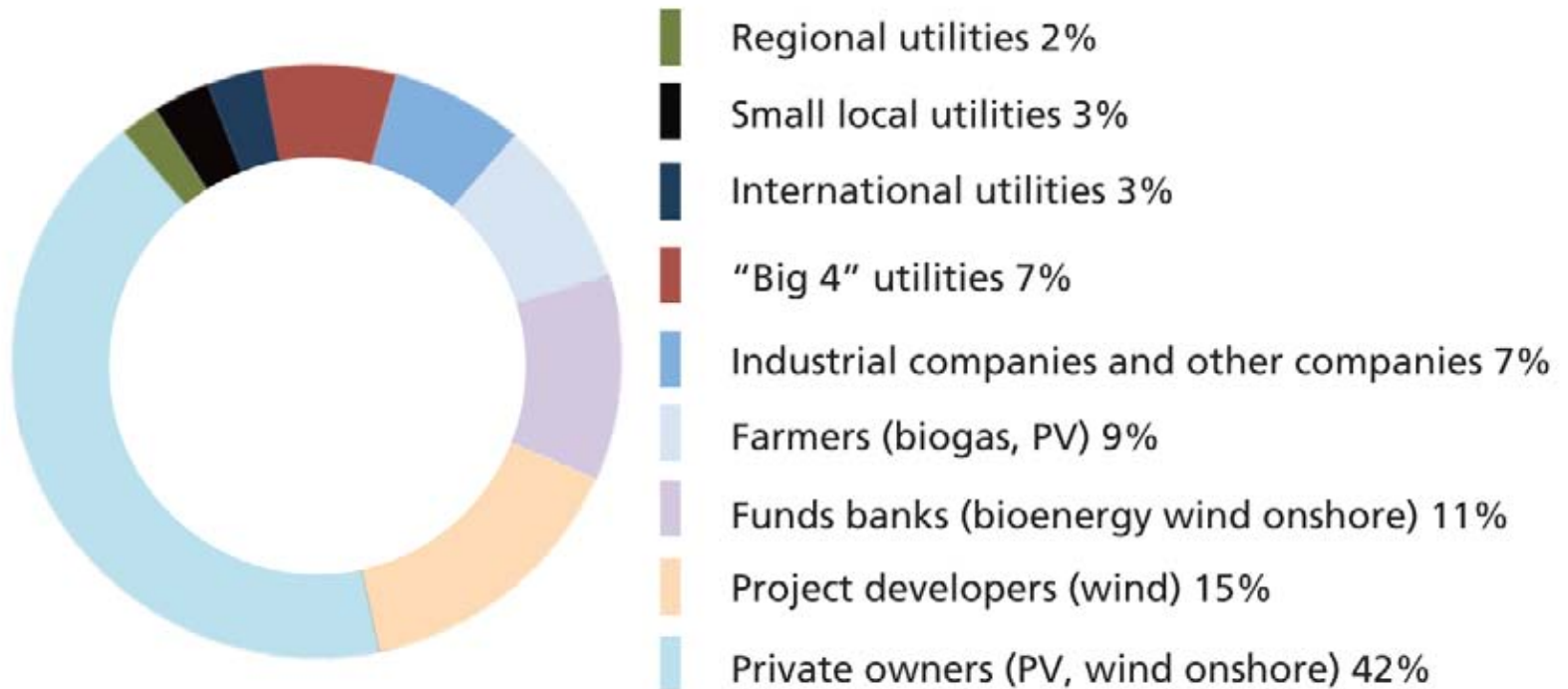
Source: International energy agency and BDEW



# Energiewende

## Ownership distribution of renewable installations

More than half the capacity is in the hands of citizens, not big companies



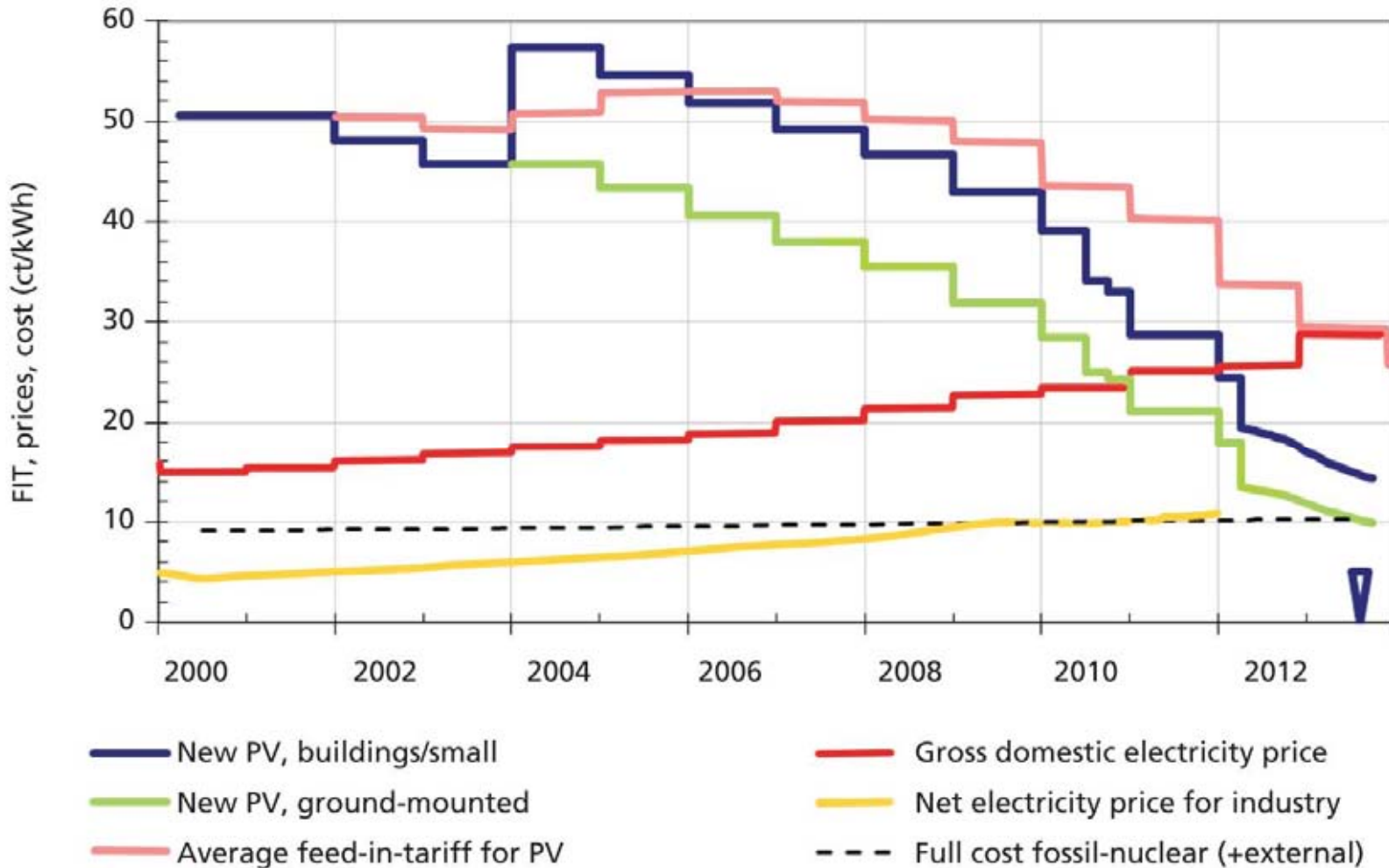
Source: Agora Energiewende







# Energiewende: Falling prices



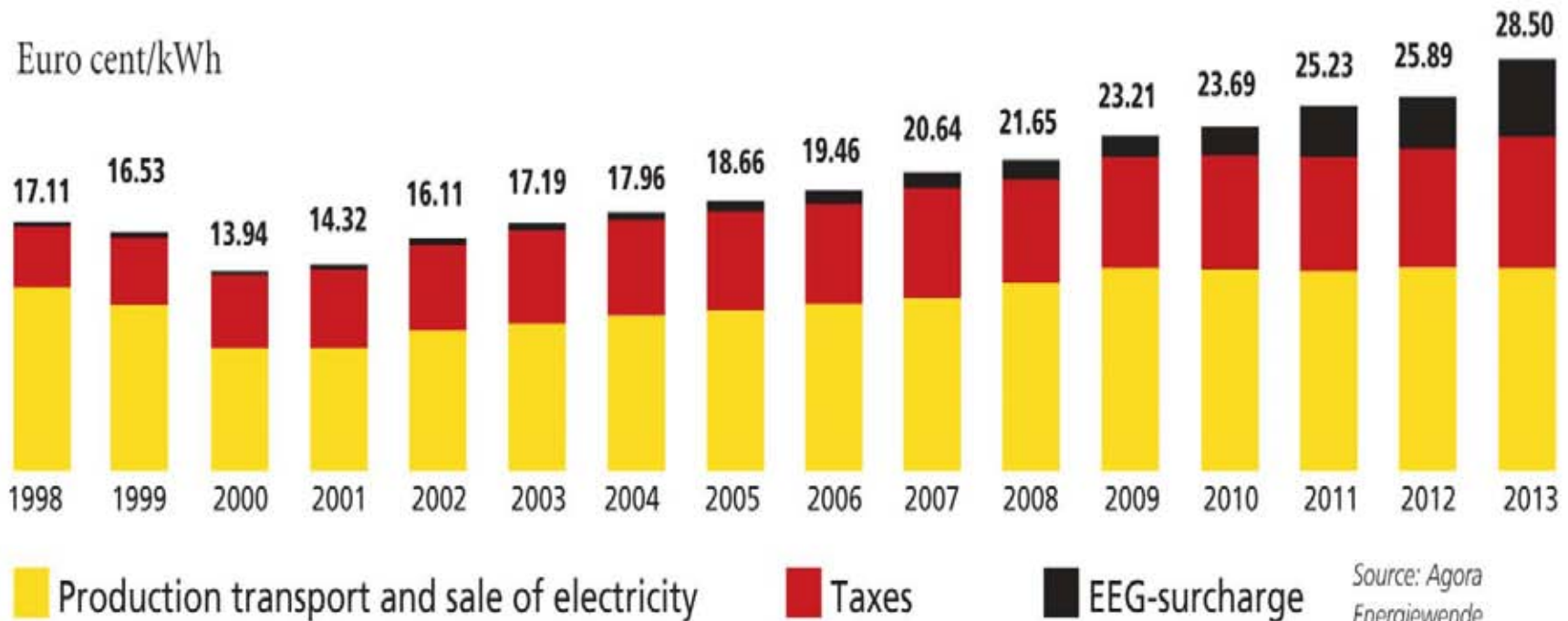
Source: Fraunhofer Institute of Solar Energy



# Energiewende: Increasing costs

## Surcharge inflates electricity rate

Of all taxes, increase in renewables surcharge is the sharpest

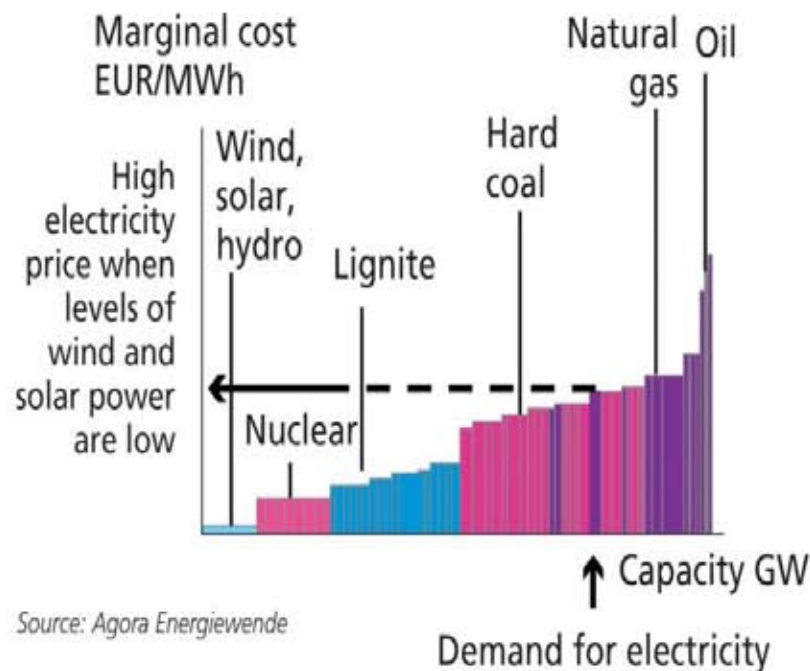




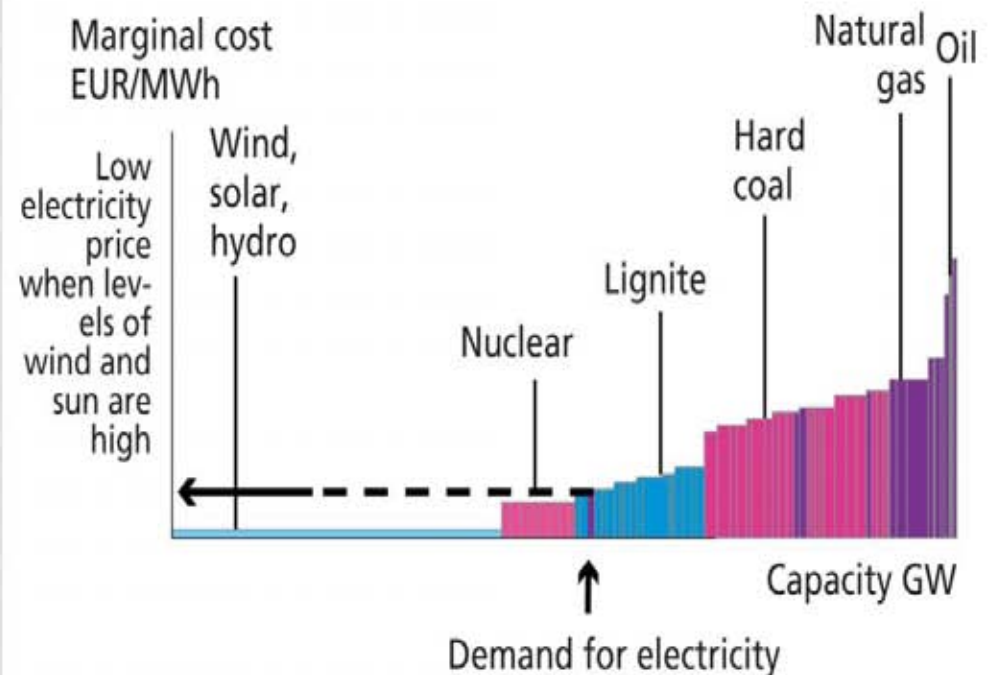
# Energiewende: coal and gas closing down

## Renewables displace conventional energy from spot market

### Low wind, solar power production



### High production of wind and solar power







# Energiewende: Future?

- **How to make it 24X7?**
  - Increase renewable to meet near 100% demand on good sunny and windy day
  - Incentivise conventional power plant to generate electricity when required
  - Store excess electricity from wind and solar in form of hydrogen or water power (pump storage dams) or batteries
  - Regional grid to import-export renewable power
- **How to fund it?**
  - **Reduce the price of renewable by increasing demand**
  - **But the era of cheap energy is over.**