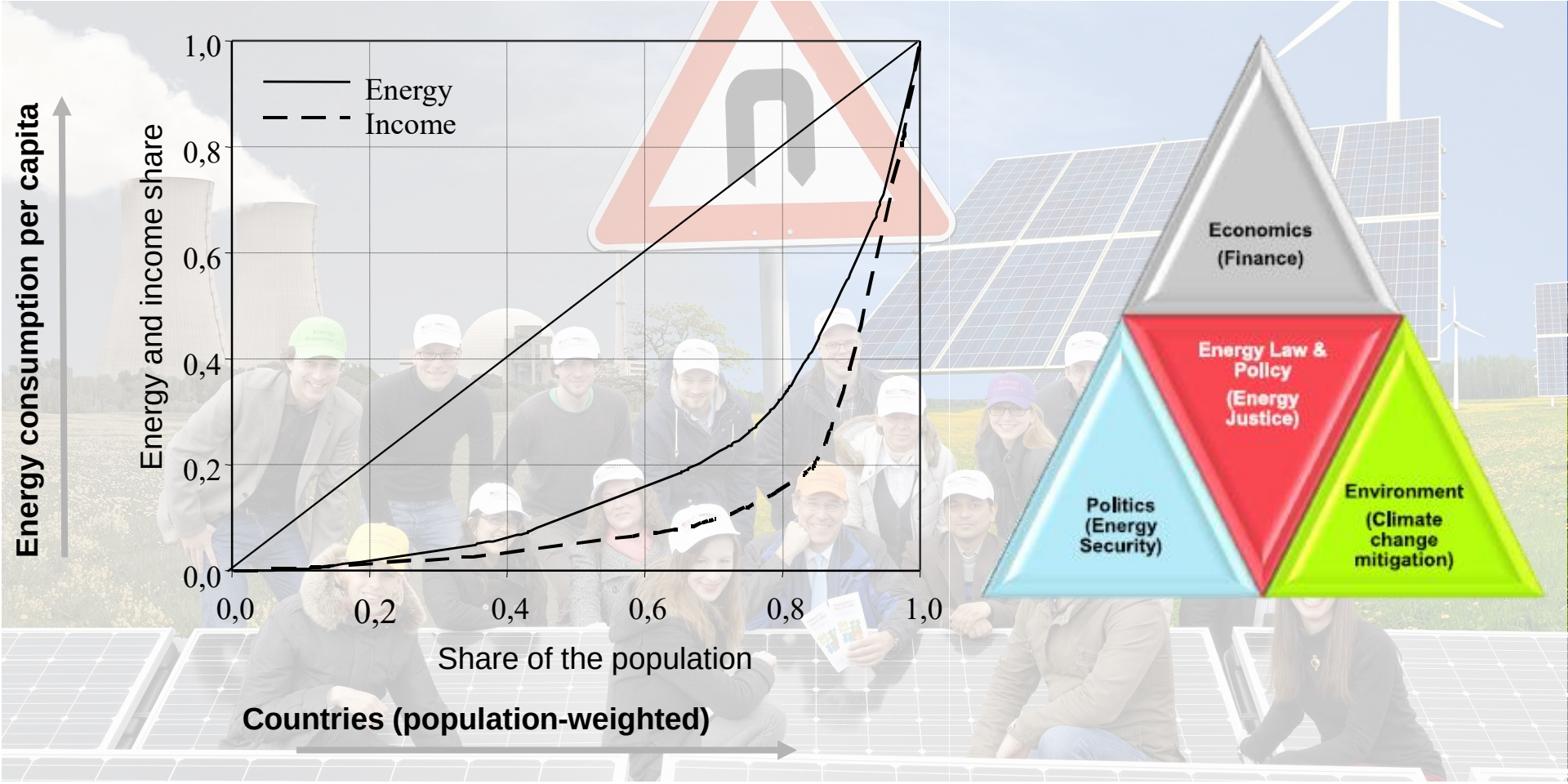

Energy Prosumage, Energy Poverty, and Energy Justice

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"Energy Challenges for the Next Decade"

FCN | Future Energy Consumer Needs and Behavior

E.ON Energy Research Center

RWTH AACHEN UNIVERSITY

AACSB ACCREDITED

Outline

1. **Introduction**
   - Rapid rise of interest in politics, society and research
   - Terms “prosumage”, "energy poverty" vs. "energy justice”
2. **Heterogeneity of energy consumption**
   - Spatial dimension (national, (supra-) regional, local, etc.)
   - Time dimension (development, convergence?)
3. **The one corner of the "energy trilemma"**
4. **Unequal distribution of income and energy**
   - Metrics (Lorenz curves, Gini coefficients etc.)
5. **Distributional effects of the *sustainable energy transition***
6. **Conclusion**

Introduction (1/2)

1. In recent years the **scientific and political interest** in energy inequality, justice, poverty and prosumers **has grown** at an astonishing pace

2. Still, **many questions, gaps and pitfalls remain** – new questions pop up in light of the sustainable energy transition and the "3 Ds"

3. Fact that **energy is an essential good** seems to justify the separate discussion (versus justice and poverty in general)

4. I will argue that the

   i. ***Energiewende* and the "3 Ds"** (or "4 Ds" incl. democratization) will have **enormous impact on income and energy equality and justice** → tremendous need to change the energy mix and energy infrastructure

   ii. **Enormous complexities of holistically studying the co-evolution** of technology, society and the economy, and the numerous regimes and institutions involved

   iii. **Energy economists** are often concerned mainly with economic efficiency, but still mostly absent in the justice and poverty debate

Introduction (2/2)

6. There are **numerous metrics** but the choice and interpretation should be made with great caution, and **infrastructure/LCA and dynamic trends** also observed

7. **Energy efficiency and rebound** have also been discussed in the context of fuel poverty / justice → overall **social / economic welfare** aspects important

8. **Smart energy technologies** can enable better monitoring and thus increase transparency regarding increases and decreases in energy poverty and justice

9. Despite **globalization**, the energy systems of the future are expected to be **more decentralized** than the established hierarchical systems (→ more **heterogeneity / mass customization** and more **autonomy** of consumers / prosumers)

10. There is **need for a multi-level strategic and holistic approach** that enables to address both **spatially narrow** and **system-wide resources** and requirements

11. **Appropriate social norms and economic incentives** are needed to foster economic efficiency, reduce / avoid poverty, and achieve / maintain energy justice (of much more cellular, modular, interrelated, multi-directional systems)

1. Introduction: Strongly increased interest in prosumer households / energy prosumage

Oberst C.A., Schmitz H., Madlener R. (2019). Are Prosumer Households That Much Different? Evidence from Stated Residential Energy Consumption in Germany, *Ecological Economics*, 158: 101-115.

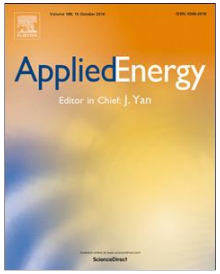
Rosen C., Madlener R. (2016). Regulatory Options for Local Reserve Energy Markets: Implications for Prosumers, Utilities, and other Stakeholders, *The Energy Journal*, 37(SI2): 39-50.

Green R., Staffell I. (2017). "Prosumage" and the British Electricity Market, EEEP, 6(1) (EEEP Best Paper Award)

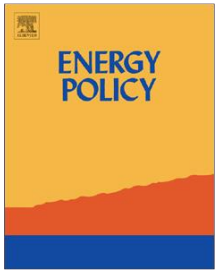
Schill W.-P., Zerrahn A., Kunz F. (2017). Prosumage of Solar Electricity: Pros, Cons, and the System Perspective, EEEP, 6(1)

M. Flaute, A. Großmann, C. Lutz, A. Nieters, A. Aretz, S. Gährs, R. madlener, C.A. Oberst (2018). Prosumer-Haushalte und ihr Beitrag zur Transformation des Energiesystems und der Gesellschaft,
in: C. Lautermann (Ed.) (2018), *Die Energiewende der Bürger stärken*, Metropolis-Verlag Ökonomie, Gesellschaft und Politik, Weimar (Lahn), Teil III „Selbstversorgung und Suffizi Neue Perspektiven des Energiekonsums", S. 167-189.

1. Introduction: Strongly increased interest in energy poverty and energy justice in science (rapid literature growth)



- ***2016 Applied Energy* Special Issue** on "Low Carbon Energy Systems and Energy Justice" (edited by D. McCauley, L. Mundaca, B. Sovacool, R. Heffron, D. Mebratu, V. Ramasar)
- Heffron, R. J. et al. (2018): Balancing the **energy trilemma** through the Energy Justice Metric, *Applied Energy 229 (2018), 1191-1201*
- David, M. (2018): The Role of organized publics in articulating the **exnovation** of fossil-fuel technologies for intra- and intergenerational energy justice in energy*, Applied Energy 228 (2018), 339-350*

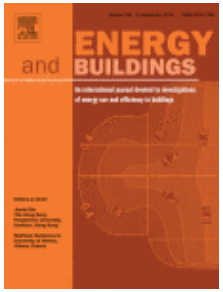


- ***2017 Energy Policy* Special Issue** on "Exploring the Energy Justice Nexus" (edited by D. McCauley, K. Jenkins, A. Forester)
- Carnegie LaBelle, M. (2017): In Pursuit of Energy Justice, *Energy Policy 107 (2017), 625-620*
- Heffron, R. J., McCauley, D. (2017): The Concept of Energy Justice Across the Disciplines, *Energy Policy 105 (2017), 658-667*

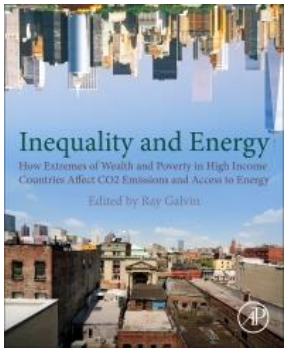
- ***2019 Energy Policy Special Issue** on* "Energy Poverty in India, China and the ASEAN States: A New Approach in Support of Energy for Everybody in This Part of the World" (edited by H. Phoumin, F. Kimura, D. Zhang, ERIA)

1. Introduction: Strongly increased interest in energy poverty and energy justice in science (rapid literature growth)

- ***2016 Energy Research & Social Science* Special Issue** on "Energy Demand for Mobility and Domestic Life: New Insights from Energy Justice" (edited by N. Simcock, C. Mullen)
- Jenkins, K. et al. (2016): Energy justice: A conceptual review*, Energy Research & Social Science 11 (2016), 174-182*
- Jenkins, K. (2018): Setting Energy Justice apart from the crowd: Lessons from environmental and climate justice, *Energy Research & Social Science 39 (2018), 117-121*

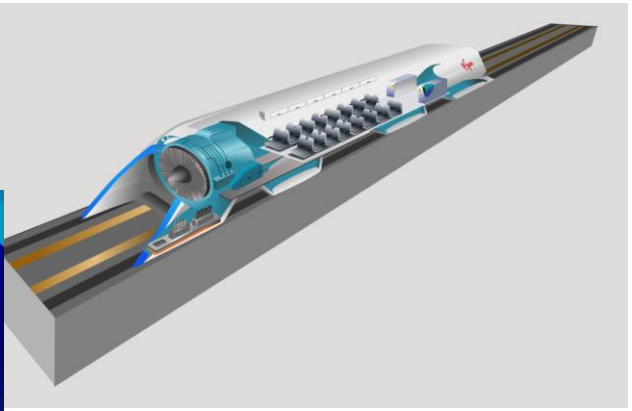


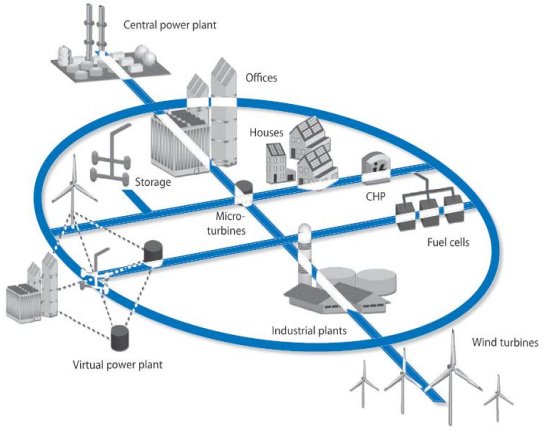
- **2019 *Energy & Buildings* Special Issue** *on "Energy Poverty Varieties"*
- Williams, S., Doyon, A.: Justice in energy transitions*, Environmental Innovation and Societal Transitions* (online Jan 2, 2019) *https://doi.org./10.1016/j.eist.2018.12.001*



- Madlener R. (2019). Sustainable Energy Transition and Increasing Complexity: Trade-offs, The Economics Perspective and Policy Implications, in: R. Galvin (Ed.) (2019), **Inequality and Energy: How Extremes of Wealth and Poverty in High Income Countries Affect CO_2 Emissions and Access to Energy**, Elsevier / Academic Press (Part III Reflections, Ch. 11, pp.251-286, in press). [978-0-12-817674-0]

1. Introduction: Sustainable Energy Transition, the 3Ds etc. – it‘s not all about electricity, it‘s not all sustainable …





Many (fascinating) ideas, but the world needs solutions, soon…

Anthropozene

1. Introduction: The Prosumer Household (→ self-consumption of self-generated energy)

- Number of **Energy Prosumers* / Prosumage**** is steadily increasing, as are concepts such as Microgrids, VPP, Energy Clouds / Communities
- Potential to be a **central part of the sustainable energy transitions**
  - Shift to emission-free electricity and heat generation
  - Combination with blockchain technology (P2P networks etc.)
  - **Decentralization**, reduces need for grid expansion
  - **Diversification** of technology mix
  - **Democratization** energy sector

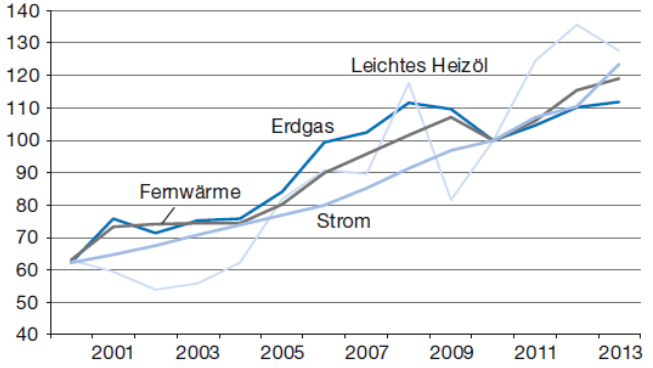
- From a **technical viewpoint**, prosuming effects are fairly straightforward
- From an **economics and social perspective**, much research is needed
- **Distributional effects** (cf. Schill et al., EEEP 2017):
  - Interaction with grid charges (“utility death spiral”)
  - Energy-based grid charges increasingly burden non-prosumers
  - Prosumage mainly in upper segments of the income distribution
  - Exemptions for self-consumed electricity (energy taxes, other surcharges)

* Toffler A. (1980), The Third Wave; ** Prosumer, Consumer + Storage

1. Introduction: What is "energy poverty"? (1/4)

- **Electricity, space heating and water heating** are considered as **essential goods** in developed economies (→ low elasticity of demand, at least up to need saturation), important for **individual well-being** and **social participation.**
- When **large portions of income** have to be used to provide these goods, this is referred to as **'energy poverty'** or **'fuel poverty'**, various definitions (→ later)
- In the **United Kingdom** already since the 1970s an important topic in politics + research (e.g. because of the oil crisis 1973/74, abolition of subsidies on electricity and gas); see Boardman (1991)
- Important **influencing factors**, e.g.
  - Low incomes
  - Relatively high energy demand
  - Relatively low energy efficiency
  - High energy costs

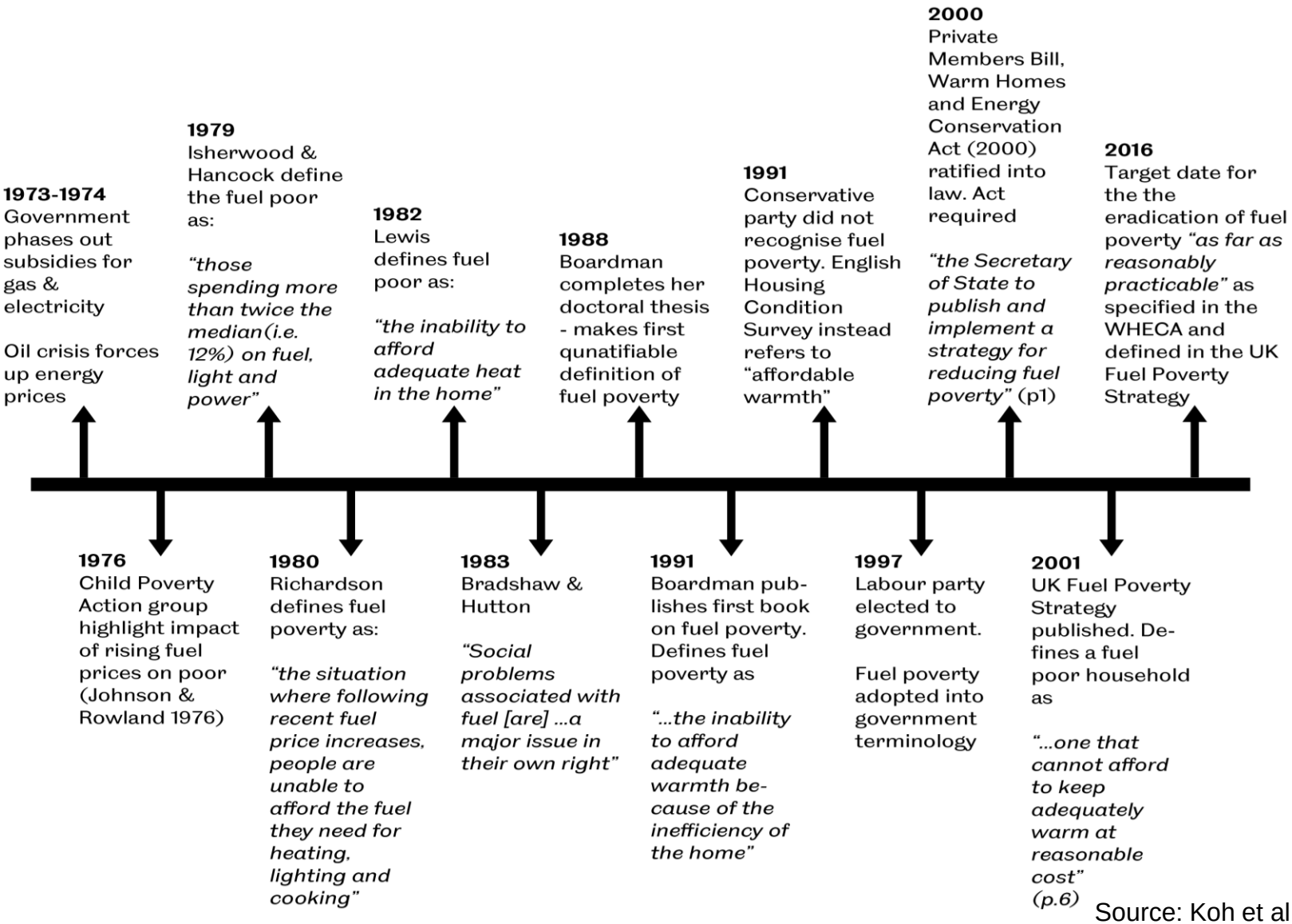
Price development of natural gas, light fuel oil, district heating and electricity (Germany)



Quelle: Destatis: Daten zur Energiepreisentwicklung, Lange Reihen von Januar 2000 bis Februar 2014, Wiesbaden 2014.

Source: Heindl (2014)

1. Introduction: History of the fuel poverty discussion in the UK



Source: Koh et al. (2012)

1. Introduction: What is "energy poverty"? (2/4)

- Derived, among others, from the **general discussion on poverty and justice** (environmental issues), increasingly discussed also **in the context of the sustainable energy transition**
- Terms **“energy poverty”** (no access to modern energy services) vs. **“fuel poverty”** (inability to afford adequate warmth at home), often used synony-mously
- Differentiation **“energy poverty”** – **“energy justice”** (3 dimensions: distribution – procedure – recognition; cf. Williams and Doyon 2019)
- Concept of **"spatial energy justice"** (emphasis on the geographical dimension of energy equity or inequality)
- **Measurement** of energy poverty generally requires two components (Heindl 2014):
  - Suitable energy poverty limit (normative!)
  - Matching metrics (+ robust results!)
- **Problem:** Assessment of the extent of energy poverty depends on both!

1. Introduction: What is "energy poverty"? (3/4)

- Numerous **definitions** of "energy poverty" in the literature:
  - **Expenditure on energy >10%** of income
  - (Share of) expenditure on energy more than 2 times the average / median (share) of the control group

  → mostly **defined in relative terms** (debatable what is fair or right)

Table 2: Overview of fuel poverty lines and their properties

Type	Measurement	Properties	Equiv. Income
10%	Expenditure on energy services greater or equal to 10% of Income (or any other share).	HH specific poverty line dependent on HH income. Fuel poverty line.	No (optional)
2x median energy exp.	Expenditure on energy services greater or equal to 2x median expenditure (or any other factor).	Unique poverty line within sample, not dependent on income. Fuel poverty line.	Not applicable
2x median share	Share of energy expenditures relative to income greater or equal to 2x median share of expenditures in the sample	Unique poverty line within sample as ratio of median expenditures and income	Yes (optional no)
2x average energy exp.	Expenditure on energy services greater or equal to 2x average expenditure (or any other factor).	Unique poverty line within sample not dependent on income. Fuel poverty line.	Not applicable
2x average share	Share of energy expenditures relative to income greater or equal to 2x mean share of expenditures in the sample	Unique poverty line within sample as ratio of mean expenditures and income	Yes (optional no)
MIS based	Residual income after expenditure on energy services and housing costs less or equal the MIS (after housing costs and expenditure on energy services).	HH specific poverty line dependent on HH type and income. Income poverty line.	Yes
High cost / low income	Households that spend more than the median on all energy services and fall below the poverty line of 60% of median income after expenditures on energy services are subtracted from income.	HH specific poverty line dependent on HH type and income. Hybrid income and fuel poverty line.	Yes

Source: Heindl (2015)

1. Introduction: What is "energy poverty"? (4/4)

- **Energy poverty in Germany:** on the basis of different assessment bases the share of people affected varies, but is always present
- Energy poverty has to be considered as an **important aspect in the further development** of energy supply
- **Social acceptance** of and **participation** in the transition, **social cohesion**

Table 3: Fuel poverty measures for Germany (2011)

Type	Share fuel poor in sample	Share of fuel poor (population weights)	Average equivalised Income of fuel poor (BHC)	Share of fuel poor below poverty line (952 EUR)	Average exp. on energy services of fuel poor (equiv. income)
10% NE BHC	25.1%	29.8%	1,054	45.7%	20.3%
2x median expenditure	4.6%	4.1%	2,549	8.1%	21.5%
2x median share of exp.	11.2	12.0%	933	58.2%	28.2%
2x mean expenditure	2.9%	2.4%	2,648	7.9%	22.1%
2x mean share of exp.	4.9%	5.4%	779	74.8%	36.5%
MIS (SGBII)	8.8%	9.9%	721	89.2%	25.0%
HCLI EI BHC	10.5%	11.1%	907	52.2%	26.3%
HCLI EI AHC	12.6%	13.7%	998	43.5%	24.5%

AHC = After Housing Costs; BHC = Before Housing Costs;
HCLI = High Cost / Low Income; MIS = Min. Income Standard.

Source: Heindl (2013)

1. Introduction: Energy justice and economics

Knut Wicksell (1851-1926) and **Eric Lindahl (1891-1960):**

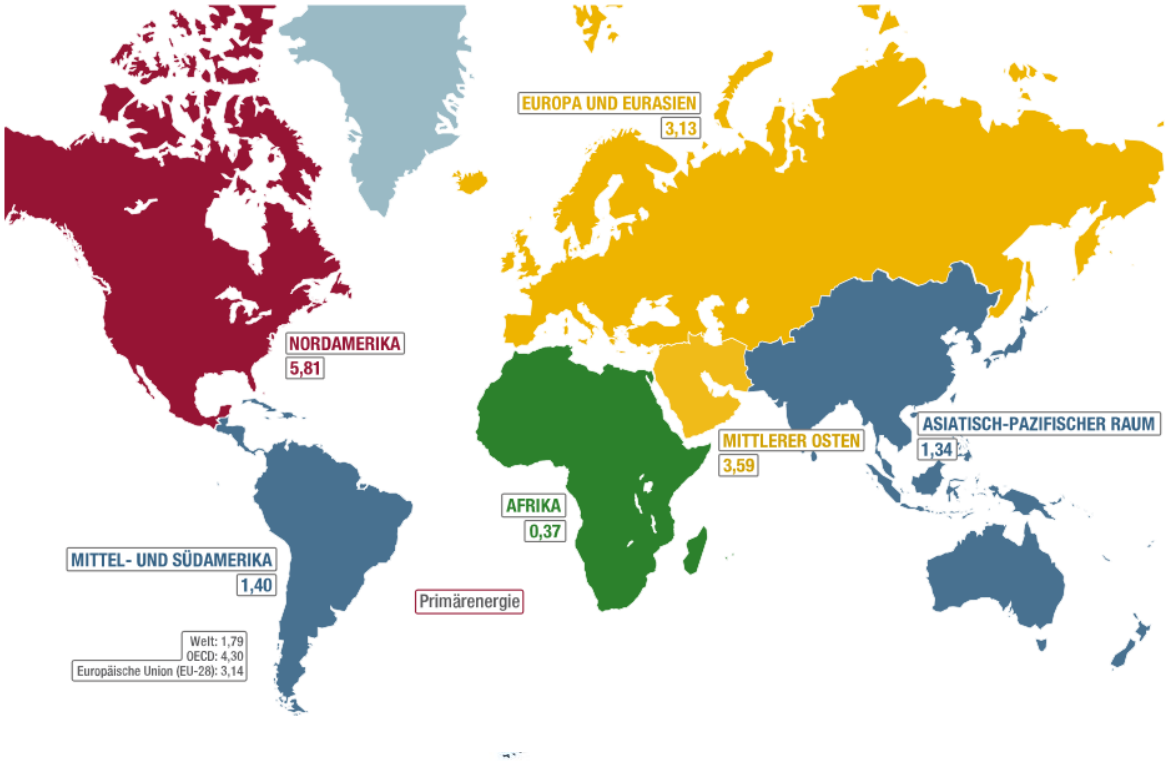
- Seminal ideas **on justice and public goods** in the economics literature
- Distinction between **social justice** (guided by utilitarian principles) and **economic justice** (guided by benefit principle → what services to provide, how to finance them)
- Economic justice requires **anonymous agreement** between political representatives, leading to what has become known as **economic efficiency**
- **Respect for individual interests** and **elimination of power abuse**
- **Power asymmetries** are a main danger for economic justice (not so much concerned about principal-agent problems, free riding and size of government)
- Policy space is inherently multi-dimensional, because supply of public services has to be simultaneously be determined with distribution of costs

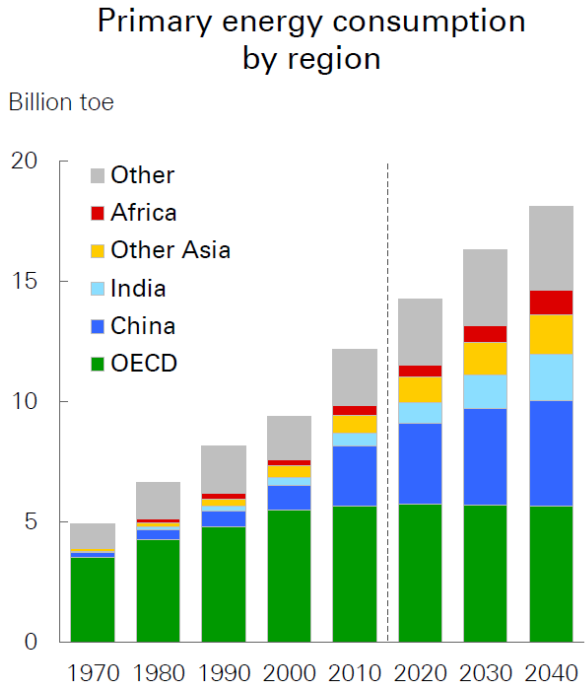
→ What does this mean for **energy justice**? How much public service in the future?

2. Heterogeneity of energy consumption: Global development of primary energy consumption (temporal and spatial)

Primary energy consumption per capita

in t.o.e., by region, 2014





Source: BP World Energy Outlook 2018

Quelle: British Petroleum (BP): Statistical Review of World Energy 2015; United Nations Conference on Trade and Development (UNCTAD): Online-Datenbank: UNCTADstat (Stand: August 2015)
Lizenz: Creative Commons by-nc-nd/3.0/de
Bundeszentrale für politische Bildung 2016 | www.bpb.de

- **World Energy Council (WEC):**

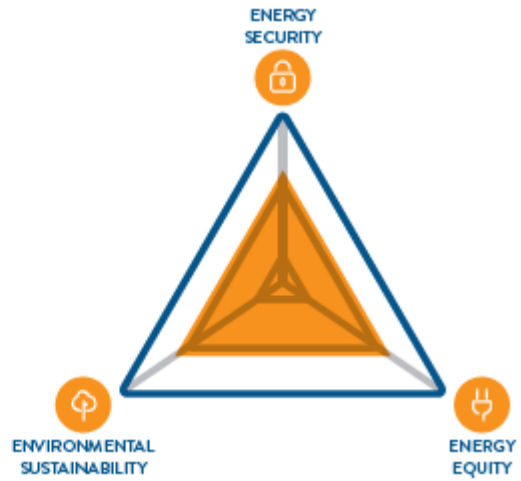
  1.5 t.o.e. per capita and year as a minimum for adequate economic and social development for all. Increase ⇨ approx. 40% higher primary energy consumption than today!

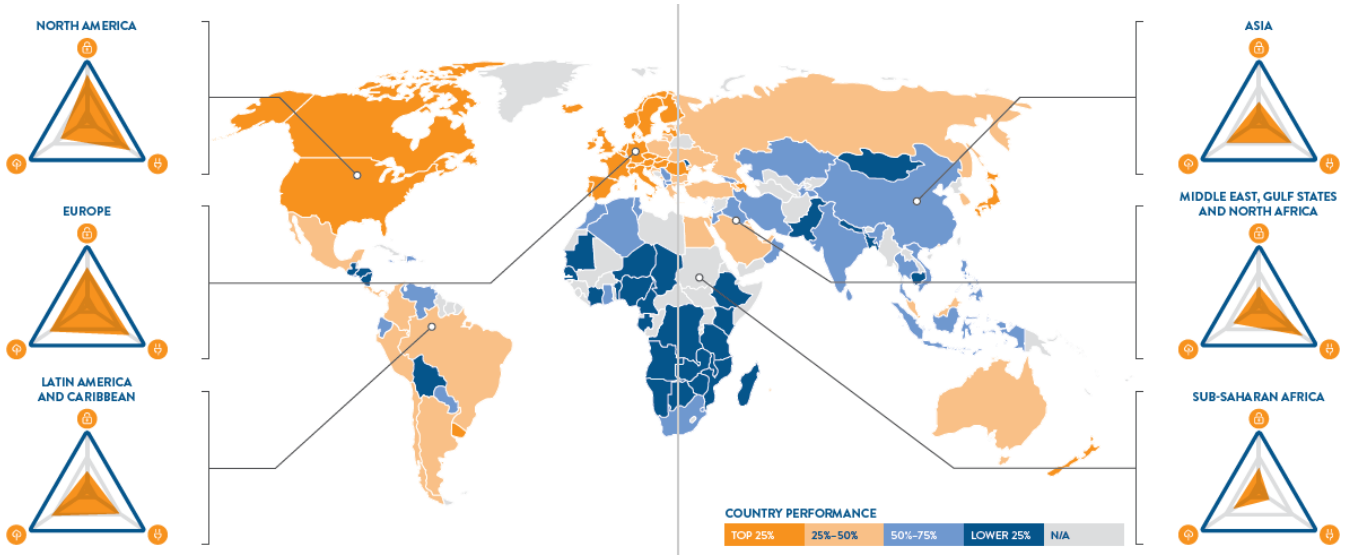
3. One corner of the “energy trilemma": access and affordability
The energy trilemma index (World Energy Council) (1/3)

ENERGY SECURITY
Effective management of primary energy supply from domestic and external sources, reliability of energy infrastructure, and ability of energy providers to meet current and future demand.

ENERGY EQUITY
Accessibility and affordability of energy supply across the population.

ENVIRONMENTAL SUSTAINABILITY
Encompasses achievement of supply- and demand-side energy efficiencies and development of energy supply from renewable and other low-carbon sources.



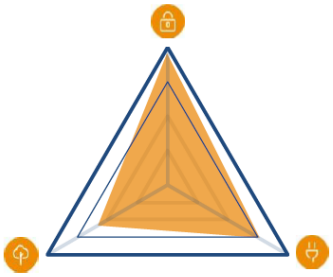


Source: WEC (2018)

3. One corner of the “energy trilemma": access and affordability
The energy trilemma index (World Energy Council) (2/3)

RANK **6**

SCORE **AAB**



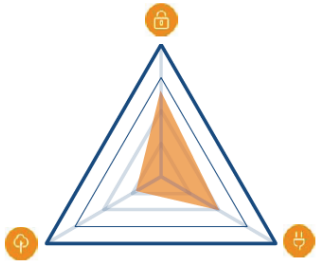
	2016	2017	2018	Trend	Score
Overall rank and balance score	**12**	**10**	**6**	▶	**AAB**
Energy performance					
Energy security	2	2	2	▶	A
Energy equity	25	31	33	▶	A
Environmental sustainability	44	43	58	▶	B
Contextual performance	35	31	29	▶	

Slovenia

China

RANK **78**

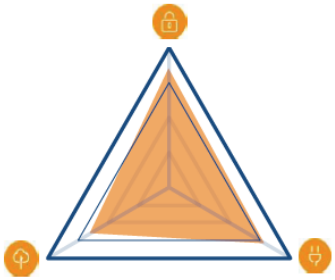
SCORE **BBD**



	2016	2017	2018	Trend	Score
Overall rank and balance score	**87**	**86**	**78**	▶	**BBD**
Energy performance					
Energy security	62	58	43	▶	B
Energy equity	77	76	81	▶	B
Environmental sustainability	117	117	104	▶	D
Contextual performance	62	47	45	▶	

RANK **7**

SCORE **AAB**



	2016	2017	2018	Trend	Score
Overall rank and balance score	**5**	**6**	**7**	▶	**AAB**
Energy performance					
Energy security	7	12	12	▶	A
Energy equity	15	17	29	▶	A
Environmental sustainability	31	32	40	▶	B
Contextual performance	15	16	16	▶	

Germany

Source: WEC (2018)

3. One corner of the “energy trilemma": access and affordability
The energy trilemma index (World Energy Council) (3/3)

THE INFLUENCE OF GDP ON TRILEMMA PERFORMANCE

INCREASING GDP

1

GDP PER CAPITA GREATER THAN US$33,500

- Includes all top 10 Index performers, except Slovenia
- Index ranks in this group range from 1 to 70 with median rank of 17
- Lower index ranked countries in this group include “fossil fuelled” countries such as UAE (36), Qatar (39), and Oman (67)

2

GDP PER CAPITA US$14,300–33,500

- Index ranks in this group range from 6 to 96 with median rank of 49
- Geographically diverse group and diverse energy resource profiles
- Includes a number of emerging economies, including 3 Sub-Saharan African, including Botswana (95) and Gabon (96) and 4 Asian countries including Malaysia (37), Kazakhstan (72) and Thailand (75)

3

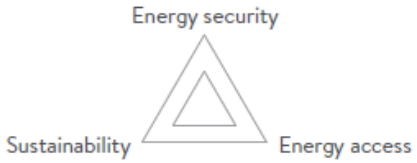
GDP PER CAPITA US$6,000–14,300

- Index ranks in this group range from 43 to 111 with median rank of 80
- Includes countries from all regions except North America
- Includes rapidly growing economies such as China (78), Vietnam (83) and India (88) that are taking actions to increase diversity of energy generation while trying to meet rising energy demand

4

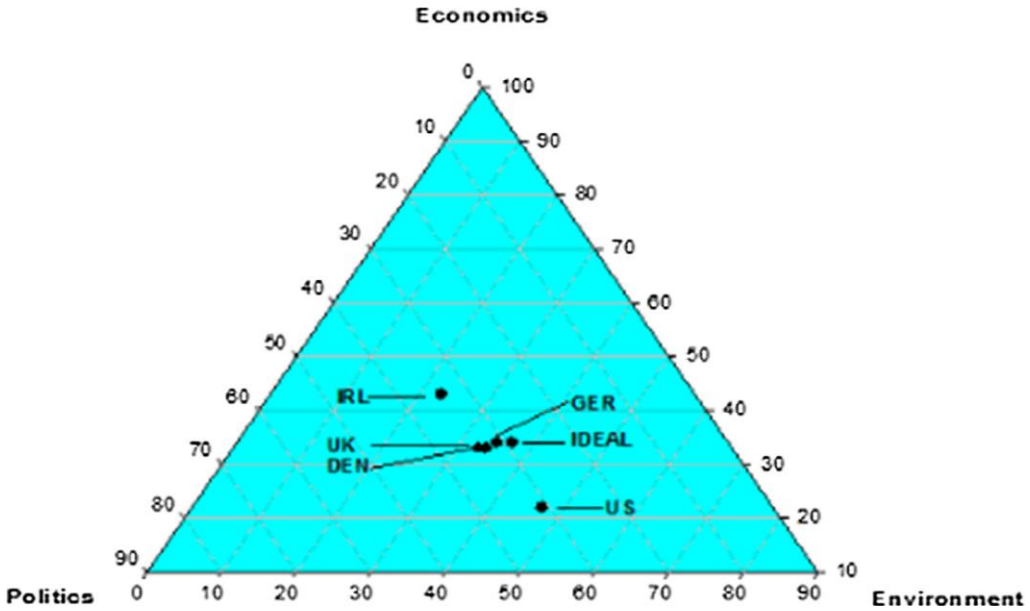
GDP PER CAPITA LESS THAN US$6,000

- Index ranks in this group range from 91 to 125 with median rank of 112.5
- Members are predominantly countries from Sub-Saharan Africa region
- Includes countries with some of the lowest energy access rates in the world



Source: WEC (2018)

3. One corner of the “energy trilemma": The “Energy Justice Metrics” (Heffron et al. 2018)



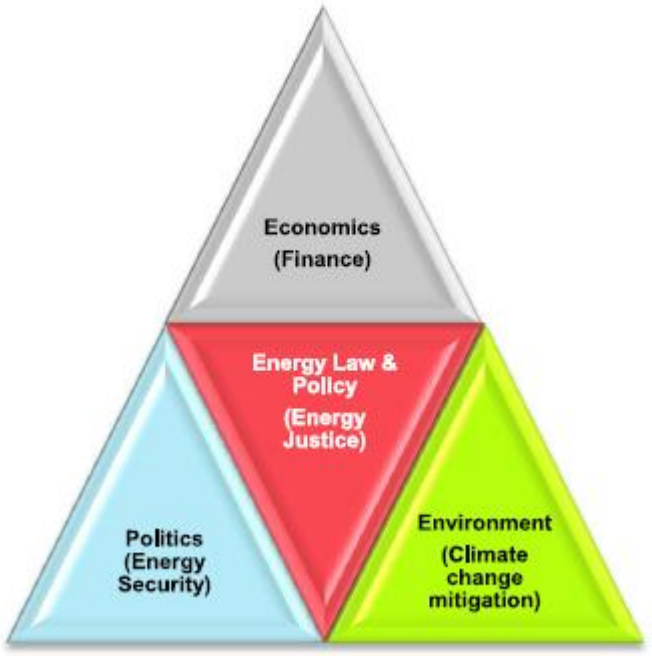


Table 3

Energy Justice Metric Index for each of the 3 ‘parts’ of the Trilemma for the US, the UK, Germany, Ireland and Denmark.

Energy Trilemma Issue	Ideal	US	UK	Ger	Ire	Den
Economics	100	93	86	83	83	93
Politics	100	46	92	89	62	95
Environment	100	65	97	97	47	100

Source: Heffron et al. (2018)

3. One corner of the “energy trilemma": Energy crossroads

- Supplementing the "energy trilemma" with **social acceptance** as the fourth dimension (may also depend on economic or contextual factors, not only on social justice!)
- **Political decisions** by government and companies are **often not** made sufficiently explicit / **transparent** (energy trilemma: creditable, but naïve)
- E.g. Dichotomy between **energy security** and **environmental justice**

- The „**4 A**s“ of energy security:
  - ***Availability,***
  - ***Accessibility,***
  - ***Affordability,***
  - ***Acceptability***

→ Overemphasis on security of supply and economic feasibility (left-hand side Fig.2)

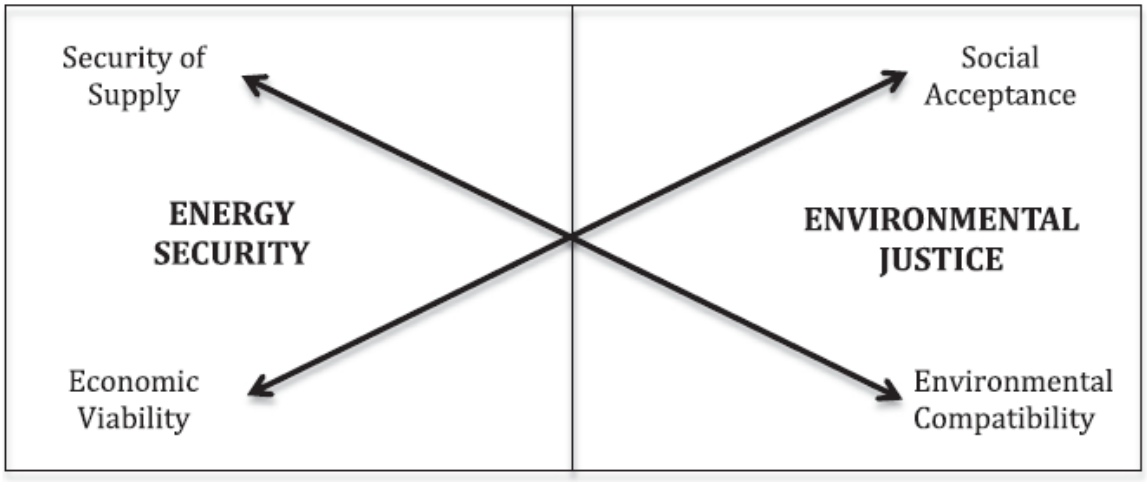
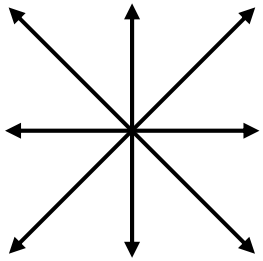


Fig. 2. The energy crossroads.

Source: Rehner and McCauley (2016)

4. Unequal distribution of income and energy (heterogeneity of the energy consumption) – many dimensions and aspects

- Temporal
- Sectoral
- Intra- / intercontinental, intra- / interregional, continental
- Quantitative, but also structural
- Relative and absolute
- Dependent, among others, on income / prosperity, but also on production and consumption activities and lifestyles



- Partly also **climate-related** (heating, air conditioning), but often building stock designed accordingly
- Depending on (availability of) the **main energy resources used** (and which parts of the population have access to them)
- Financial impacts and exposure to **physical infrastructure** (e.g. windmills vs. power lines); more people affected by decentralization?

Sources: Energy Primer, Heindl (2014)

4. Unequal distribution of income and energy – regional macro-economic analysis

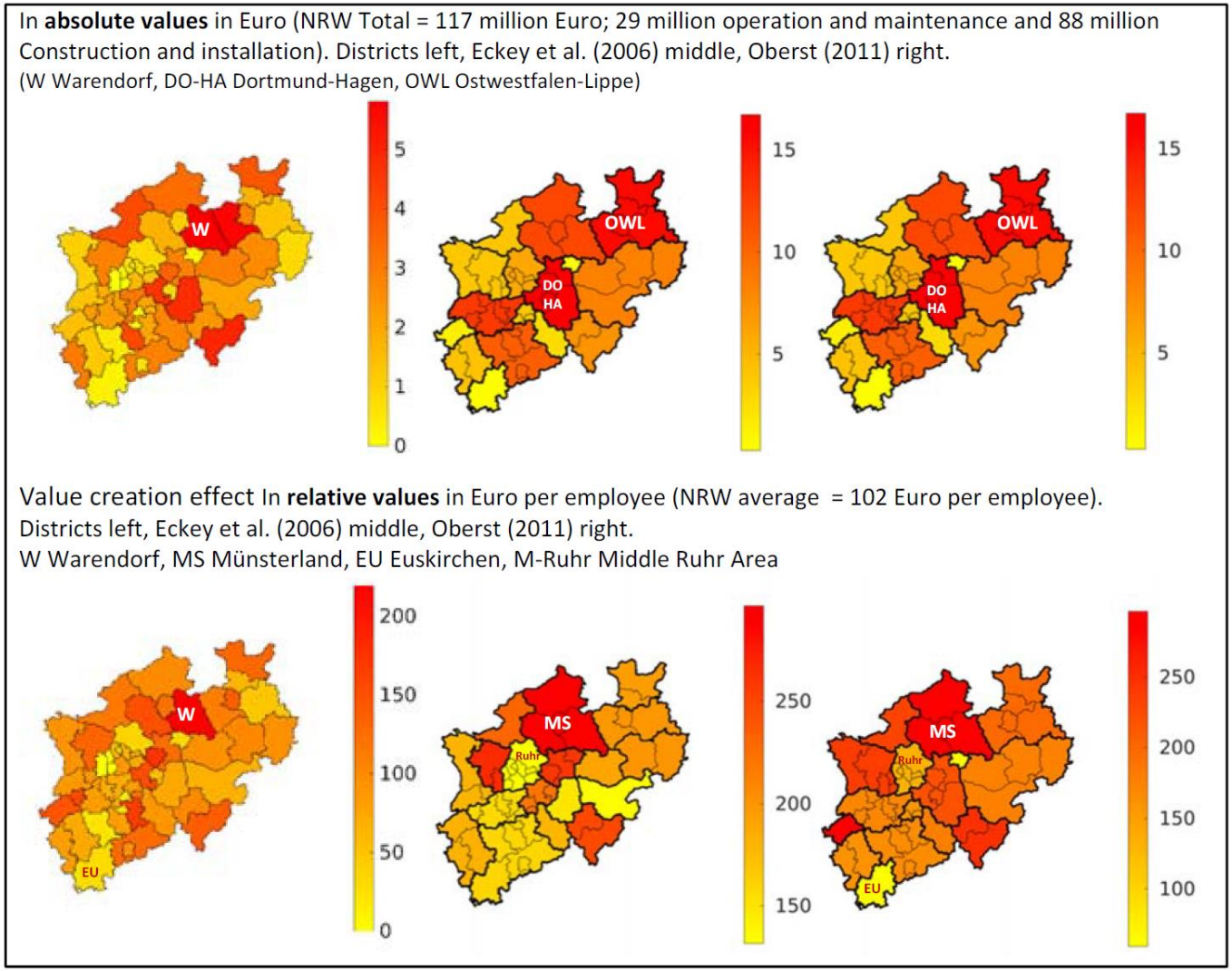


Figure 2: Regionalized value creation effect of the machinery branch

- The **regionalization heuristic** is applied to results from the I-O analysis undertaken by Kobiela & Vallentin (2016)
- Detailed regional economic investigation in **North Rhine-Westphalia (NRW)** of:
  - Industrial value creation
  - Private consumption
  - Changes in economic structure
- **Regionalization procedure:**
  - by 53 labor market districts
  - by commuter classes (Oberst 2011)
  - by labor market regions (Kropp & Schwengler 2011)

Höwer, Oberst, Madlener (Utilities Policy 2019)

4. Unequal distribution of income and energy (LCA consideration)

- **Life-cycle analysis** (LCA; “well-to-wheel”; “cradle-to-grave”) of energy equity
  - The **sustainable energy transition** is not necessarily "green" or "fair" in LCA terms
  - The analytical framework needs to go way **beyond current energy consumption** (grey energy, rare earths, social standards in commodity exporting countries, etc.)
- Traditionally, LCA most often done along the **ecological and economic dimension** of sustainability only → neglect of the **social dimension** (incl. poverty and justice)
- Remedy: **Social life-cycle analyses** for the sustainable energy transition (along the entire material flow or value chain):*
  - Raw material extraction, production, transport
  - Distribution, power generation, waste management

- Effects on (extremely strong) **affected stakeholder groups**, e.g.:
  - Workers, electricity consumers, local communities, society as a whole

* Source: Fortier et al. (2019)

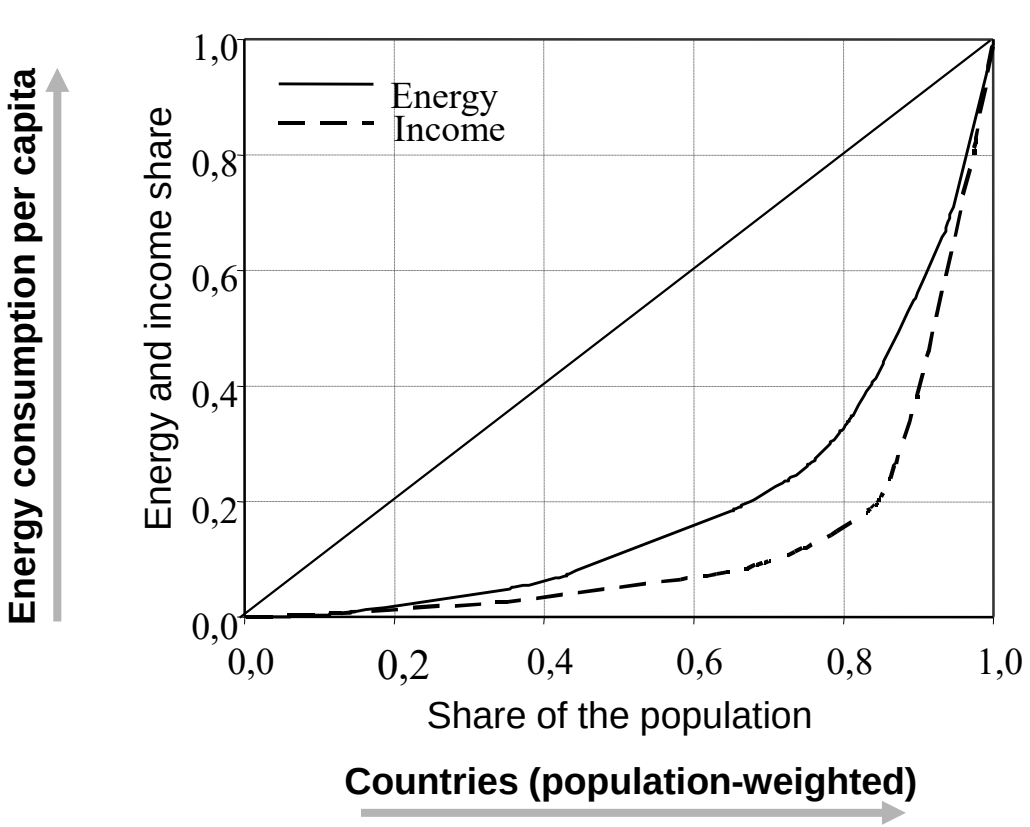
4. Unequal distribution of income and energy („exnovation“ vs. innovation)

- In order to achieve a sustainable energy transition, the **share of renewable energy must increase;** therefore, the **production from conventional energy sources** must be reduced with constant demand
- This requires not only the promotion of renewable generation technologies, but at the same time **concepts to replace unsustainable infrastructure, technologies, products** and **practices** (**path dependencies**, lock-in situations)

➢ **Process / Concept of "exnovation"** (counterpart to "innovation") (David, 2018)

- E.g.: nuclear phase-out, coal phase-out, ban on incandescent lamps, ...
- Not only individual technologies, but **entire socio-technical systems** connected with them are eliminated, which raises some problems:
  - **Justice** issues → energy justice
  - **Resistance** from various stakeholders: In contrast to innovation, “exnovation” cannot be directly profited from (rather a kind of "removal of contaminated sites")
  - **Political enforceability**

4. Unequal distribution of income and energy: Lorenz curves and Gini coefficients



- Energy is an **essential good** - and is therefore demanded <u>disproportionately</u> by people with low incomes
  (⇨ income distribution even more curved than energy distribution!)
- When incomes are very low, people resort to **non-commercial** energy sources to cover their basic needs
  (i.e. the demand for energy grows <u>disproportionately less</u> with increasing income)

Source: Erdmann, Zweifel (2007). p.99

4. Unequal distribution of income and energy: Lorenz curves and "Gini out of the bottle" (Jacobson et al. 2005)

- Energy consumption as **an indicator of national economic performance**, growth **and** human **impact on the environment**
- **Lorenz curves and Gini coefficients:** proven concepts for estimating **income inequalities**; also useful for analysis of **energy consumption inequality**

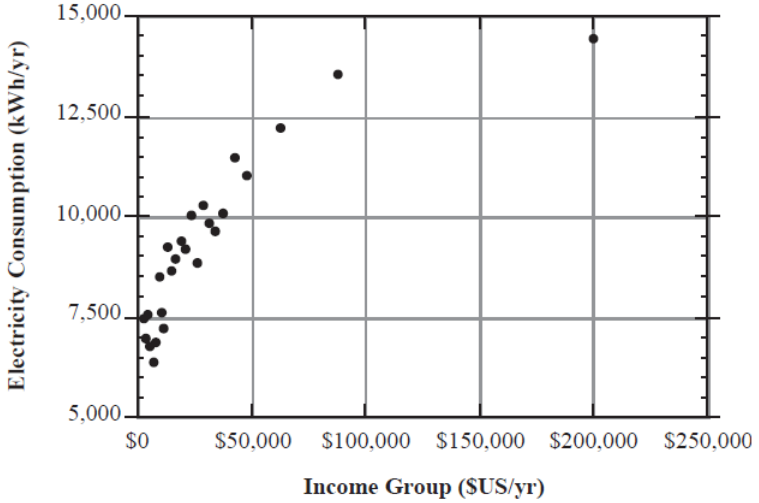
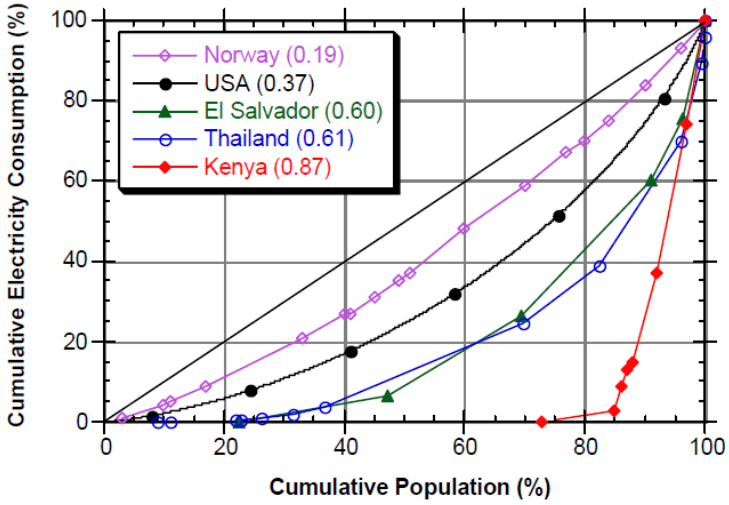


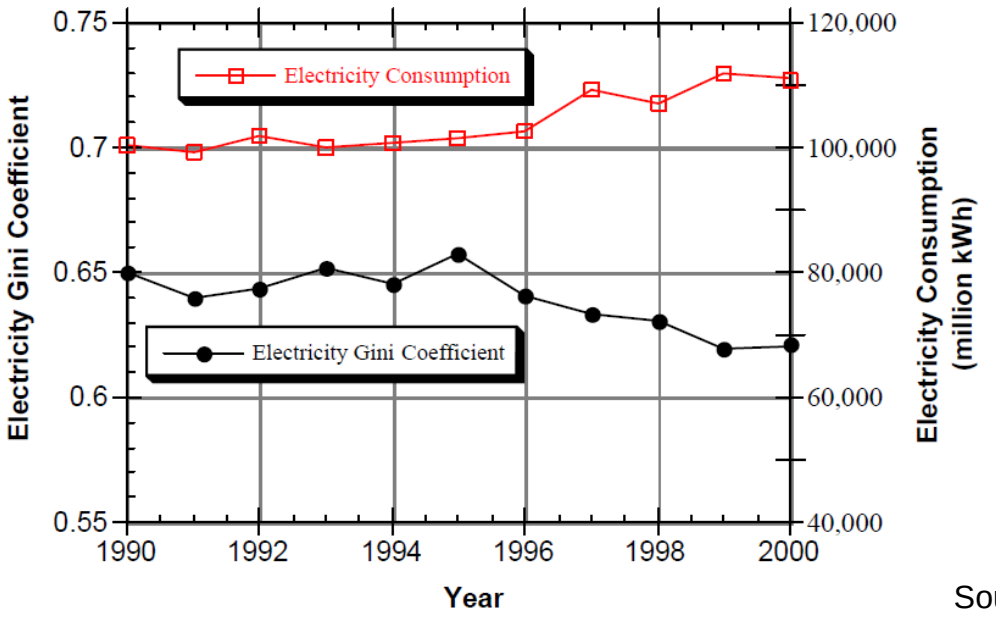
Fig. 1. Household electricity versus income for the US in 1997.

- Allows **inter- and intranational comparison** and **trend analyses**
- With an approximately linear correlation between income and energy consumption (e.g. USA, 1997), **Lorenz curves and Gini coefficients** can be determined for the **energy consumption of private households** (~ constant marginal revenues)



Source: Jacobsen et al. (2005)

4. Unequal distribution of income and energy: Lorenz curves and "Gini out of the bottle" (Jacobson et al. 2005)



Source: Jacobsen et al. (2005)

Fig. 5. Gini coefficients and total electricity consumption for commercial and industrial accounts in California from 1990 to 2000.

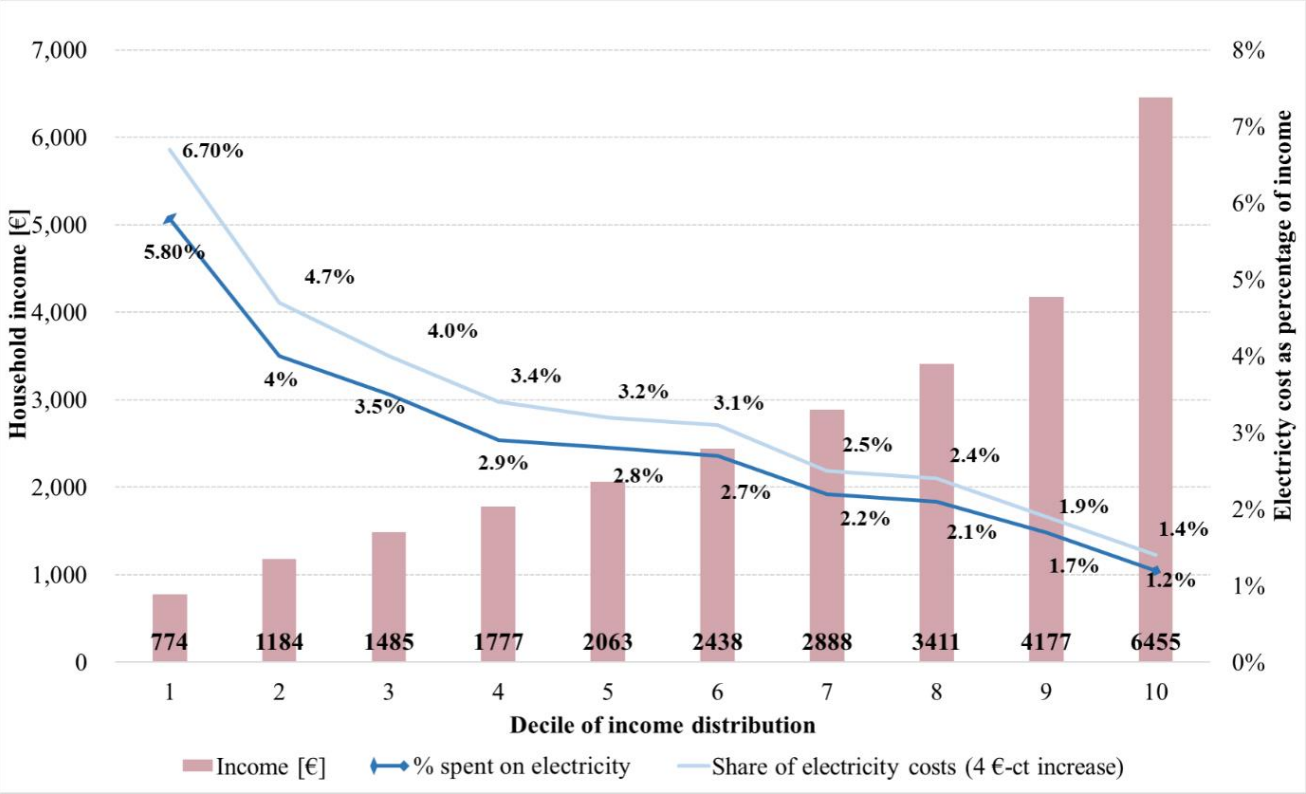
- Relatively **stable development 1990-1995**, after which electricity consumption rises rapidly and the **Gini coefficient falls** by 4% to 0.62
- **Interpretation** (by the authors)**:** Possible indication that the **importance of small enterprises** has increased, possibly due to an increasing **division of labor** (various factors conceivable as possible explanations!)

5. Distributional effects of the *sustainable energy transition*: Taxes and levy

- **Taxes** have, depending on the energy good (service) concerned, different effects
  - Mobility → tending to be progressive
  - Heat → rather neutral
  - Electricity → rather regressive
- All households have **a certain basic need for electricity**, regardless of their income
- **Increased electricity prices** therefore affect poorer households differently and relatively more strongly
- **Distribution effect of EEG at state level:** levy renders some states net contributors (e.g. North Rhine-Westphalia), whereas others benefit more (e.g. solar energy in Bavaria)
- **Distribution effect at firm / industry level:** some companies are exempted from EEG levy (2017: 2,092 enterprises or independent parts of enterprises; cf. BAFA)

Source: Heindl (2014)

5. Distributional effects of the *sustainable energy transition*: Share of electricity costs in income



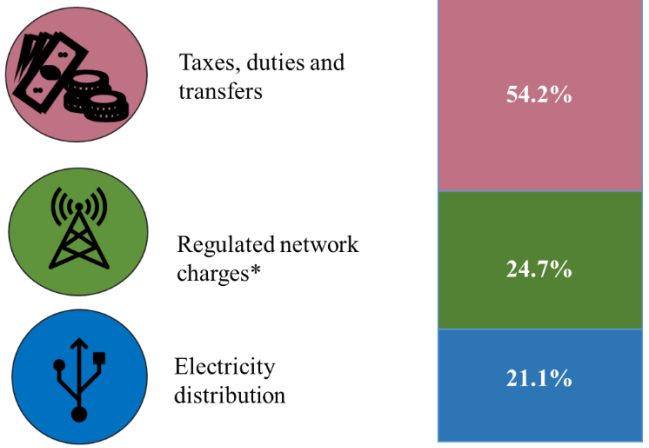
- Income distribution **in Germany** (2012): Share of electricity costs in household income, status quo and an increase in electricity costs by 4 €-ct/kWh
  → illustrates the additional burden on lower income groups

Source: Heindl (2014)

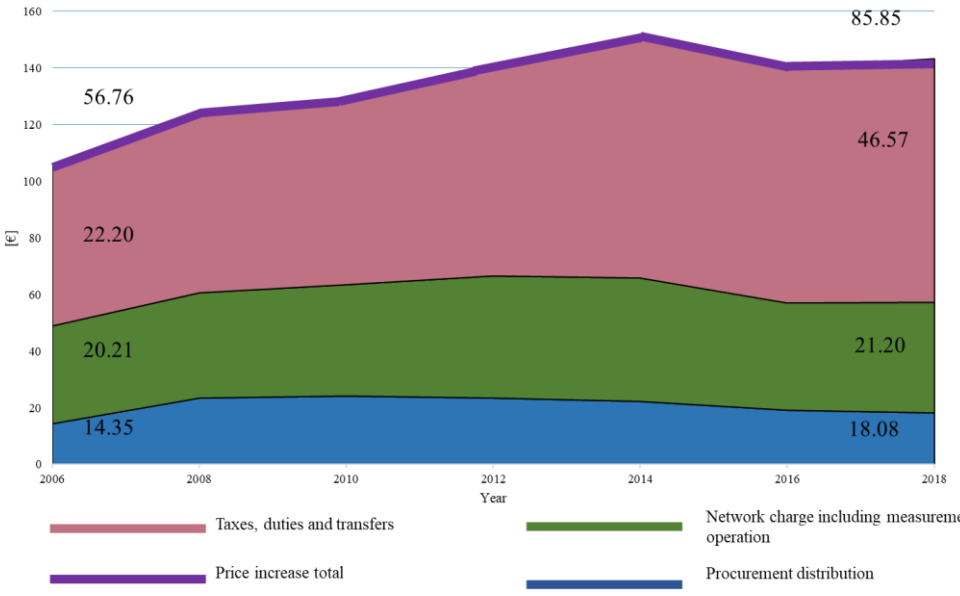
5. Distributional effects of the *sustainable energy transition*: EEG levy, 2010-2019

Source: netztransparenz.de

5. Distributional effects of the sustainable energy transition: Increase in energy prices



Change in composition of monthly average household electricity cost in Germany from 2006 to 2018. Data source: BDEW (2018) Bundesverband der Energie- und Wasserwirtschaft. https://www.bdew.de/



*Average net network charge, including charges for measurement and measuring point operation, may vary significantly from region to region

Source: BDEW (2018)

Conclusions (1/2)

1. The **scientific and political interest** in the topics of **prosumage, energy poverty and energy justice** has strongly increased in recent years

2. **Prosumers** are a building block for decentralization, social participation and acceptance; But: not every household can/will become a prosumer household

3. The origin of the energy justice debate comes from the **environmental justice literature** and the relatively long history of the **fuel poverty debate in the UK**; in times of rising energy prices / lower income likely to pop up elsewhere, too

4. The analysis of energy poverty requires both a **measure** (poverty threshold) and a **metric**; **existing metrics** often produce very **different results** and can only help to a limited extent to find just solutions

5. **Social, economic and ecological** injustices (but also historical / temporal and spatial / geographical) – there are numerous dimensions, the **energy trilemma** not uniquely defined, and justice aspects are found in all three dimensions

[1] Research Area EME, Fak. WiWi, RWTH Aachen

Conclusions (2/2)

6. Consideration of **energy poverty and energy justice** is also relevant for **guiding any *sustainable energy transition***, not least for **bearing the cost burden** of (existing, new, replaced) **lived energy infrastructure** and maintaining social cohesion, and appreciation of the transition

7. **Systemic and comprehensive analyses** are very important (e.g. **social LCA**; assessment of supra-national / supra-regional impacts); **conclusions on justice** may be different from the consideration of **individual energy sources / needs**

8. The energy transition implies the shift towards **new business models**, different lifestyles, new policies etc. → energy poverty and justice likely need to be redefined and reassessed (and **new metrics, economic incentives** introduced)

9. **Energy economics** can contribute to the debate – an inefficient system is likely not just, the **economic implications of the sustainable energy transition** are enormous, as are the potential distributional and poverty consequences

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4. Unequal distribution of income and energy: Lorenz curves and Gini coefficients (methodology)

- Analogous to the Lorenz curves of income distribution, the **cumulated household energy consumption** is plotted over **the cumulated population shares** in order to obtain a **Lorenz curve** for household energy consumption
- The **Gini coefficient** is then calculated as the **quotient** of the **area enclosed by the Lorenz curve and the first bisecting angle** and the **total area below the first bisecting angle**, or formally to:

$$G_e = 1 - \sum_i (Y_{i+1} + Y_i)(X_{i+1} - X_i)$$

  - X_i: share of the energy users in group *i* in the total population
  - Y_i: share of energy consumption of group *i* in total energy consumption, in ascending order by energy consumption

Source: Jacobsen, Milman, Kammen (2005)