



Exergy as Currency - Road to a Sustainable Economy (Building on ideas of ThermoEconomics)

„Money that is not backed by reality must inevitably fail at some point because of reality.“ (GS, 2026)

Gerd Schuster
(Friede-Gard-Stiftung)
Oktober 2026



Capitalism: ‚market prices‘ - fair or unfair?

- oil price
- gasoline price
- butter price
- price of meat
- jeans
- apartment rental
- price of shares
- minimum wage
- statutory pension
- manager salaries

What would you
give (up) for an
‚objective‘ price?



Reasoning in four steps

- Intro: some ‚sideswipes‘
 1. ThermoEconomics can calculate exergy expenditure for all processes in an economy
 2. Exergy can perform all functions of money
 3. a sustainable economy with exergy as currency is possible - with the help of the - simple and ancient - Reciprocity Principle
„What you give (in Exergy), you recover (in Exergy).“
„You get (back in Exergy), what you give (in Exergy).“
 4. (almost) any size of welfare state or climate protection is possible (under defined prerequisites) - even now
- Final: on the implementation of an Exergy-Economy

Capitalism - an ,insane‘ system



„TOO MUCH & NEVER ENOUGH“

- Incarnation of Capitalism:
Greed for profit as the highest virtue („Profit first“)
- „*Drill, Baby, drill!*“ -
„dead certain“ path into the abyss:
Destruction of Nature and Society
(then also Destruction of the Economy)
=> **Change of direction** (instead of „B.a.u.“)
(„Business as usual“)
- Change by Design! CHANGE BY DESIGN !!!
(otherwise **Change by Disaster** !!!!!)



‘Cornerstones’ of ‘plain Politics’

- Bail out of banks (saving our financial system, rescue of Euro):
 - *„Whatever it takes ...“* (Mario Draghi, EZB, 2012)
- Corona-Rescue Package (saving our economy):
 - *„Wumms“* (130Mrd) (Olaf Scholz, Secretary of Finance, 2020)
 - *„Whatever it takes“* (Markus Söder, Prime Minister Bavaria, 2020)
- Defense against Russia (saving our liberty):
 - *„Double-Wumms“* (200 Mrd) (Olaf Scholz, Chancellor, 2022)
 - *„We will spend 5% of GDP“* (Friedrich Merz, Chancellor)
- Saving of climate (saving our livelihoods)
 - *„We need more growth and good profits so that we can afford climate protection“* (CDU/ CSU u.a., on every occasion)
 - *This would be an economic and economic stimulus program without equal (but not for the ruling large corporations/ PV sacrificed for the car industry)*



,Subtotal‘

„Politics is the entertainment department of business“ (Frank Zappa)

Capitalism * = „Fuck the Planet“



Planet broken



Mankind broken $\Rightarrow$ Capitalism broken

„If the World was a Bank, it had been rescued. -

A new World is not possible, a new economic system is !“

(Ralph T. Niemeyer (2009))

* ,real existing Socialism‘ was not better & some ,State capitalistic‘ countries aren’t either



... but the market economy is so much better?

- Market price mechanism - at the heart of every ‚Crash‘
 - tulip bulb mania 1630 - 1637
 - stock price bubble 1923 - 1928
 - US-house price bubble 2000 - 2007
 - Market price mechanism - at the heart of many revolutions
 - French revolution 1789 („If you can't afford bread, eat cake“)
 - February Revolution 1917 (price increases & food shortages)
- ★ Social and environmental standards are ‚democratic‘ successes



With Clarity into the Unknown

A new World is not possible,
a new economic system is!

IF THE WORLD
WAS A BANK IT HAD
BEEN RESCUED

A new World is not possible,
a new economic system is!



RALPH T. NIEMEYER



Exergy as Currency - more than plain Nonsense?

- ‚Energy‘ (= Exergy) is the ‚fuel‘ of the economy
 - „deep earth tender“
 - Steve Keen: ‚technical progress‘ (total factor productivity of Cobb-Douglas production function) -> ‚Extent‘ of energy use
- „Petroleum - ...“
 - „the subterranean mint“
 - „the crude standard“
 - „liquid black Gold“
 - „blood of the machines“
 - „dark currency of the earth“
 - „the black tide of commerce“

Exergy - money that ,works‘

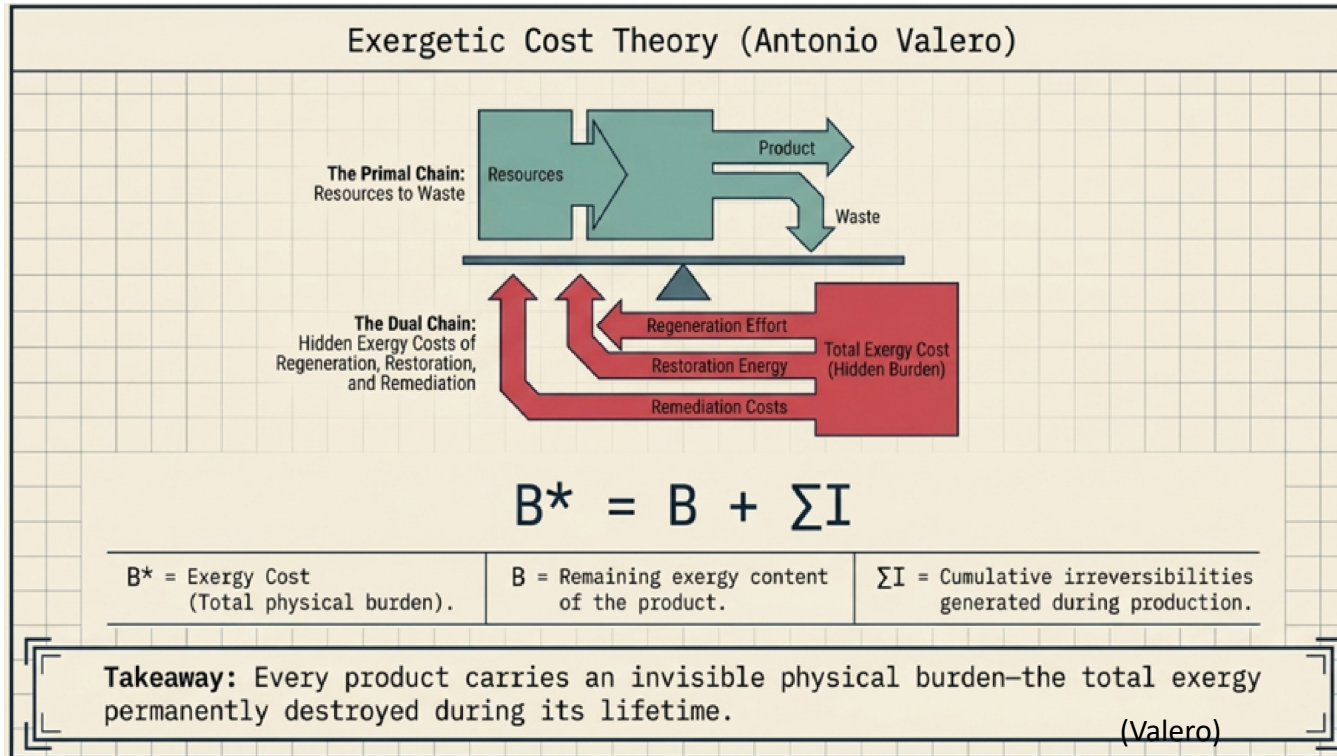


Exergy drives the economy,
like water drives the waterwheel.

Only the ,energy‘ of the water,
that gets onto the blades
drives the wheel, i.e. is capable of
performing useful work („Exergy“).

Water that splashes out of the
blades, has no effect,
i.e. efficiency <100%
(process-internal losses)

ThermoEconomics - Exergy-Cost-Calculation



above (green) - left -> right:

Exergy-Flow

(goes to product & waste & process-internal losses, dependent on efficiency)

below (red) - right -> left:

Exergy-Cost

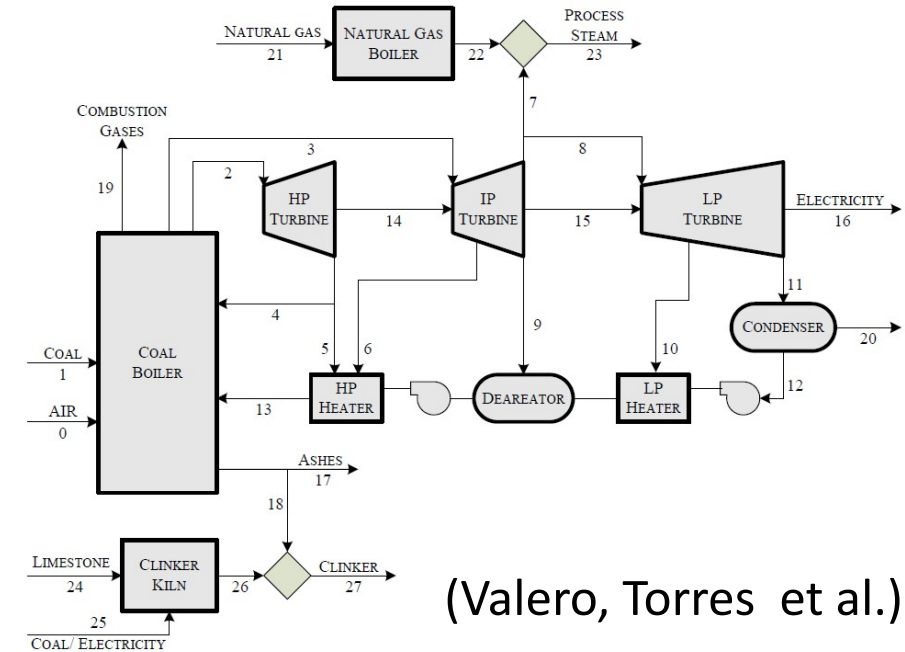
(goes to product alone)

„By replacing monetary flows with physical exergy flows, exergy costs propagate rigorously through complex supply chains without relying on arbitrary market prices“ (Valero: Award speech Friede-Gard-Preis 2026)

ThermoEconomics

- >40 ys. experience exergy calculations
- Applications:
 - Optimization of industrial plants
 - Extraction costs of raw materials
 - ‚Costs‘ of environmental destruction
 - ‚Robbing‘ of future generations
 - ‚Quality‘ of our environment
 - ‚Fitness‘ of the circular economy
- physically defined, i.e. ‚real‘ (Exergy-Cost-), Prices‘
- Exergy-Costs depending only on the state of technology *
(* and the degree of exploitation of the deposits)

Figure 1. Physical structure of an eco-industrial park, integrating a power plant, a steam generator and a cement factory.



(Valero, Torres et al.)

Classical Monetary Functions acc. Textbooks

	<i>Exergy as currency</i>
Unit of account and standard of value	• physical Unit: J (Joule), kWh - same as Energy ($1 \text{ J} = 1 \text{ Nm} = 1 \text{ Ws}$) • objective capability of performing (physical) work
Means of payment	• as money in accounts serves as a means of payment, exergy can be recorded in accounts and serve as a means of payment
Store of value	• Exergy can be stored (physically), e.g. battery, water reservoir

Classical Monetary Functions - Criticism

<i>criticism of ruling monetary system</i>	<i>Exergy as currency</i>
<u>Silvio Gesell</u> : hoarding of money brings money circulation to a standstill -> ‚Charges‘ on hoarding („Rusting money“)	storage requires exergy & brings losses over time
<u>Irving Fisher</u> : ‚uncovered‘ loans lead to crash -> Loans only to the extent that savings exist („100%-Money“)	only existing exergy can be lent out („Loanable Funds“)
<u>Austrian School</u> : Tendency of governments & central banks to incur debt -> „Commodity money“ (gold cover), i.e. binding to ‚reality‘	exergy represents ‚real‘ (i.e. physical) value

Other Monetary 'Functions'

<i>not wanted, but present</i>	<i>Exergy as currency</i>
,Bribery' ... Plutocracy	• Exergy could be ,given away', but the ,bribed' can not ,pay back' (everything being transparent & reciprocal)
,Value multiplication' ... Matthew-Effect („ <i>them that has, gets more</i> ")	• Reciprocity principle: not „<i>he who has, will be given</i>", but „<i>he who gives, will be given</i>" • Exergy bears no interest
,Exploitation' ... ,Surplus value' (Marx)	• relations are reciprocal • therefore no ,surplus value' arises

'Side Effects' of Monetary System

<i>currently</i>	<i>Exergy as currency</i>
Inflation ,devalues' the standard/ the values	physically defined standard of value, no arbitrary ,market price' - value changes only via changes in technology (& the degree of exploitation of the deposits)
external effects („prices lie“)	no external effects ((Exergy-cost-)prices ,tell the truth')
free store of value -> „liquid. premium“ (Keynes), i.e. interest	no liquidity premium (Keynes), since no hoarding of exergy for free - ,Saver of exergy' has costs for storing of exergy (i.e. loss of value) - avoidable only if he ,lends' it
interest & compound interest	no interest & compound interest -> no urge to grow/ growth compulsion -> so no big wealth inequality



,Fake'-Exergy-Economy (NOT sustainable!)

<i>Measure</i>	<i>Effect</i>
current currency only pro forma ,exchanged' by exergy	Conversion as for money exchange - e.g. 2,22 kWh per € Advantages: ,real' 100% cover, hoarding fee
otherwise business as usual: • raw material extraction without ,cure' • recycling by ,market conditions' • wages collectively bargained • price finding by ,market' • any profit markups • underfunded state • social policy by cash position • environm. protection acc. cash situation	old disadvantages possible: • acceptance of externalities • ,technology openness' destroys nature • wage pressure for ,surplus value' • oligo & monopoly prices • inflation by profits • large wealth inequality • social dumping • environmental dumping

,Real' Exergy-Economy

<i>Measure</i>	<i>Effect</i>
current currency replaced by exergy (with Exergy-Cost-Calculation according ThermoEconomics)	advantages secured (,neutral money'): • real & 100% cover (,Public Money') • hoarding costs • no inflation • no external effects
implement reciprocity principle („<i>he who gives (exergy), will be given</i> (back the same amount)“) (...'<i>and then you can again afford, what you have given</i>')	advantages secured + in addition: • no profits (entrepreneur's wage only) • no exploitation (no ,surplus value') • no interest & compound interest • no desire/compulsion to grow • no (major) wealth inequality

Economically Sustainable Exergy-Economy

<i>Measure</i>	<i>Effect</i>
exergy (acc. ThermoEconomics) replaces current currency	advantages secured
implement reciprocity principle	advantages secured + more
raw material-,neutrality' (extraction ,net zero')	maximal possible circular economy
waste-,neutrality' (,wastes' as resources)	reuse/ recycle wastes
	=> ,economic operation' ,for all times' possible

Ecologically Sustainable Exergy-Economy

<i>Measure</i>	<i>Effect</i>
exergy (acc. ThermoEconomics) replaces current currency	advantages secured
implement reciprocity principle	advantages secured + more
CO ₂ -neutrality (emission ,net zero') -> renewable energies (inherently neutral)	additional efforts for ,climate healing' (CCS; reforestation, ..)
waste-,neutrality' (no waste disposal into the environment)	waste does not go into the environment + additional efforts for ,environmental healing'
	=> ,Nature' ,operation' ,for all times'

Socially Sustainable Exergy-Economy

<i>Measure</i>	<i>Effect</i>
exergy (acc. ThermoEconomics) replaces current currency	advantages secured
implement reciprocity principle	advantages secured + more
labor sufficiently paid for indiv. & societal ,reproduction' • not only ,day laborer' wages • also ,retirement'-wage • also for governmental and societal ,Infrastructure'	fair prosperity for all - in security & freedom
	=> ,society operation' ,for all times'



(My) Product Calculation with (Exergy-)Costs

<i>Costs for</i>	<i>Exergy-Economics</i>	<i>Exergy-Costs</i>
Energy	,donation' of Sun	• exergy-expense for ,harvesting'
Raw Materials	,gift' of Nature (taken as only ,borrowed')	• exergy-expense for extract. & recycl. • Raw materials ,run in circles' (circular economy)
(Prod.-)Capital	depreciation	• leads to replacement investment • becomes (requires) labor • no original production factor • only labor is ,rewarded'
Labor	,Use of energy' • of people or people with machines	• only & ,cost object' of ,last resort' • creative factor (invents products .. processes, creates culture)
(max.) Profit	no profit	• entrepreneurial wage



(My) Assumptions about the Future Scenario

- NOT ,abundance' of ,everything' (as capitalism claims)
 - SCARCE ,exergy harvest' (so far only 10% from renewable energies)
 - especially too low ,yield' in winter
 - Storage of exergy complex (technology, land)
(even for short periods of time, the more the whole dark season)
 - SCARCE raw materials (the best deposits are already exploited)
 - for technologies for ,exergy production'
 - for goods for human need
 - SCARCE land (the quality & yield is massively worsened by climate change)
 - huge areas for photovoltaics & wind power & etc. required
- => ,frugal' society (instead of current affluent society)
(if more exergy is ,harvested', more is possible ...)



(My) Sustainable Economy with Exergy

- fundamental principles
 - planetary limits -> no growth (stationary economy, only qualit. ,growth')
 - Reciprocity (*,what you give (in exergy), you regain (in exergy)'* (not more)
-> ,simple' reproduction -> stationary economy)
 - Costs are the exergy costs for the production/ provision of goods
 - Prices equal just these costs (not more)
(i.e. no profits, only entrepreneurial wages)
 - Wages are the exergy costs for the production factor ,Labor'
(including the costs for the individual & societal reproduction)
 - Capital is no original production factor (only a derivative one:
,embodied' work) - production factors are Exergy, ,Nature' + Labor ->
Exergy is ,gift by sun', 'Nature' is ,only borrowed', only Labor is ,paid')



Money Creation = ‚Exergy Harvest‘

- Exergy supply as public responsibility (not by ‚market‘)
 - analogous to money creation by central banks
- Price for exergy is Cost-Price (not market price)
 - price varies with day/ night & summer/ winter
(at least longer logistic routes in winter (& possibly at night))
- public, government-independent authority meets needs
 - cheapest offers are accepted until demand is met
 - provide exergy at uniform price (except variations as above)
- scarce ‚harvest‘ has to be distributed ‚in a democratic way‘
 - prioritizing the needs (NOT the most solvent determines this)
 - basic needs are given priority (food, clothing, housing)
 - limited ‚luxury goods‘ production (in case of shortage: none)

(Exergy-)Economy in Input-Output-Form

	Sektor 1	Sektor 2	Sektor 3	Haushalte	Staat	SUMME
Sektor 1	40	80	0	40	40	200
Sektor 2	40	40	20	150	150	400
Sektor 3	0	80	20	50	50	200
Arbeit	60	100	80	10	0	250
Staat	60	100	80	0	10	250
SUMME	200	400	200	250	250	

- e.g.
Sektor 1: raw materials
Sektor 2: capital goods
Sektor 3: consumer goods
Units: e.g. Joule, € \$ ¥ £, ...
- columns: Inputs
- rows: Outputs
- ‚communicating tubes‘ (National Accounts)
- in equilibrium:
Sum In = Sum Out (per sector)

(Exergy-)Economy in Input-Output-Form

	Sektor 1	Sektor 2	Sektor 3			Haushalte	Staat		SUMME
Sektor 1	40	80	0			40	40		200
Sektor 2	40	40	20			150	150		400
Sektor 3	0	80	20			50	50		200
Arbeit	60	100	80			10			250
Staat	60	100	80				10		250
SUMME	200	400	200			250	250		1300

	Sektor 1	Sektor 2	Sektor 3	Klimaschutz	Soziales	Haushalte	Staat	Export	SUMME
Sektor 1	40	80	0	20		40	40	20	240
Sektor 2	40	40	20	20		140	150	25	435
Sektor 3	0	80	20	10	10	50	50	15	235
Klimaschutz	40	30	35			30			135
Soziales*						95			95
Arbeit	60	100	80	100	110	10			460
Staat	60	100	80	-15	-25	40	10		250
Import		5				55			60
SUMME	240	435	235	135	95	460	250	60	1910

- two big sectors ,funded' in addition
- new equilibrium by ,communicating tubes' (adjustment of inputs)

(Exergy-)Economy ... five-fold increase (1.. 2)

	Sektor 1	Sektor 2	Sektor 3	Klimaschutz	Soziales	Haushalte	Staat	Export	SUMME
Sektor 1	40	80	0	100		40	40	100	400
Sektor 2	40	40	20	100		140	150	85	575
Sektor 3	0	80	20	50	10	50	50	115	375
Klimaschutz	200	150	175			150			675
Soziales*						95			95
Arbeit	60	100	80	500	110	10			860
Staat	60	100	80	-75	-25	100	10		250
Import		25				275			300
SUMME	400	575	375	675	95	860	250	300	3530

	Sektor 1	Sektor 2	Sektor 3	Klimaschutz	Soziales	Haushalte	Staat	Export	SUMME
Sektor 1	40	80	0	100		40	40	100	400
Sektor 2	40	40	20	100		140	150	65	555
Sektor 3	0	80	20	50	50	50	50	100	400
Klimaschutz	200	150	175			150			675
Soziales*						475			475
Arbeit	60	100	80	500	550	10			1300
Staat	60	100	80	-75	-125	200	10		250
Import		5	25			235			265
SUMME	400	555	400	675	475	1300	250	265	4320



Exergy-Economy in Input-Output-Form

- Prerequisites for the increase of inputs:
 - enough exergy available
 - enough ‚Labor‘ for the provision of services available
 - enough raw materials for the provision of services available
- Prerequisites for the feasibility (ideally):
 - no ‚losses/ squandering‘: what is produced, will be consumed (resp. only what is demanded will be produced) & 100% efficiency
 - has to be paid out of additional ‚overheads‘ otherwise
 - closed economy resp. self-sufficiency
 - in open economy: competition of social & environmental standards („race to the bottom“) - special conditions need to be created; being as self-sufficient as possible facilitates these



Comparative Overview

present capitalistic economy

- wasteful...
promises eternal abundance
- exploitation of ‚Labor‘ ...
‚surplus value‘ enriches ‚capitalists‘
- Money with interest & compound
interest privileges the ‚super-rich‘
- Prices ‚lie‘ (external effects)
- Inflation robbes ‚little people‘
- Social dumping & currency wars
- Promise of growth...
Destruction of livelihoods
(we are ‚one step before the abyss‘...
and tomorrow one step further)

exergy economy

- thrifty...
sustainable use of resources
- fair remuneration based on performance ...
no ‚surplus value‘
- Exergy-currency bears no interest ...
has no destabilizing dynamics
- Prices ‚tell the truth‘
- Prices stable, since standar of value ‚fixed‘
- exergy as global uniform standard of value
- stationary economy ...
with protection of livelihoods ...
plenty of space for creativity & non-material
‚growth‘ (cp. Hidalgo „Why information grows“)

Exergy-Economics - the building blocks

	<i>Building block</i>	<i>Effect</i>
6	(relative) Self-sufficiency	sovereignty in social & environm. standards
5	Labor-,Exergy- Cost'-Calculation	social sustainability
4	Neutrality-Principles: raw materials-, waste-, CO ₂ -	economic & ecological sustainability
3	Reciprocity principle	fair, stationary economy
2	Exergy-Cost-Calculation	,genuine' costs (,prices tell the truth')
1	Exergy as currency	,real' currency with 100% cover & hoarding fee



Implementation of a Exergy-Economy

- IMMENSE RESISTANCE against implementation expected by
 - (very large part of) large corporations & super-rich & politicians:
current system of self-service would be gone
 - established (neoclassical) economics:
ruling position and ‚wisdom‘-nimbus would be gone
 - (the unenlightened) average consumer („Average Joe“):
Dream of becoming a billionaire would be over („main prize in the lottery“)
(no one explains to him how much better he would ‚perform‘ in an exergy-economy)
- Potential supporters
 - future generations (resp. their representatives: their parents)
 - ‚green‘ ‚pioneers‘, networks, cooperatives, medium-sized companies, etc.:
breeding ground for a sustainable ‚practice‘
 - the ‚reasonable‘ ones everywhere (ready to respect planetary boundaries)
 - states rich in renewable energies
- N.B. Nature: has canceled ‚overdraft‘ (elimination is threatening (J.Lovelock))

So: Continue to have FUN ? -

but beware ...

- The Titanic is sinking.
- But the music plays
UNTIL THE END!



LAST SOLEMN MOMENTS ON BOARD THE TITANIC.
THE BAND PLAYS "NEARER, MY GOD, TO THEE."



- Dance & enjoy the party!
- For you there are
NO LIFEBOATS !



OR:

DON'T LET THIS BE THE END -
LET US SAVE THE 'TITANIC'
(„Stand up & fight back ... „!!!)



*„May it come like with the wheel:
it is used all the time -
and sometimes you wonder
why it wasn't invented earlier.“* (GS, 2026)

Thank you very much for your attention



detailed elaboration as pdf-file available under
mail@friede-gard-stiftung.de

when providing assurance of substantive feedback
(slides at www.friede-gard-stiftung.de)