

Operations and Performance Update Nuon Power Buggenum



GTC meeting, oct 2002

Marco Kanaar

Manager Projects & Engineering

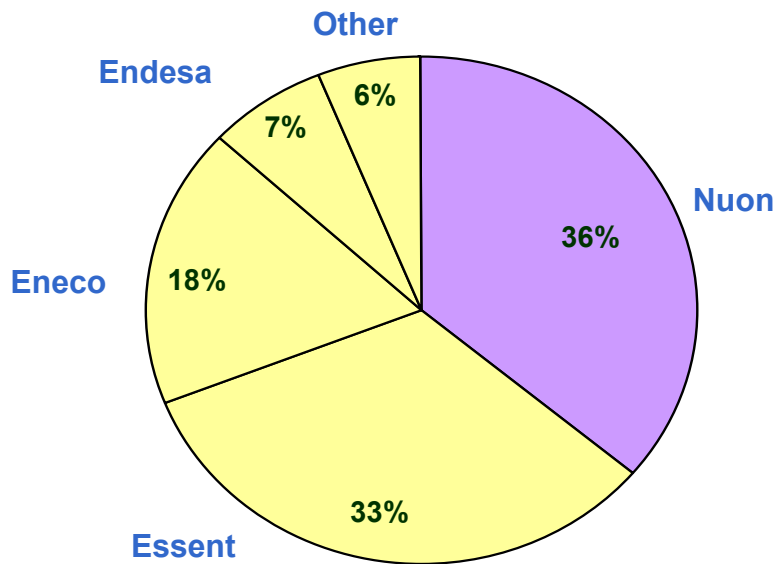
Suppliers in the Netherlands 2001



Marketshare in the Netherlands 2001

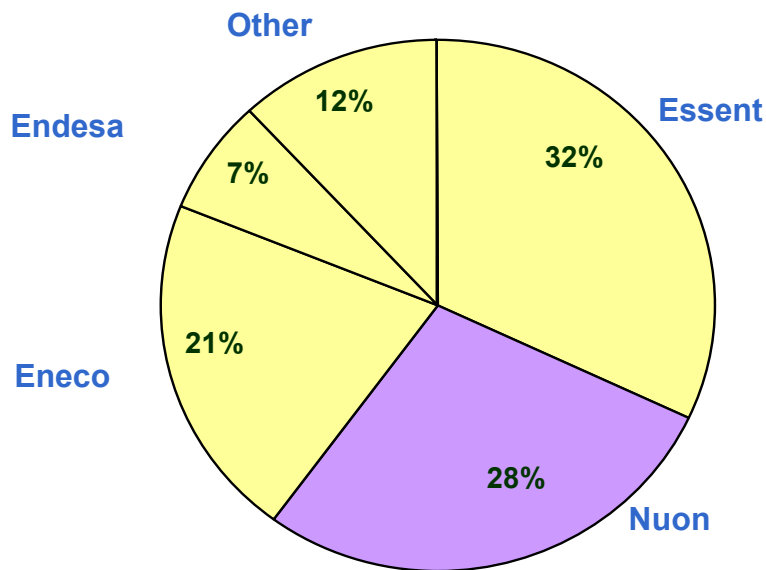
clients electricity

100% = 7.2 mln



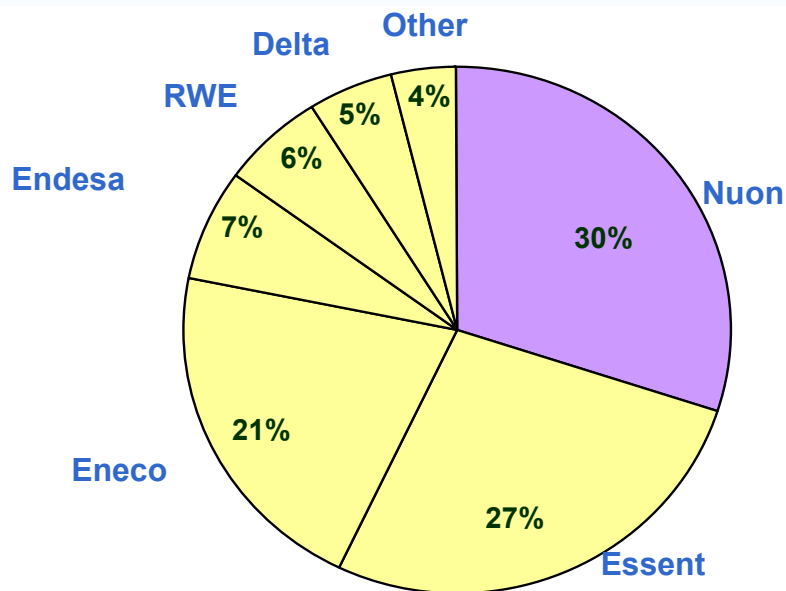
clients green electricity

100% = 0.75 mln

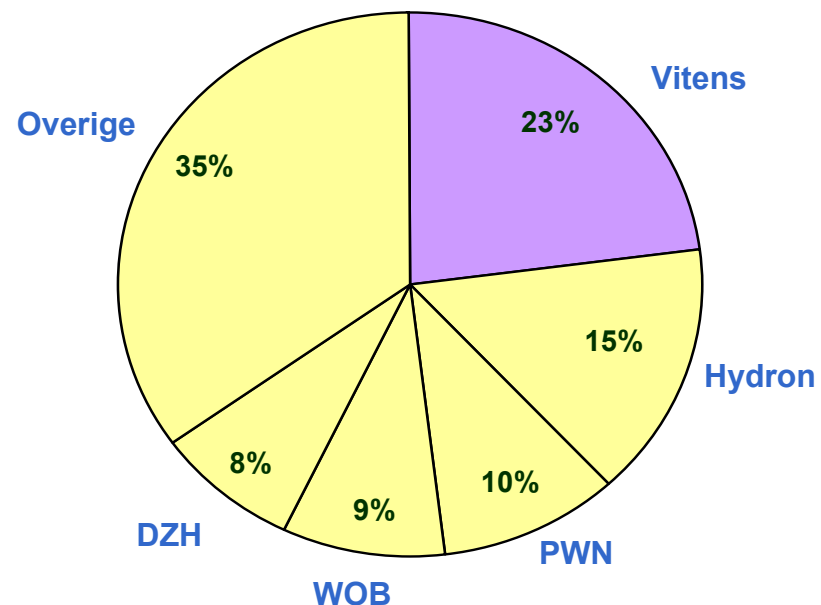


Marketshare in the Netherlands 2001

clients gas
100% = 6.7 mln



clients water
100% = 6.6 mln



Sustainable energy Nuon 2001

- **Sustainable energy**
4.275 million kWh
being 15,5% of the whole sale
- **“Green Power”** for business market
12,6 million kWh of which 1,1 from the WAC
- **“Natural Power”** for retail
534 million kWh
generated out of sun, wind and water
- **As from 2002: “Green Power”** for retail
generated out of biomass, wind and water

Why the Willem-Alexander Centrale?

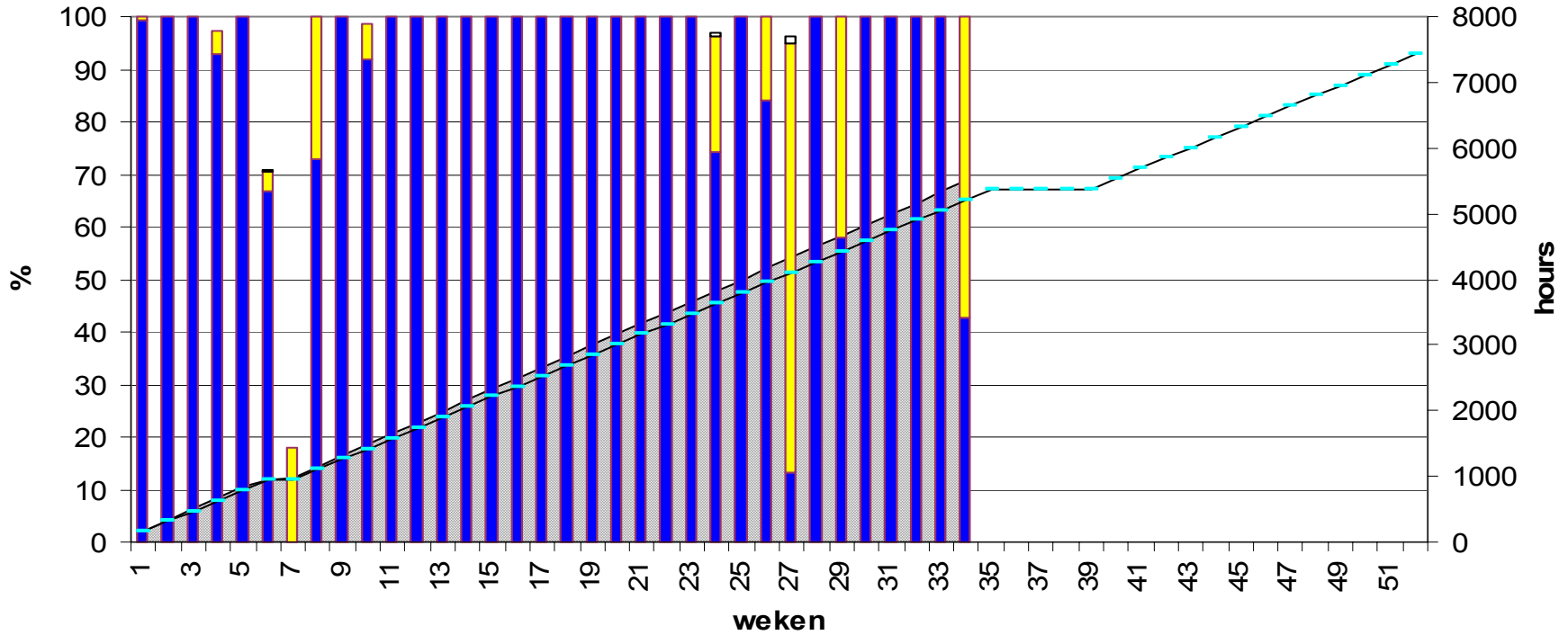
- Limited own production capacity
- Clean coal technology
- Lots of opportunities
- Large potential for green energy

Performance of the Willem-Alexander Centrale

	1.1.2002 t/m 30.8.2002	target 2002
Availability WAC:	96,4 %	86 %*
Planned shut-down:	3,3 %	9,9 %
Unplanned shut-down:	0,3 %	4,3 %
Availability gasifier:	86,1 %	69 %
Planned shut-down:	8,3 %	13 %
Unplanned shut-down:	5,6 %	18 %

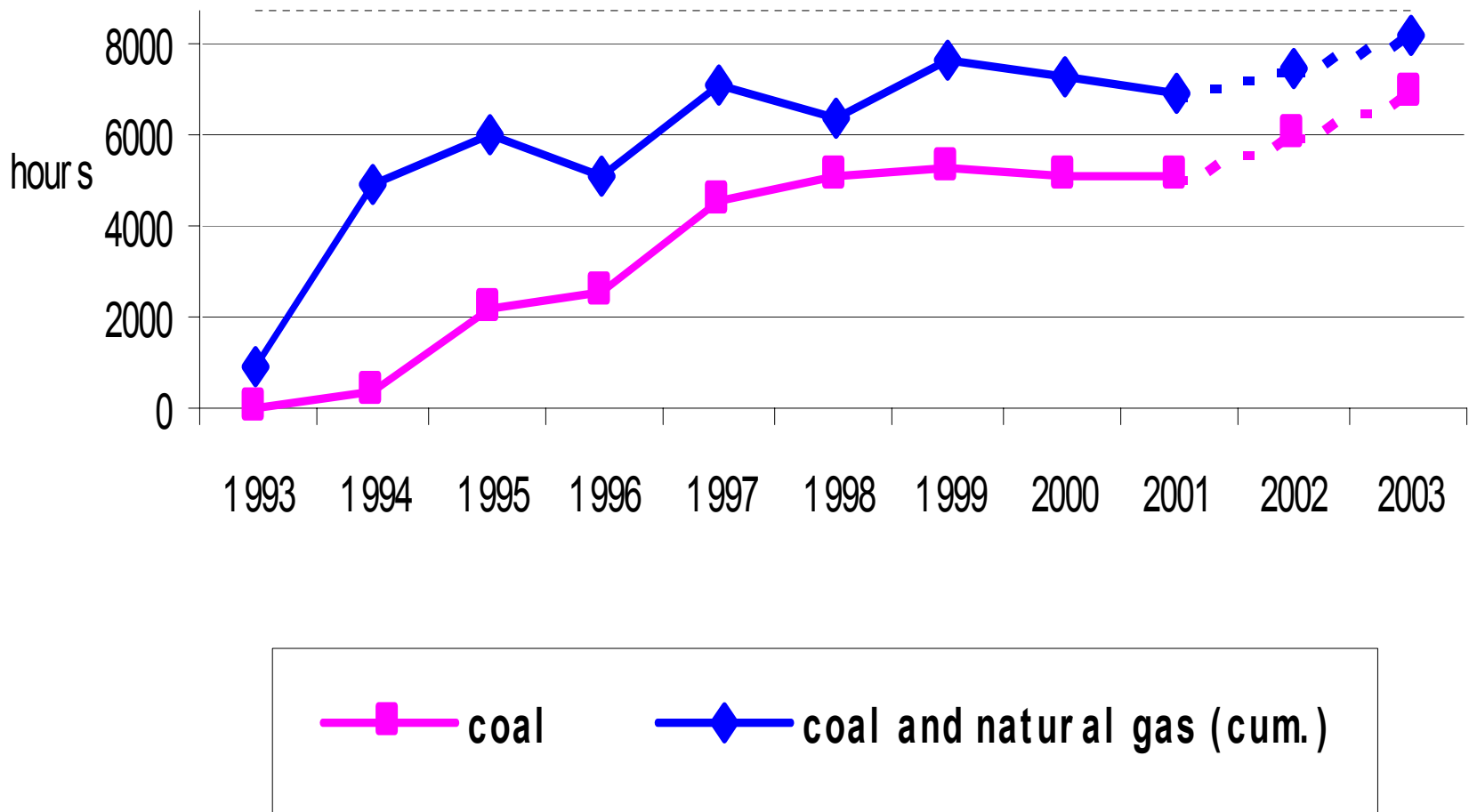
* realisation in 2001: 79%

IGCC Operating hours
SG / NG in % per week **planning and realisation**

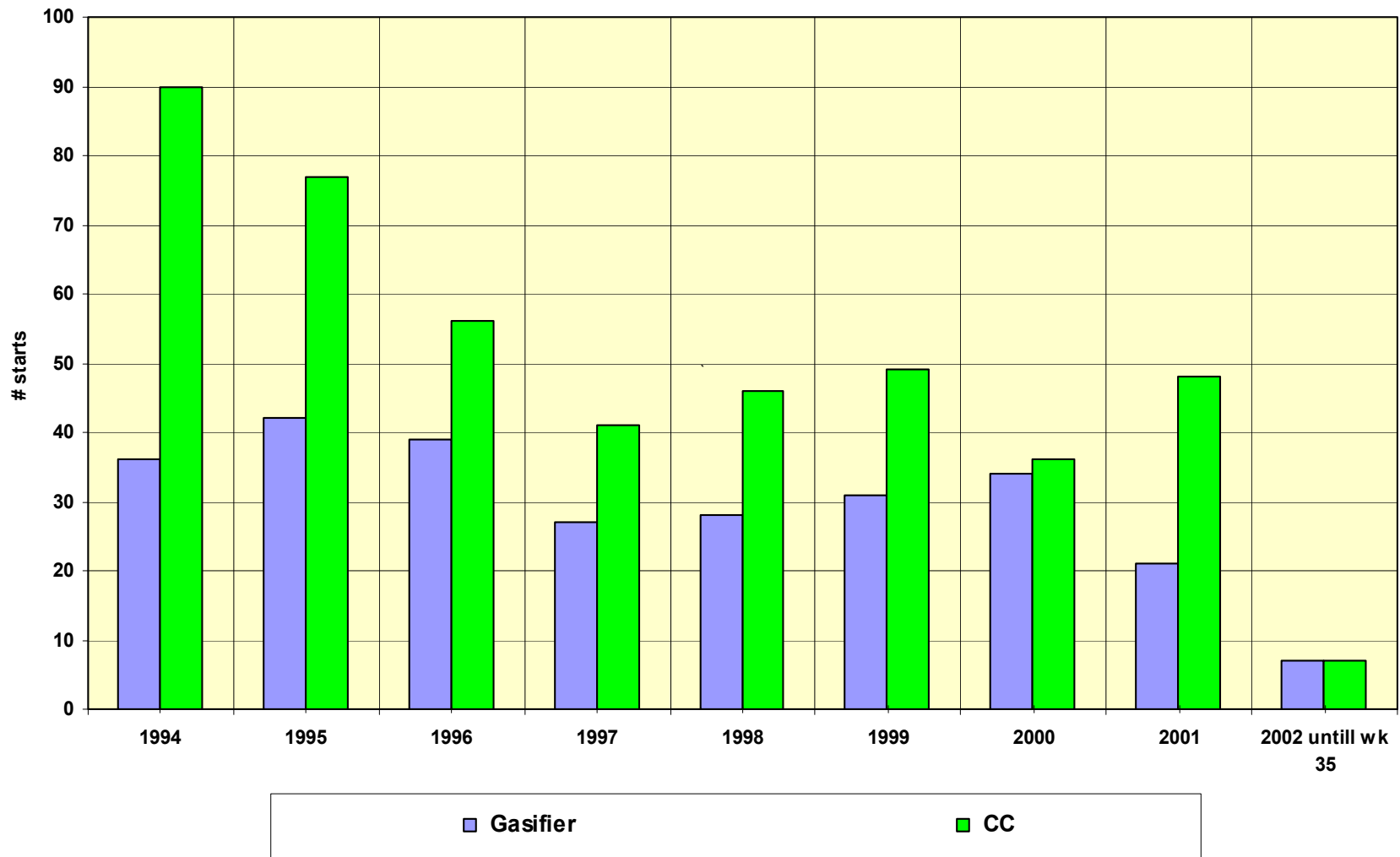


Realisatie
 % week SG
 % week AG
 van het net

Operating hours per year and per fuel



Gasifier and CC starts



Reasons for better results

✧ Different mode of operation:

- ✧ Operate on power unbalance market, lower base load.

- ✧ Note: every 4 seconds new setpoint!

✧ Clear purpose.

- ✧ Power unbalance prices are high! Focus on reliability

✧ Nuon buys coal on Buggenum specification.

Syngas production

- ✧ Formation of slag lumps
- ✧ Discharge and processing of slag fines
- ✧ Damage heatskirt
- ✧ Bridging in powder coal sluicing vessel
- ✧ Leakages syngas cooler
- ✧ Severe fouling of top of syngas cooler
- ✧ Processing of slag bath water

Syngas and waste water treating

- ✧ Failure ceramic candles
- ✧ pH-control syngas scrubber
- ✧ Degradation sulfinol
- ✧ Contamination of water with sulfinol
- ✧ Plugging waste water equipment
- ✧ Separation and processing of salt crystals
- ✧ Zero liquid discharge/surplus process water

Combined cycle, ASU and auxiliaries

- ✧ **Burners gas turbine (humming, overheating)**
- ✧ **Production of make up water steamcycle**
- ✧ **General controls ASU**
- ✧ **Hydro-thermal ageing molsieve material**
- ✧ **Oxygen distribution (compressor, back-up)**
- ✧ **Damage seals LIN/LOX pumps**

Recent problems less serious:

✧ Leakages:

- ✧ hot gas filter blow back nozzle (trip)

- ✧ slag bath circulation system (trip)

- ✧ LIN-vaporizer, cracks due to thermal shock

- ✧ Caustic line, Halogenes wash column.

- ✧ GT trip due to calibration work in ASU

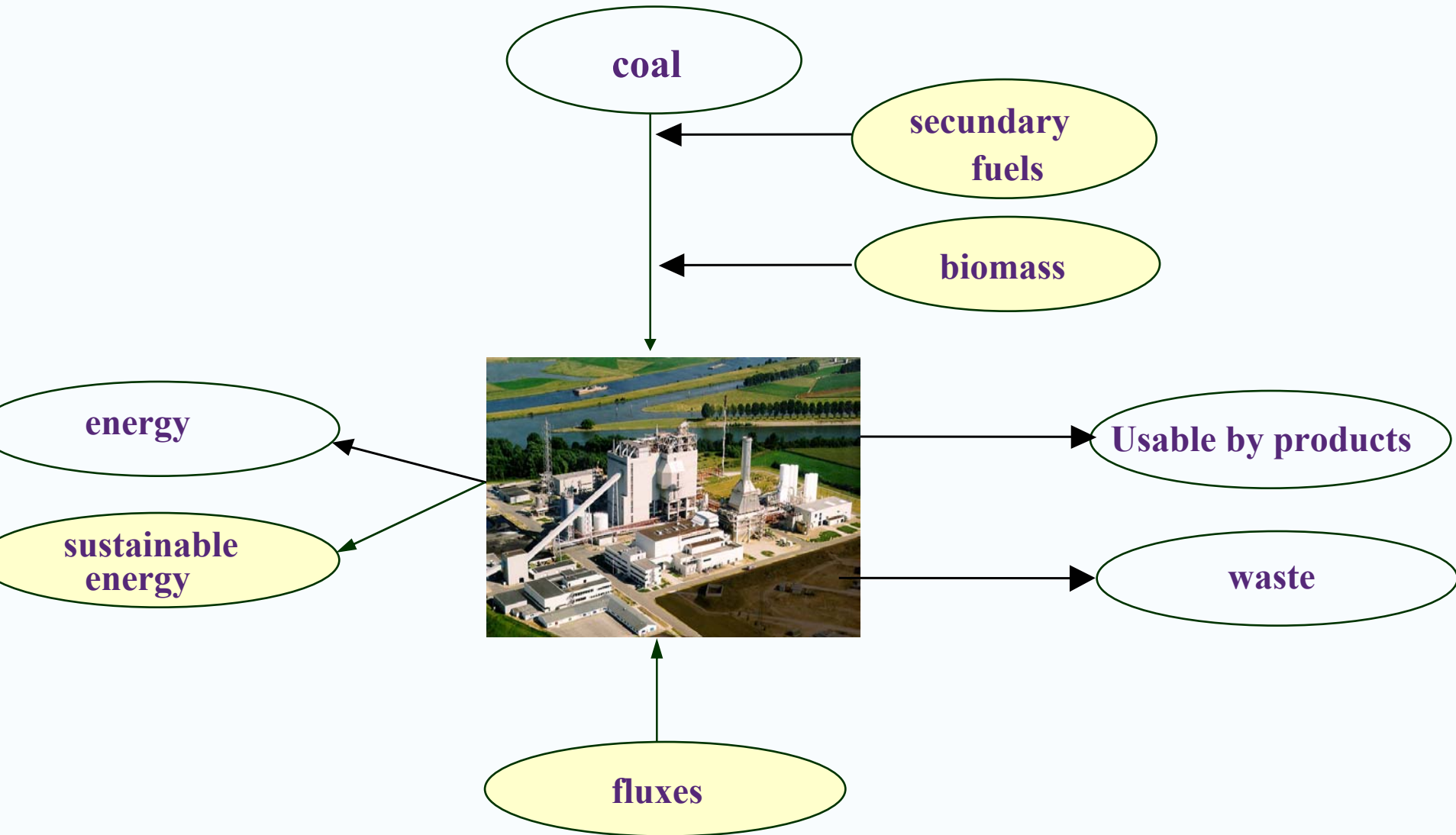
- ✧ HC build up in ASU (trip)

- ✧ Trip quench gas compressor (instrumentation)

- ✧ Flyash transportation (plugging)

- ✧ Slag transportation chain stuck

Existing and planned activities



Project Green Power

Want

- Stake holders value Nuon
- Front runner sustainable energy

Must

- Kyoto: climate covenant
- Dutch coal covenant

Boundary Conditions

- ✧ **Slag and fly-ash disposal through existing channels**
- ✧ **Nett CO₂-reduction**
- ✧ **Integrity installation**
- ✧ **Availability biomass**
- ✧ **Emission requirements**
- ✧ **Profitable**
- ✧ **Sustainable**

Example of slag and fly ash re-use



19 9 2002

Separation walls in bulk storage area



19 9 2002

Detail showing included slag particles



Examples cogasification fuels

- **Biomasses**

Poultry litter, sewage sludge, waste wood, road side grass

- **Fluxes**

Chalk grains, paper pulp, bentonite

- **Other fuels**

Subcoal, pet cokes, pyrolysis cokes

Testprogram

<u>Fuel</u>	<u>Tested (ton)*</u>	<u>Planned (ton)**</u>
Sewage sludge	2.300	5.000
Chicken litter	800	10.000
Wood	130	500
Paperpulp	<u>1.000</u>	<u>300</u>
	4.230	15.800

* Nov 2000 - Dec 2001

** Juni 2002 - Dec 2002

Project execution in 2 phases

- **Phase 1: 30 wt % co-gasification
early 2004**
- **Phase 2: 50 wt % co-gasification
2005***

*** 3 x 100.000 ton biomass per year,
appr. 50 MWe**

Biomass logistics



12 per day



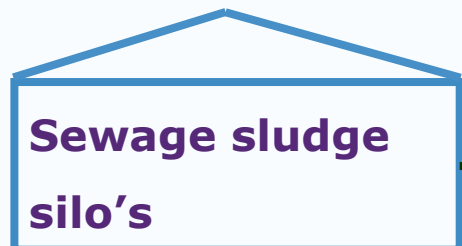
Chicken litter silo's



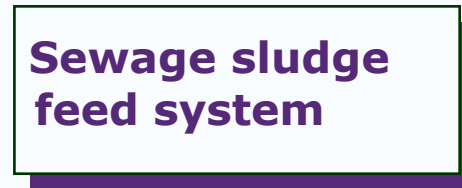
Chicken litter feed system



10 per day



Sewage sludge silo's



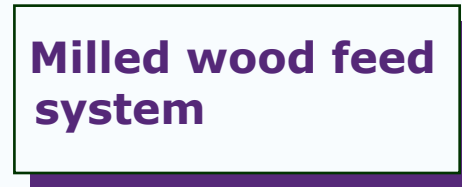
Sewage sludge feed system



22 per day



Milled wood silo's



Milled wood feed system



2 per week



Alternative transport wood



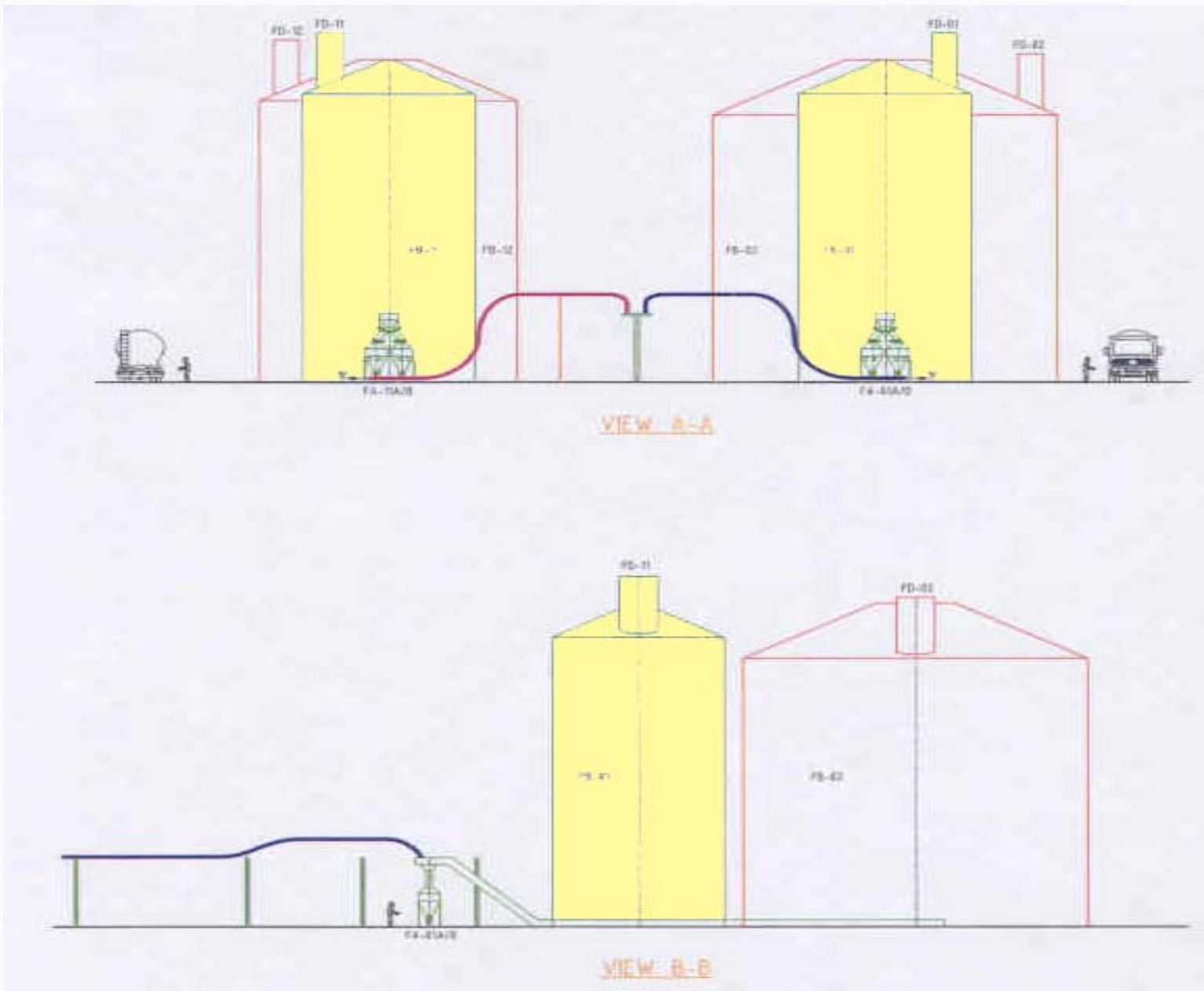
New



Coal-mills



Existing



Fuel packages considered (kton/year)

	<u>Reference package</u>	<u>Average package</u>	<u>Worst case pack.</u>
	6200 hrs coal gas 1200 hrs nat. gas	6200 hrs coal gas 1200 hrs nat. gas	8760 hrs coal gas 2000 hrs nat. gas
Coal	543	363	471
Nat. gas	51	68.4	107
Sewage sludge		100	382
Poultry litter		100	
Wood		100	
Lime stone	14		
Paper pulp		10	38

Air emissions (concentrations mg/m³) HRSG chimney and BLA requirements

	Reference package	average package	worst case package	BLA	factor below BLA
SO ₂	3,8	3,4	6,9	40	6
NO _x	13,4	16,1	16,1	70	4
dust	< 1	< 1	< 1	5	5
HCl	< 0,05	< 0,05	< 0,05	10	200
HF	< 0,05	< 0,05	< 0,05	1	20
CO	< 1	< 1	< 1	50	50
C _x H _y	< 2	< 2	< 2	10	5
Cd	3,02E -06	1,04E -04	2,71E -04	0,05	185
Hg	3,19E -05	2,01E -04	4,10E -04	0,05	122
Sum heavy metals BLA	1,61E -02	7,10E -02	1,58E -01	1	6
dioxins/furans (ng TEQ/Nm ³)	< 0,05	< 0,05	< 0,05	0,1	2

Byproducts

- **Amount of byproducts increases**
 - **Slag and fly ash from 72 to max. 179 kton/year**
 - **Sulphur from 4,6 to max. 7,2 kton/year**
- **Byproducts stay re-usable**

Avoided environmental effects

- **CO₂-emission 30 % reduction**
- **Less biomass to dumps**
- **Savings on primary minerals**
 - **Coal**
 - **Lime stone**
 - **Marl**

Avoided CO₂ emissions

	emission fossil CO ₂ (kton)	
	average package	worst case package
Reference	1255¹⁾	1255¹⁾
Future		
Coal	835	851
Natural gas	37+	37+
Total Future	872 -/-	888 -/-
Avoided CO₂	383	367

¹⁾ 1249 kton from coal and 6 kton from lime stone

Calculated Chimney Emissions

	reference	average package	worst case package
tons/year			
SO ₂	489,5	507,5	879,3
NO _x (syngas + nat.gasbedrijf)	240+79	265+79	309+132
dust	9,3	9,3	15
HCl	0,4	0,4	0,5
HF	0,4	0,4	0,5
CO	15,5	15,5	71
C _x H _y	18	19	99
kg/year			
As	28,6	137,5	364,7
Ba	6,8	30,0	38,3
Be	0,1	0,1	0,3
Cd	0,0	0,9	2,8
Co	0,5	1,3	3,9
Cr	0,9	2,9	5,6
Cu	2,4	58,5	86,0
Hg	0,9	6,0	11,0
Mn	2,3	19,0	51,0
Mo	0,1	0,8	0,9
Ni	77,1	292,8	915,7
Pb	0,3	7,1	6,5
Sb	0,5	6,4	12,3
Se	7,0	22,1	48,2
Sn	2,5	17,7	48,2
Te	0,5	6,5	13,7
V	0,8	1,0	2,1
Zn	2,1	65,4	152,4