



*BioGasols demonstration facility
at Aakirkeby, Bornholm, Denmark*

**Project Presentation
Public Version**

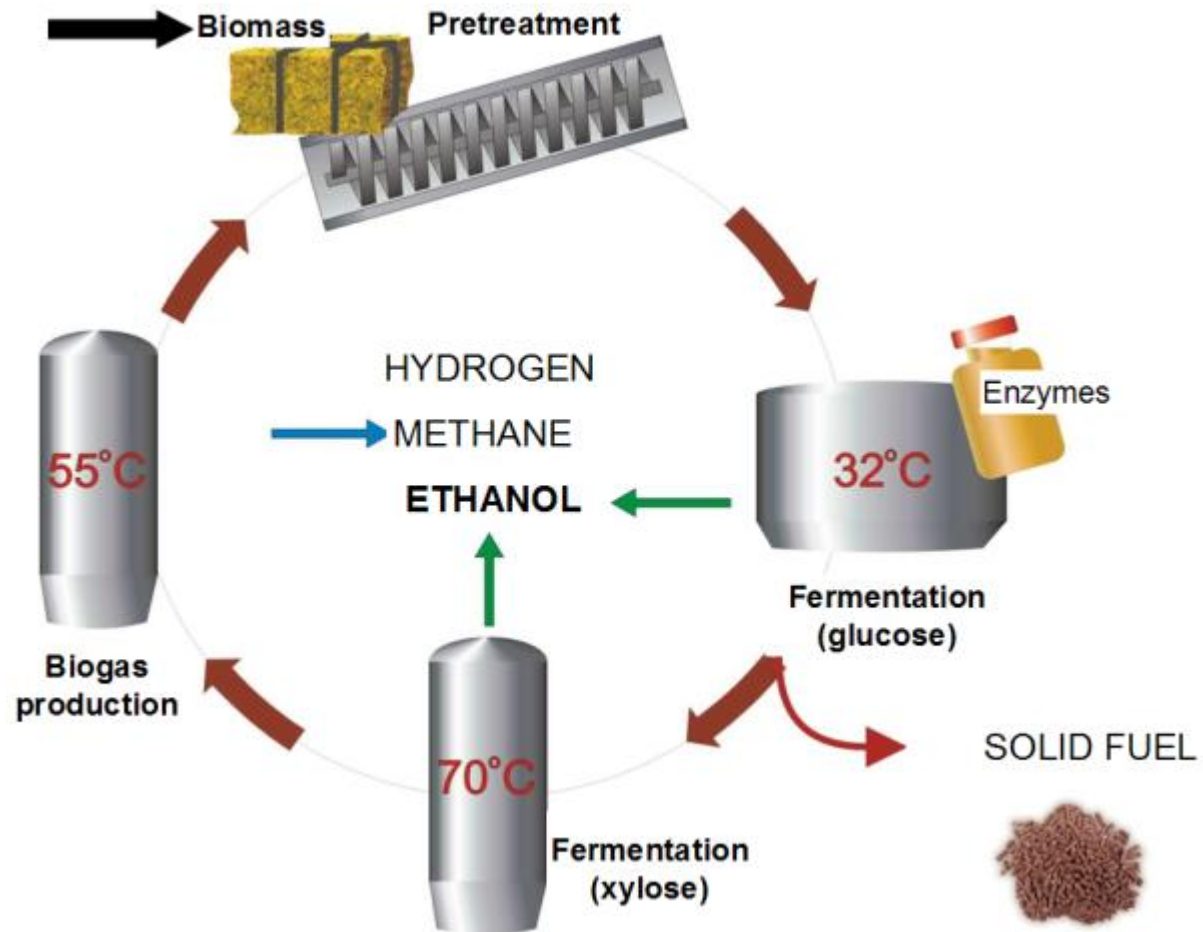


December 2008

1	Concept → Process
2	Plant & layout
3	Location & biomass
4	Organisation
5	Project Execution (Schedule, Budget etc.)

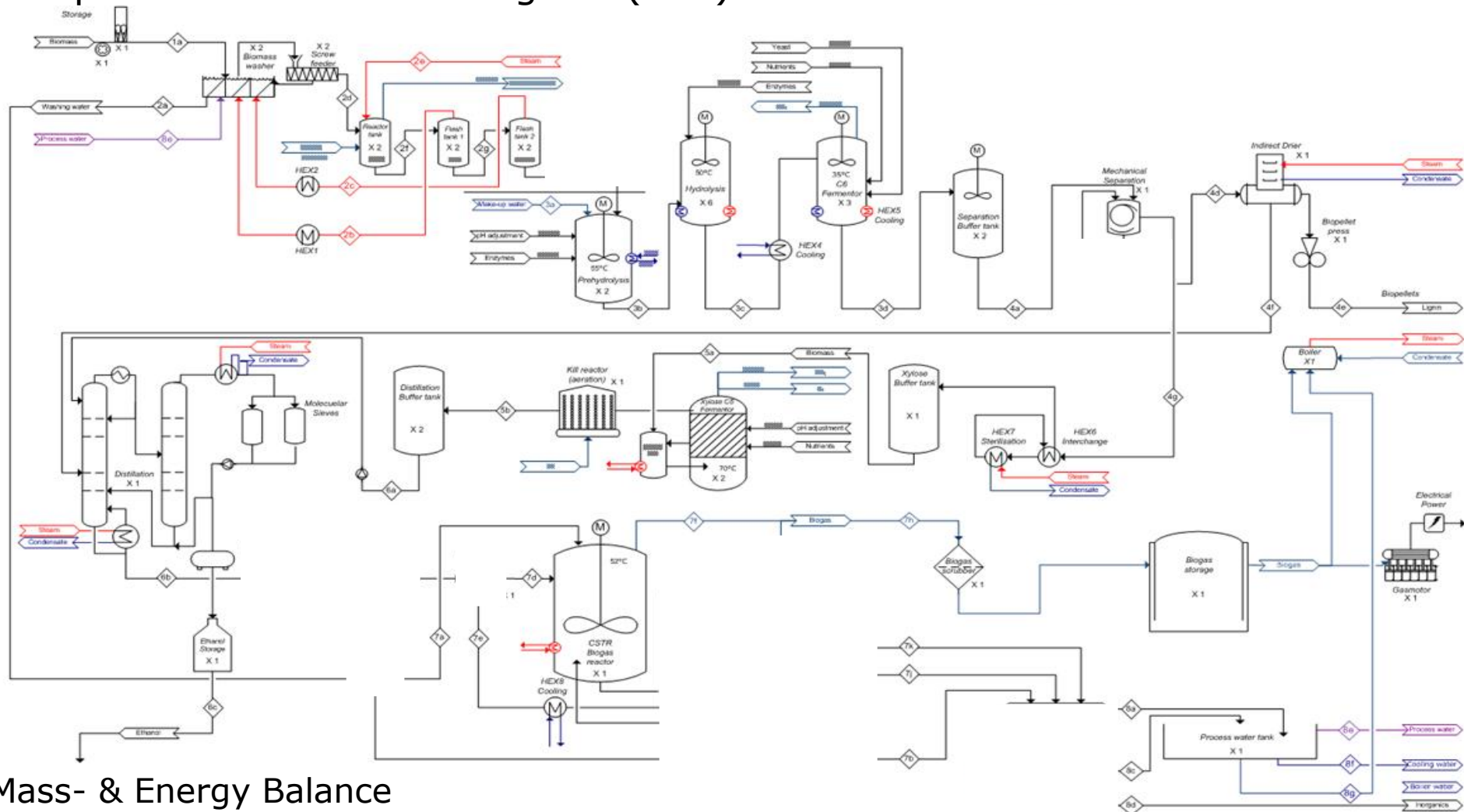
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The "Maxifuel" Concept



= The DTU Pilot plant, in operation 2006-2008

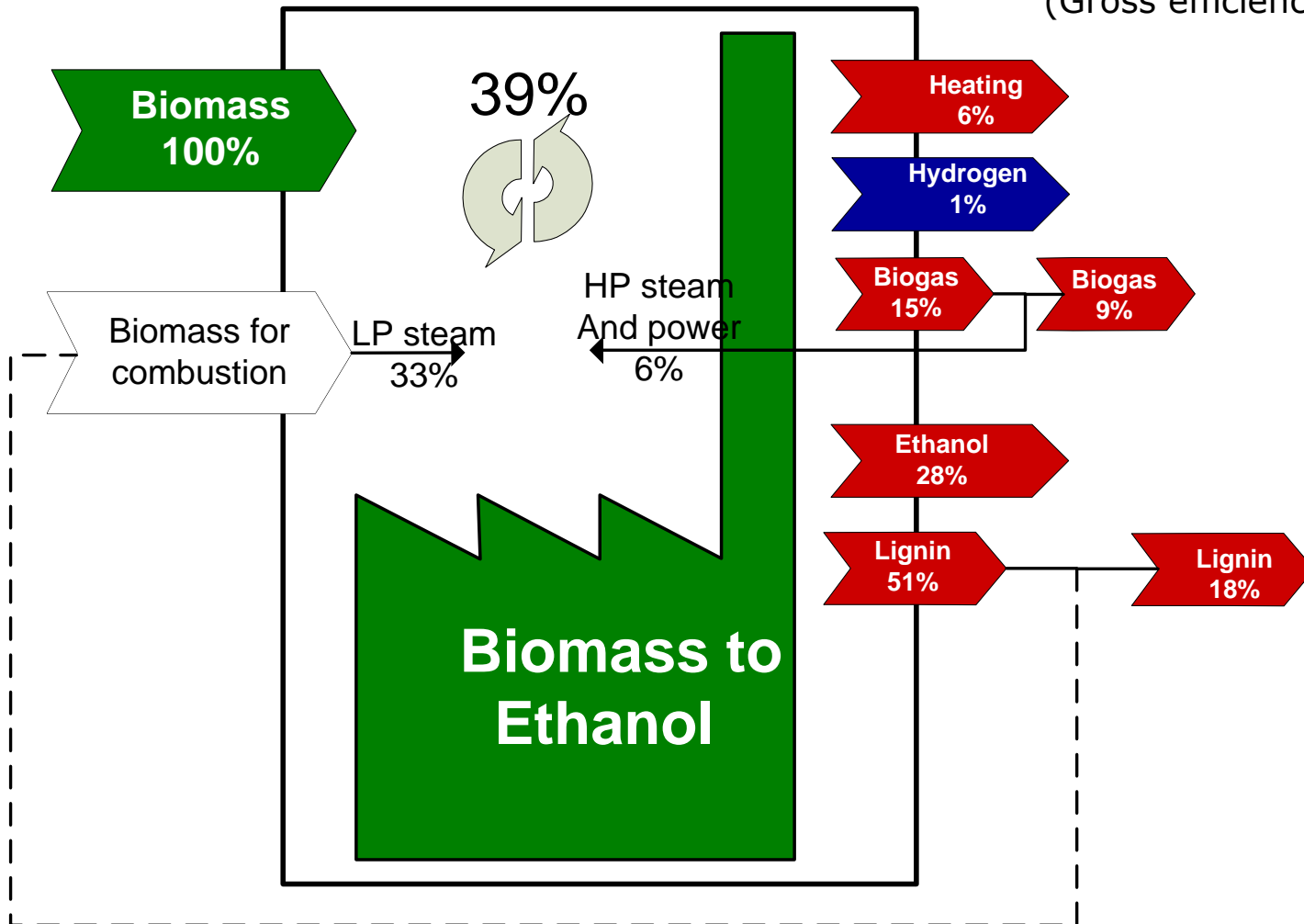
Mass- & Energy Balance



STREAM NUMBER	1a	2a	2b	2c	2d	2e	2f	2g	2h	2i	2j	2k	2l	2m	2n	2o	2p	2q	2r	2s	2t	2u	2v	2w	2x	2y	2z	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k	3l	3m	3n	3o	3p	3q	3r	3s	3t	3u	3v	3w	3x	3y	3z	4a	4b	4c	4d	4e	4f	4g	4h	4i	4j	4k	4l	4m	4n	4o	4p	4q	4r	4s	4t	4u	4v	4w	4x	4y	4z	5a	5b	5c	5d	5e	5f	5g	5h	5i	5j	5k	5l	5m	5n	5o	5p	5q	5r	5s	5t	5u	5v	5w	5x	5y	5z	6a	6b	6c	6d	6e	6f	6g	6h	6i	6j	6k	6l	6m	6n	6o	6p	6q	6r	6s	6t	6u	6v	6w	6x	6y	6z	7a	7b	7c	7d	7e	7f	7g	7h	7i	7j	7k	7l	7m	7n	7o	7p	7q	7r	7s	7t	7u	7v	7w	7x	7y	7z	8a	8b	8c	8d	8e	8f	8g	8h	8i	8j	8k	8l	8m	8n	8o	8p	8q	8r	8s	8t	8u	8v	8w	8x	8y	8z	9a	9b	9c	9d	9e	9f	9g	9h	9i	9j	9k	9l	9m	9n	9o	9p	9q	9r	9s	9t	9u	9v	9w	9x	9y	9z	10a	10b	10c	10d	10e	10f	10g	10h	10i	10j	10k	10l	10m	10n	10o	10p	10q	10r	10s	10t	10u	10v	10w	10x	10y	10z	11a	11b	11c	11d	11e	11f	11g	11h	11i	11j	11k	11l	11m	11n	11o	11p	11q	11r	11s	11t	11u	11v	11w	11x	11y	11z	12a	12b	12c	12d	12e	12f	12g	12h	12i	12j	12k	12l	12m	12n	12o	12p	12q	12r	12s	12t	12u	12v	12w	12x	12y	12z	13a	13b	13c	13d	13e	13f	13g	13h	13i	13j	13k	13l	13m	13n	13o	13p	13q	13r	13s	13t	13u	13v	13w	13x	13y	13z	14a	14b	14c	14d	14e	14f	14g	14h	14i	14j	14k	14l	14m	14n	14o	14p	14q	14r	14s	14t	14u	14v	14w	14x	14y	14z	15a	15b	15c	15d	15e	15f	15g	15h	15i	15j	15k	15l	15m	15n	15o	15p	15q	15r	15s	15t	15u	15v	15w	15x	15y	15z	16a	16b	16c	16d	16e	16f	16g	16h	16i	16j	16k	16l	16m	16n	16o	16p	16q	16r	16s	16t	16u	16v	16w	16x	16y	16z	17a	17b	17c	17d	17e	17f	17g	17h	17i	17j	17k	17l	17m	17n	17o	17p	17q	17r	17s	17t	17u	17v	17w	17x	17y	17z	18a	18b	18c	18d	18e	18f	18g	18h	18i	18j	18k	18l	18m	18n	18o	18p	18q	18r	18s	18t	18u	18v	18w	18x	18y	18z	19a	19b	19c	19d	19e	19f	19g	19h	19i	19j	19k	19l	19m	19n	19o	19p	19q	19r	19s	19t	19u	19v	19w	19x	19y	19z	20a	20b	20c	20d	20e	20f	20g	20h	20i	20j	20k	20l	20m	20n	20o	20p	20q	20r	20s	20t	20u	20v	20w	20x	20y	20z	21a	21b	21c	21d	21e	21f	21g	21h	21i	21j	21k	21l	21m	21n	21o	21p	21q	21r	21s	21t	21u	21v	21w	21x	21y	21z	22a	22b	22c	22d	22e	22f	22g	22h	22i	22j	22k	22l	22m	22n	22o	22p	22q	22r	22s	22t	22u	22v	22w	22x	22y	22z	23a	23b	23c	23d	23e	23f	23g	23h	23i	23j	23k	23l	23m	23n	23o	23p	23q	23r	23s	23t	23u	23v	23w	23x	23y	23z	24a	24b	24c	24d	24e	24f	24g	24h	24i	24j	24k	24l	24m	24n	24o	24p	24q	24r	24s	24t	24u	24v	24w	24x	24y	24z	25a	25b	25c	25d	25e	25f	25g	25h	25i	25j	25k	25l	25m	25n	25o	25p	25q	25r	25s	25t	25u	25v	25w	25x	25y	25z	26a	26b	26c	26d	26e	26f	26g	26h	26i	26j	26k	26l	26m	26n	26o	26p	26q	26r	26s	26t	26u	26v	26w	26x	26y	26z	27a	27b	27c	27d	27e	27f	27g	27h	27i	27j	27k	27l	27m	27n	27o	27p	27q	27r	27s	27t	27u	27v	27w	27x	27y	27z	28a	28b	28c	28d	28e	28f	28g	28h	28i	28j	28k	28l	28m	28n	28o	28p	28q	28r	28s	28t	28u	28v	28w	28x	28y	28z	29a	29b	29c	29d	29e	29f	29g	29h	29i	29j	29k	29l	29m	29n	29o	29p	29q	29r	29s	29t	29u	29v	29w	29x	29y	29z	30a	30b	30c	30d	30e	30f	30g	30h	30i	30j	30k	30l	30m	30n	30o	30p	30q	30r	30s	30t	30u	30v	30w	30x	30y	30z	31a	31b	31c	31d	31e	31f	31g	31h	31i	31j	31k	31l	31m	31n	31o	31p	31q	31r	31s	31t	31u	31v	31w	31x	31y	31z	32a	32b	32c	32d	32e	32f	32g	32h	32i	32j	32k	32l	32m	32n	32o	32p	32q	32r	32s	32t	32u	32v	32w	32x	32y	32z	33a	33b	33c	33d	33e	33f	33g	33h	33i	33j	33k	33l	33m	33n	33o	33p	33q	33r	33s	33t	33u	33v	33w	33x	33y	33z	34a	34b	34c	34d	34e	34f	34g	34h	34i	34j	34k	34l	34m	34n	34o	34p	34q	34r	34s	34t	34u	34v	34w	34x	34y	34z	35a	35b	35c	35d	35e	35f	35g	35h	35i	35j	35k	35l	35m	35n	35o	35p	35q	35r	35s	35t	35u	35v	35w	35x	35y	35z	36a	36b	36c	36d	36e	36f	36g	36h	36i	36j	36k	36l	36m	36n	36o	36p	36q	36r	36s	36t	36u	36v	36w	36x	36y	36z	37a	37b	37c	37d	37e	37f	37g	37h	37i	37j	37k	37l	37m	37n	37o	37p	37q	37r	37s	37t	37u	37v	37w	37x	37y	37z	38a	38b	38c	38d	38e	38f	38g	38h	38i	38j	38k	38l	38m	38n	38o	38p	38q	38r	38s	38t	38u	38v	38w	38x	38y	38z	39a	39b	39c	39d	39e	39f	39g	39h	39i	39j	39k	39l	39m	39n	39o	39p	39q	39r	39s	39t	39u	39v	39w	39x	39y	39z	40a	40b	40c	40d	40e	40f	40g	40h	40i	40j	40k	40l	40m	40n	40o	40p	40q	40r	40s	40t	40u	40v	40w	40x	40y	40z	41a	41b	41c	41d	41e	41f	41g	41h	41i	41j	41k	41l	41m	41n	41o	41p	41q	41r	41s	41t	41u	41v	41w	41x	41y	41z	42a	42b	42c	42d	42e	42f	42g	42h	42i	42j	42k	42l	42m	42n	42o	42p	42q	42r	42s	42t	42u	42v	42w	42x	42y	42z	43a	43b	43c	43d	43e	43f	43g	43h	43i	43j	43k	43l	43m	43n	43o	43p	43q	43r	43s	43t	43u	43v	43w	43x	43y	43z	44a	44b	44c	44d	44e	44f	44g	44h	44i	44j	44k	44l	44m	44n	44o	44p	44q	44r	44s	44t	44u	44v	44w	44x	44y	44z	45a	45b	45c	45d	45e	45f	45g	45h	45i	45j	45k	45l	45m	45n	45o	45p	45q	45r	45s	45t	45u	45v	45w	45x	45y	45z	46a	46b	46c	46d	46e	46f	46g	46h	46i	46j	46k	46l	46m	46n	46o	46p	46q	46r	46s	46t	46u	46v	46w	46x	46y	46z	47a	47b	47c	47d	47e	47f	47g	47h	47i	47j	47k	47l	47m	47n	47o	47p	47q	47r	47s	47t	47u	47v	47w	47x	47y	47z	48a	48b	48c	48d	48e	48f	48g	48h	48i	48j	48k	48l	48m	48n	48o	48p	48q	48r	48s	48t	48u	48v	48w	48x	48y	48z	49a	49b	49c	49d	49e	49f	49g	49h	49i	49j	49k	49l	49m	49n	49o	49p	49q	49r	49s	49t	49u	49v	49w	49x	49y	49z	50a	50b	50c	50d	50e	50f	50g	50h	50i	50j	50k	50l	50m	50n	50o	50p	50q	50r	50s	50t	50u	50v	50w	50x	50y	50z	51a	51b	51c	51d	51e	51f	51g	51h	51i	51j	51k	51l	51m	51n	51o	51p	51q	51r	51s	51t	51u	51v	51w	51x	51y	51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Energy balance [%]

Net efficiency = 62%
(Gross efficiency = 73%)



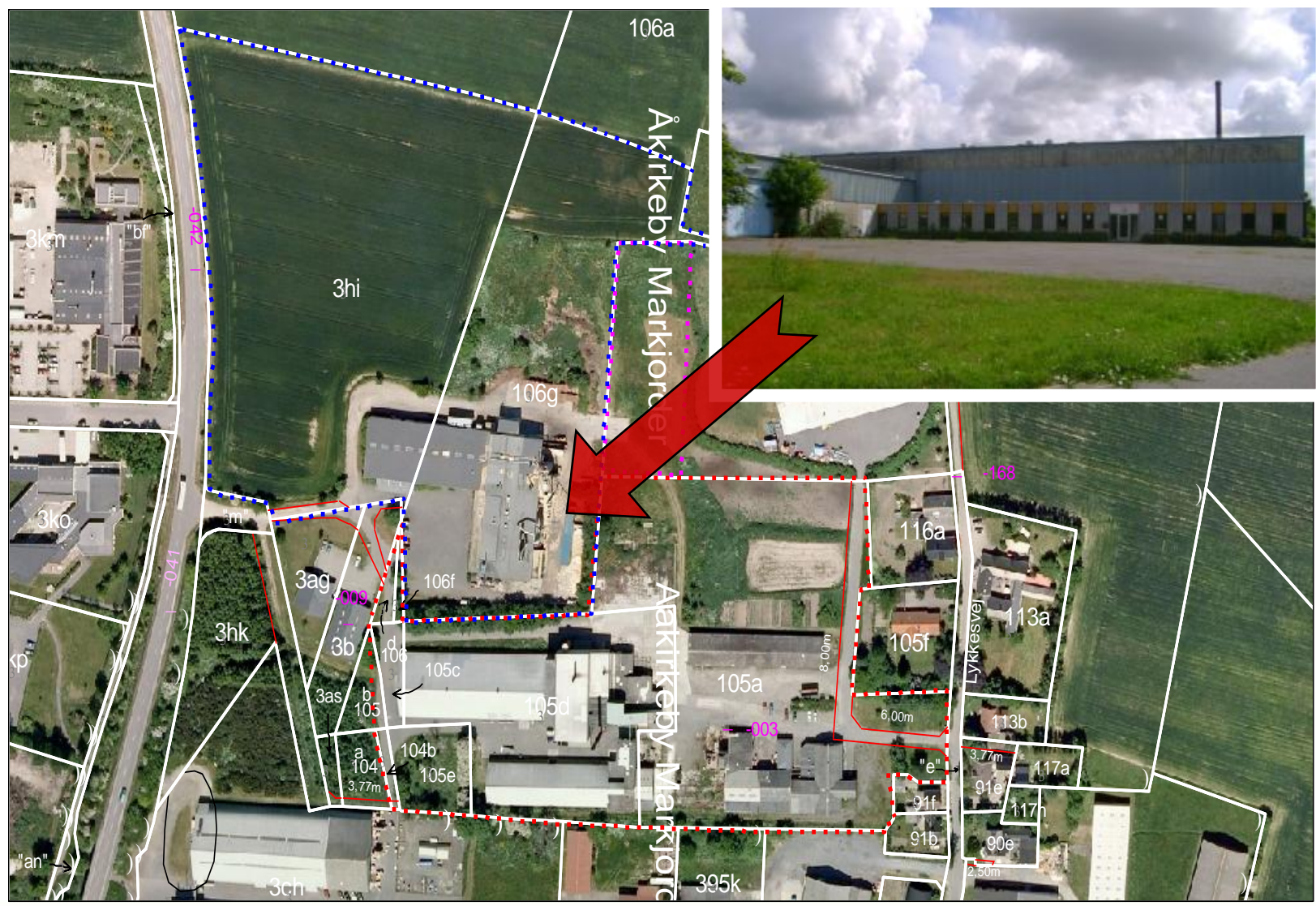
1	Concept → Process
2	Plant & layout
3	Location & biomass
4	Organisation
5	Project Execution (Schedule, Budget etc.)

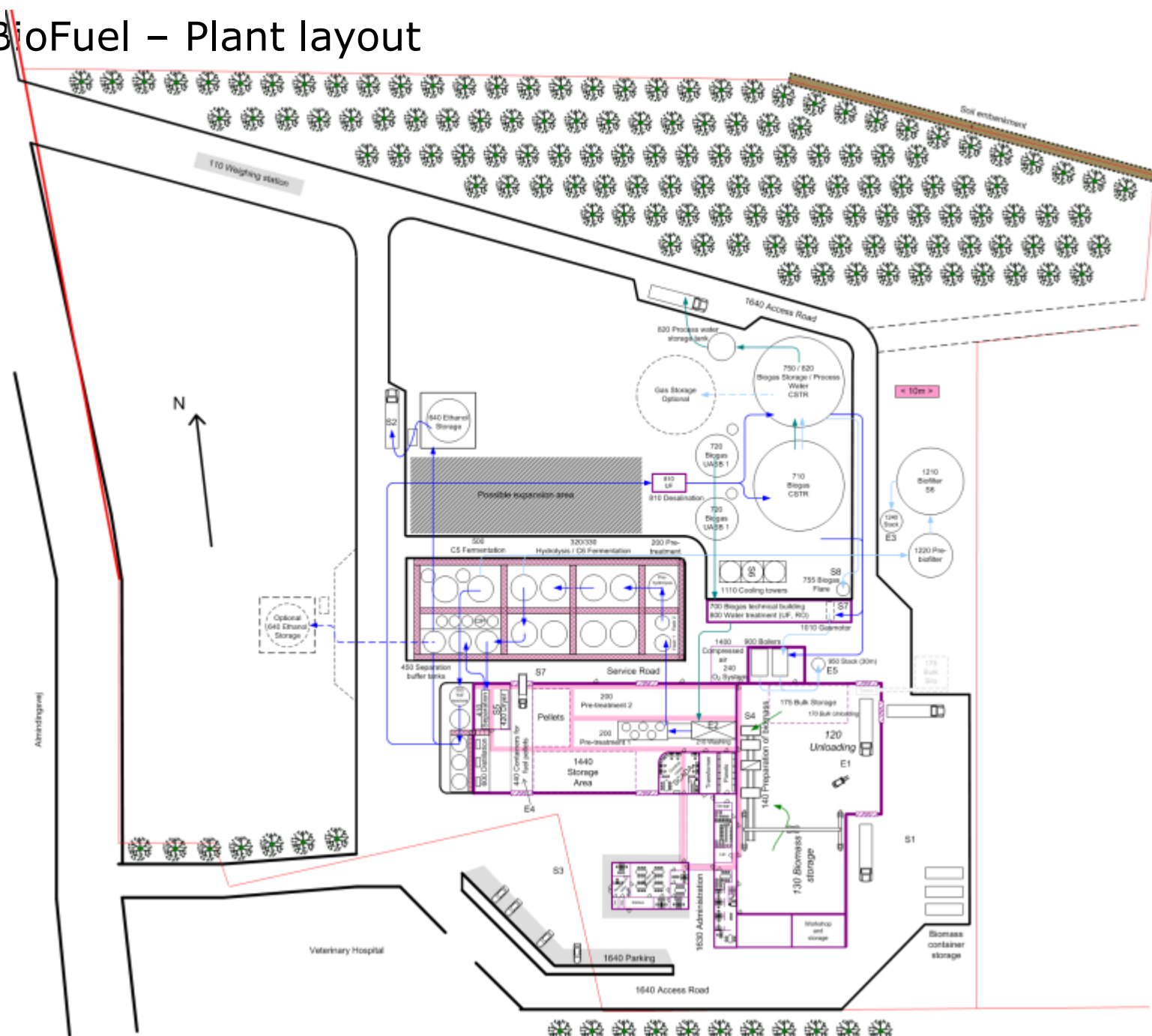
BornBioFuel – Plant key figures



- Capacity: 4t / hr (100% DM) → 5 million liters 2G Bio-ethanol pr. year
- Feedstock: Local ligno-cellulosic biomass: Various grasses, garden waste and straw
- Yearly operation: 7000hrs
- Demonstration plant
 - Test centre for technology developments at semi-industrial scale
 - Reduce technical and financial risk for future full-scale plants
 - Maturation and up-scaling of core technology
 - Feedstock flexibility
- Funding
 - 50% funded by Danish Government (EUDP / Danish Energy Authority)
 - In-kind financing by project partners (Suppliers)
 - Total cost approx. 35 mill. EUR
- BBF Phase 1 (BBF1) funding already in place
 - Approx. **8 mill. EUR** budget (of the total cost)
 - Objective: Development and up-scaling of core BioGasol technologies Pre-treatment and C5 fermentation. Reduce risk.
 - BBF1 Project duration: Jan. 2008 – June 2009
- BBF Phase 2 (BBF2) funding applied for (sept. 2008)
 - Approx. **27 mill. EUR** budget (of the total cost)
 - Applied for approx. 13 mill EUR (96 mill. DKK)
 - Objective: Integration of core BioGasol technologies into a complete plant, in order to demonstrated technical feasibility and reduce risk for future full scale developments
 - BBF2 Project duration: April 2009 – June 2011

BornBioFuel – Aakirkeby Site



[illegible]

BornBioFuel – Plant layout



BornBioFuel – Plant layout



1	Concept → Process
2	Plant & layout
3	Location & biomass
4	Organisation
5	Project Execution (Schedule, Budget etc.)

BornBioFuel – Location Bornholm, Denmark

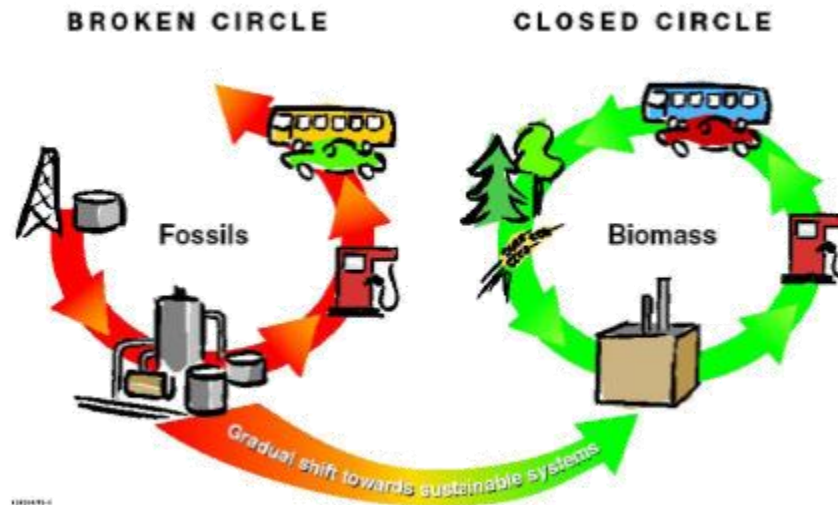


- 3 hrs by car from Copenhagen
- 30 min. by airplane (6 flights daily)

BornBioFuel – Why Bornholm???



- Biomass availability and diversity
- Island – 1% of the Danish population & 1% of the Danish landmass
- Size and location → ideal for demonstrating closed life cycle incl. CO₂



- "Green Island" profile – environmental awareness and eco-tourism
- Strong local community involvement and commitment towards supply
- Long agricultural tradition
- Cooperation with well established farmers organisation (Bornholms Landbrug), waste company (BOFA) and energy association (Østkraft)
- Synergies with:
 - Aakirkeby district heating to be installed 2009
 - "Green" electricity supply (Østkraft)
 - BioKraft biogas plant
 - Other...

BornBioFuel – Biomass availability



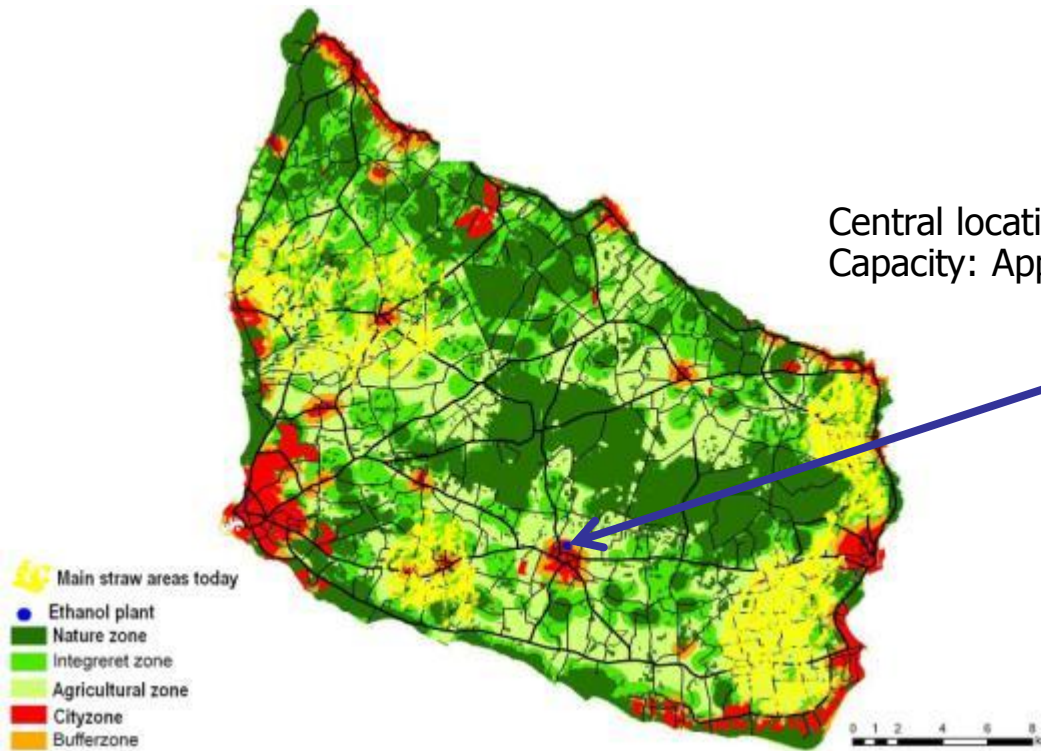
TOTAL	28.000 t DM/yr.	56% DM – approx. 50.000 t wet
Grasses	10.000 t DM/yr.	65% DM – approx. 15.000 t wet
Energy grass	5.000 t DM/yr.	65% DM – approx. 7.500 t wet
Garden waste	3.000 t DM/yr.	50% DM – approx. 6.000 t wet
Wet straw	10.000 t DM/yr.	80% DM – approx. 12.500 t wet

> 30.000ha of agricultural area

> 10.000ha of forrest area

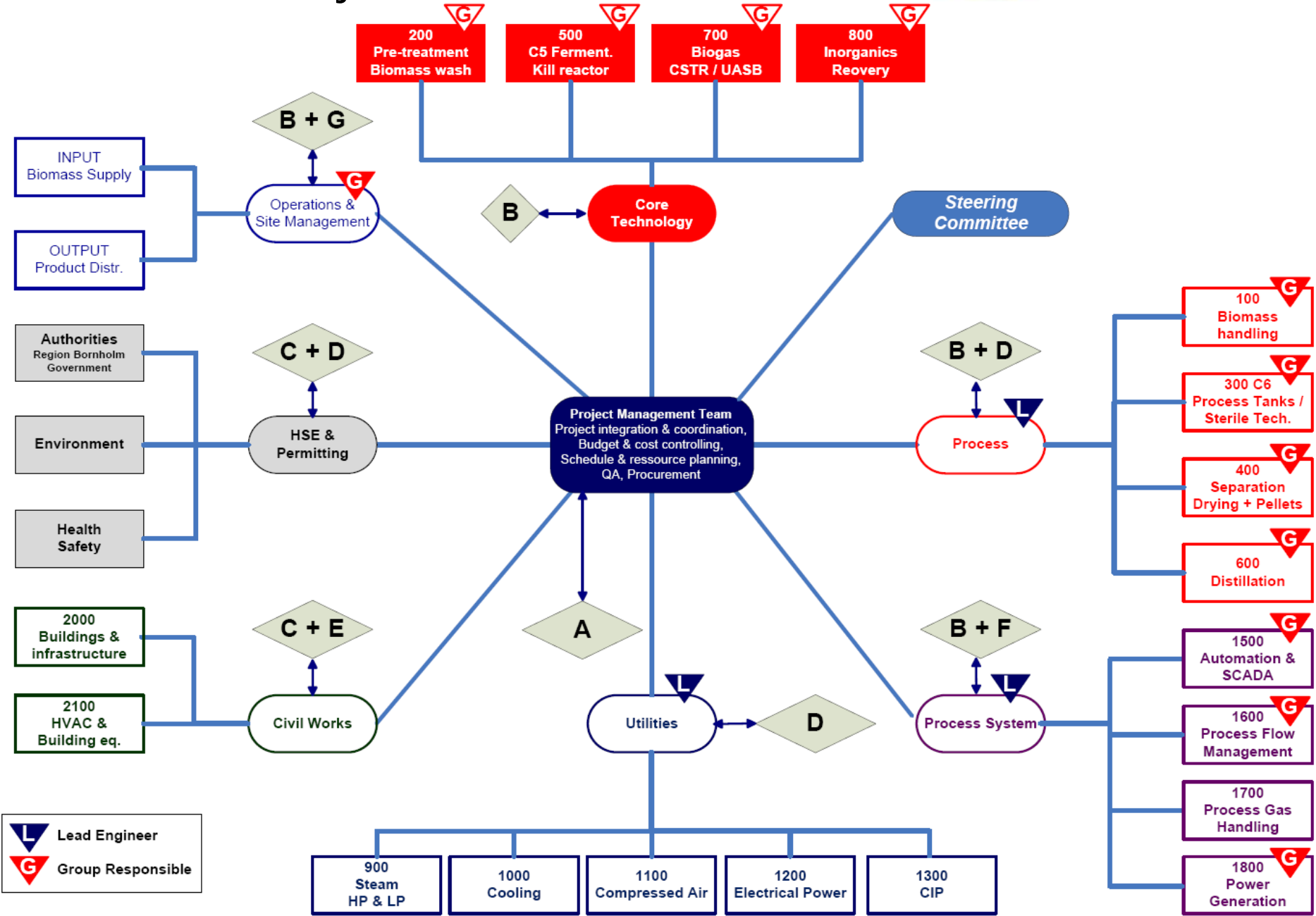
Central location of plant
Capacity: Approx. 4t DM / hour

Central location of plant



1	Concept → Process
2	Plant & layout
3	Location & biomass
4	Organisation
5	Project Execution (Schedule, Budget etc.)

BornBioFuel – Project Structure



BornBioFuel – Partners



SIEMENS

Automation, SCADA,
Drives, Electrical Power



Process equipment, Heat, Filtration
Exchangers, Separation



Pumping systems,
Dosing systems



Local power company
Biogas, Power Gen, Ressources

AgroTech

Institut for Jordbrugs-
& FødevareInnovation

Agriculture, Biomass,
Logistics, Harvesting,
Prediction

nne pharmaPlan®

Project Management, Process
Specialist, Procurement, QA

1	Concept → Process
2	Plant & layout
3	Location & biomass
4	Organisation
5	Project Execution (Schedule, Budget etc.)

BornBioFuel – Status, December 2008



- Project organisation / staffing **On hold**
- Project budget **OK**
- Project funding, phase 1 (BBF1) **OK**
- Project funding, phase 2 (BBF2) **Pending!**
- Project preparation (OBS, WBS etc.) **OK**

- Site procurement **OK**
- Site preparation
 - Demolition **OK**
 - Building renovation **OK**
 - Equipment constructions **On hold**
- Permitting & Authorities
 - Environmental permit **OK**
 - Local district plan **OK**
 - Demolition permit **OK**
 - Building permit **When needed**

- Tender material **OK for phase 1, In progress**
- Equipment vendor qualification **OK**
- Contracts issueing **In progress, Standby for phase 2**
- Conceptual Design **OK**
- Basic Design (P&IDs etc.) **OK for phase 1, Standby for phase 2**
- Detailed Design **In progress, Standby for phase 2**



- Fully integrated concept verified in pilot plant “Maxifuel”
- Redundant, parallel process flows → 2 “production lines”
- Production ramp-up in stages, 1 production line at a time
- Reduce risk by using prototype designs at pilot capacity (pre-treatment and C5 fermentation reactors – BBF1)
- Hydrolysis and C6 fermentation process similar to 1G (slow, biological processes)
- C5 fermentation based on UASB design known from biogas industry
- Flexible, modular design approach (stand-alone units)