Methanol Production by Gasification

INTEGRATED SINK ENHANCEMENT ASSESSMENT

I N S E A
P A R T N E R S

Spatially explicit analysis of bioenergy systems

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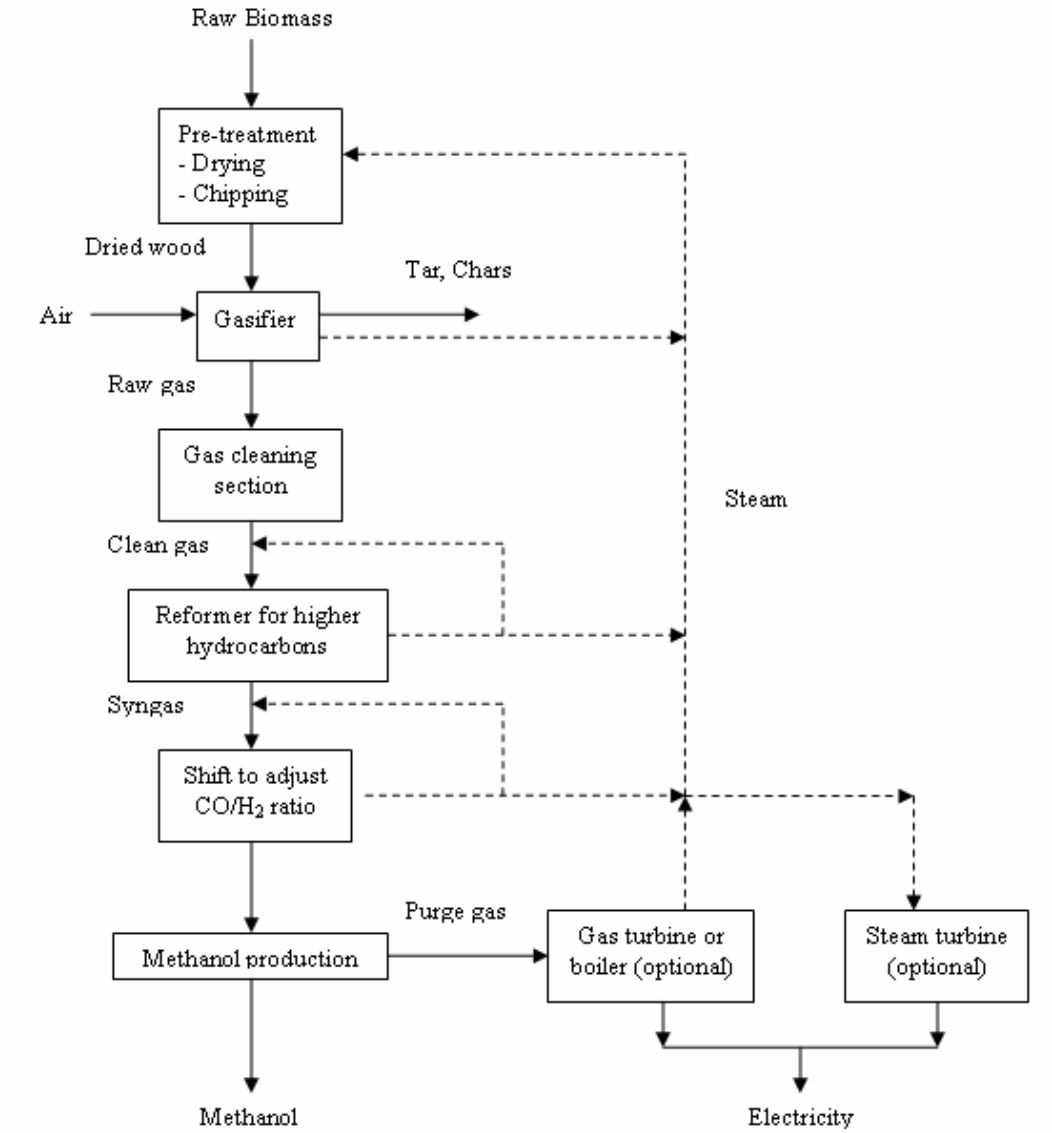
Issues

- Economies of Scale in Production
- Economic Geography and Transportation
- Polyproduction justifies smaller scales

Process


Raw Biomass
Pre-treatment
- Drying
- Chipping
Dried wood
Tar, Chars
Air
Gasifier
Raw gas
Gas cleaning section
Steam
Clean gas
Reformer for higher hydrocarbons
Syngas
Shift to adjust CO/H_2 ratio
Purge gas
Methanol production
Gas turbine or boiler (optional)
Steam turbine (optional)
Methanol
Electricity

Costs

Capital required	Description	M€$_{2003}$.
Engineering Fee	10% of PPC	18.475
Process Contingency (Using cont. listed)	2.345% of PPC	4.332
General plant facilities	10% PPC	18.475
Project Contingency	15% of (PPC +General plant facilities)	30.484
Total Plant Cost (TPC)		256.518
Adjustment for Interest and Inflation	0.34% PPC	0.6282
Total Plant Investment (TPI)		257
Prepaid Royalties	0.5% of PPC	0.924
Start-up Costs	2.7% TPI	6.943
Spare Parts	0.5% of TPC	1.286
Working Capital		12.857
Land, 200 Acres	200 Acres at 6,500 Euro / Acre	1.3
Total Capital Requirement (TCR)		280.46

Costs

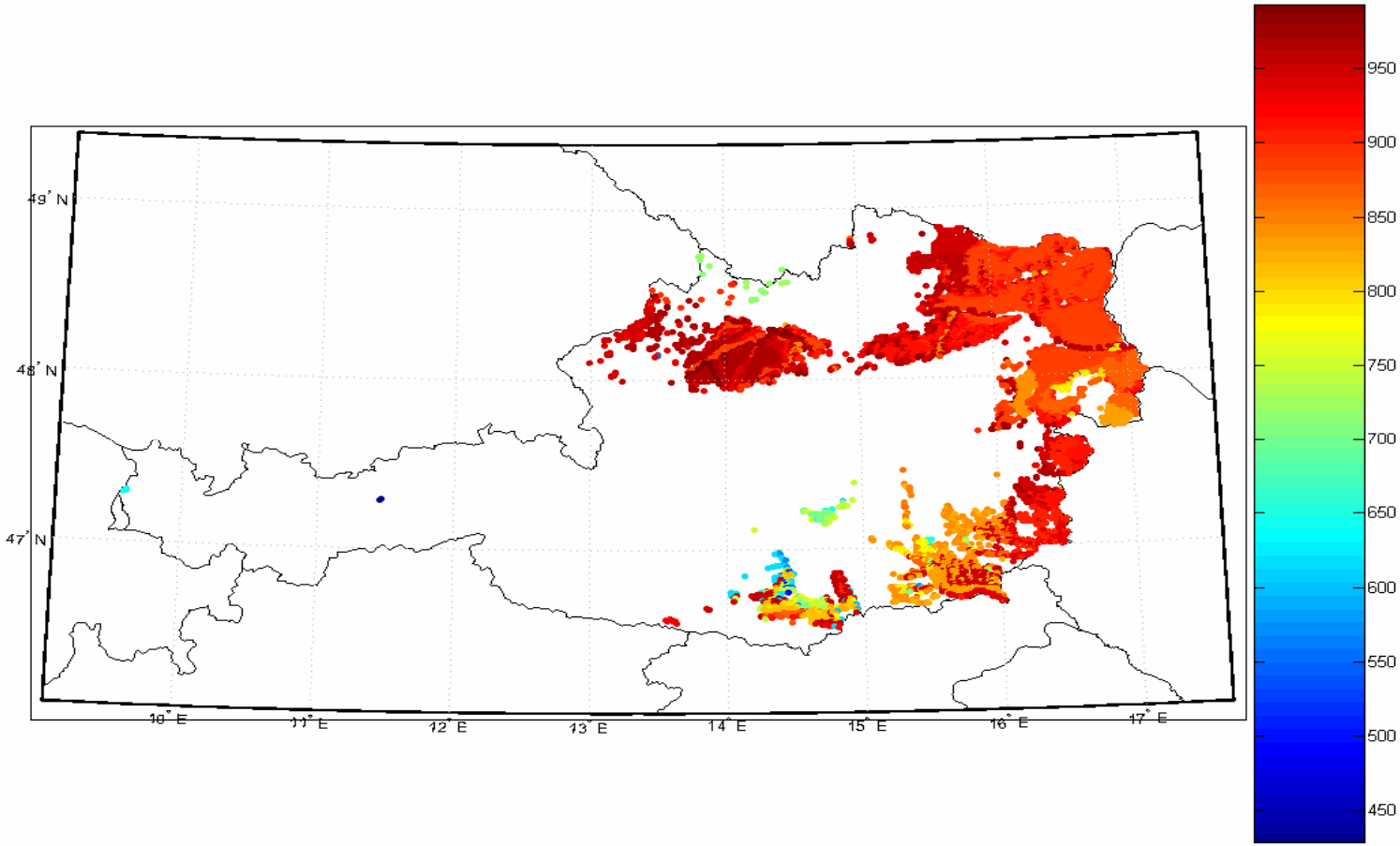
Operating and maintenance	Description	M€$_{2003}$.
Wood		61.783
Operator Labor	3% of TPI	7.714
Supervision and Clerical Labor	30% of O&M Labor	2.314
Maintenance Costs	2.2% of TPC	5.643
Insurance and Local Taxes	2% of TPC	5.130
Operating Royalties	1% of Wood Cost	0.6178
Miscellaneous Operating Costs	10% of O&M Labor	0.077
Net Operating Cost		88.424

Scenarios

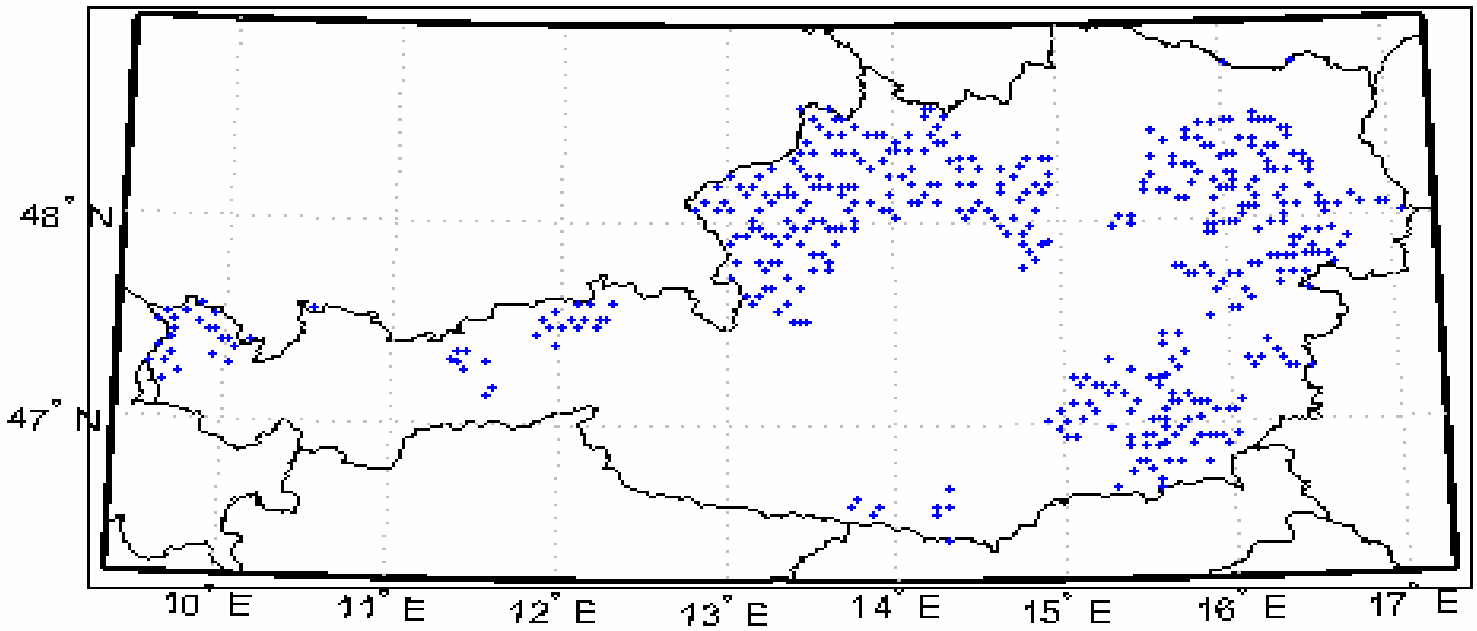
Scenario I:

Optimize Power Plant Location and Size
- Given Heat Demand function
- Given constant MeOH Price
- Given constant electricity price

Poplar Plantations from EPIC



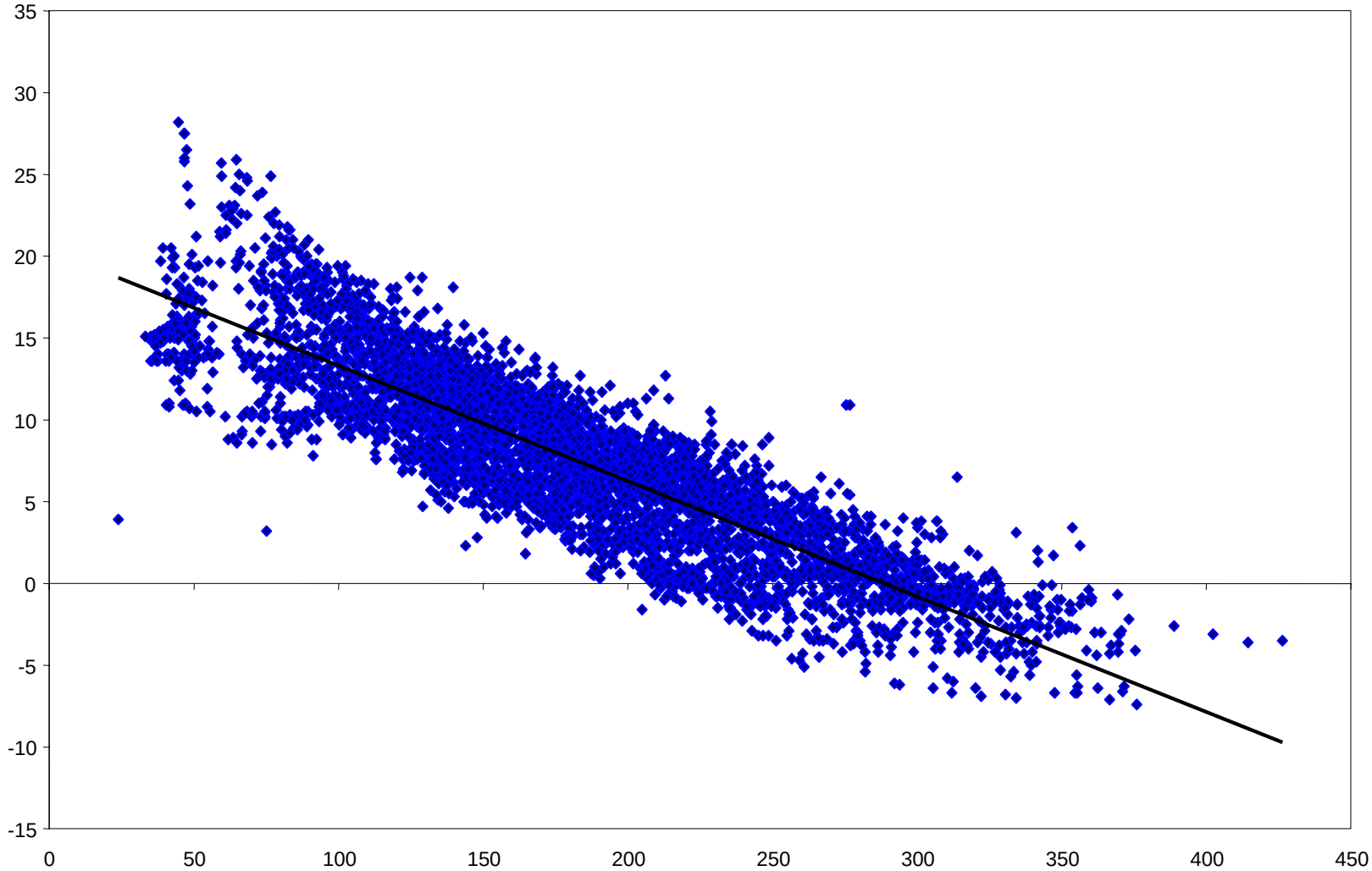
Gas Filling Stations



Heat demand features

- Time of day effect
- Weekend/weekday effect
- Seasonal effects
- Time varying volatility

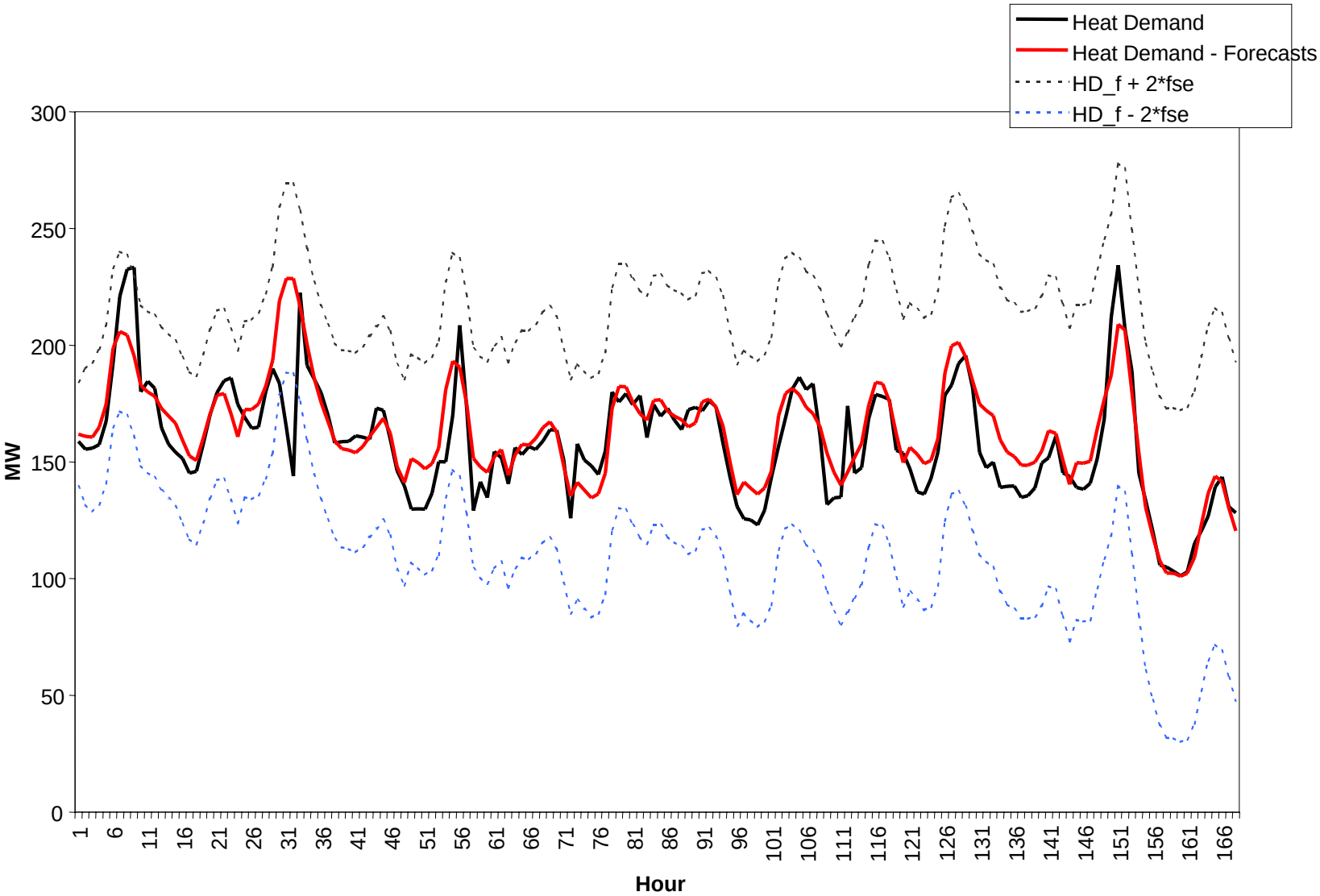
Heat demand vs. outside temperature



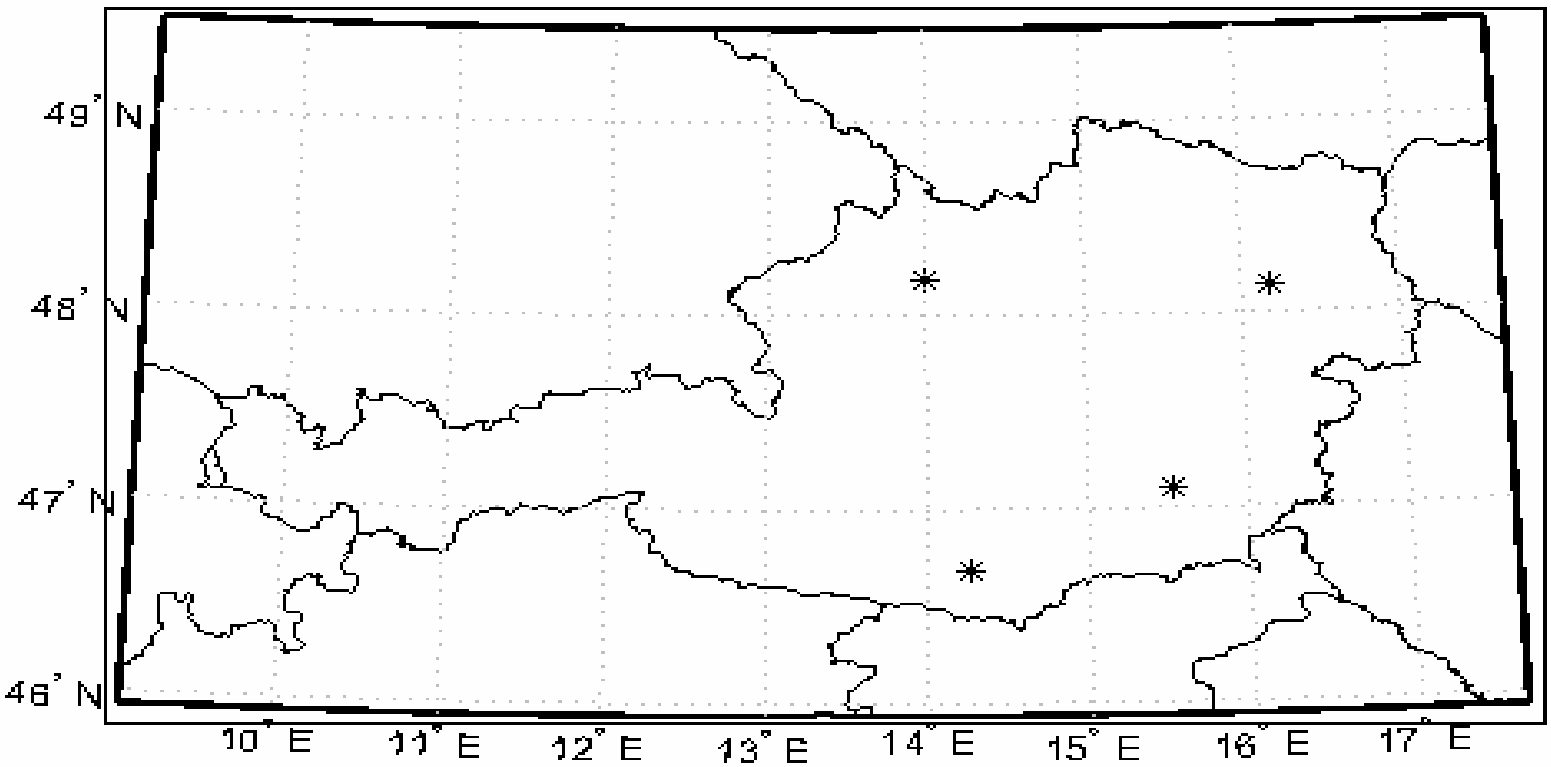
Summary of the time-series models

Description of the model	Abbreviation
Global models	
no temperature	
ARMA on HD	M1
ARMA on log HD	M2
SARMA on HD	M3
with temperature	
ARMAX on HD	M4
ARMAX on log HD	M5
SARMAX on HD	M6
SARIMAX on HD	M7
non-linear SARIMAX on HD	
with structural temperature of lag 0	M8
non-linear SARIMAX on HD	
with structural temperature of lags 0 and 1	M9
SARIMAX on log HD	M10
non-linear SARIMAX on log HD	
with structural temperature of lag 0	M11
non-linear SARIMAX on log HD	
with structural temperature of lags 0 and 1	M12
Separable models	
no temperature	
ARMA on HD	M13
ARMA on log HD	M14
ARIMA on HD	M15
ARIMA on log HD	M16
time varying coefficient model on HD	M17
with temperature	
ARMAX on HD	M18
ARMAX on log HD	M19
ARIMAX on HD	M20
ARIMAX on log HD	M21
non-linear ARIMAX on HD	
with structural temperature of lag 0	M22
non-linear ARMAX on HD	
with structural temperature of lag 0	M23
time varying coefficient model on HD	M24

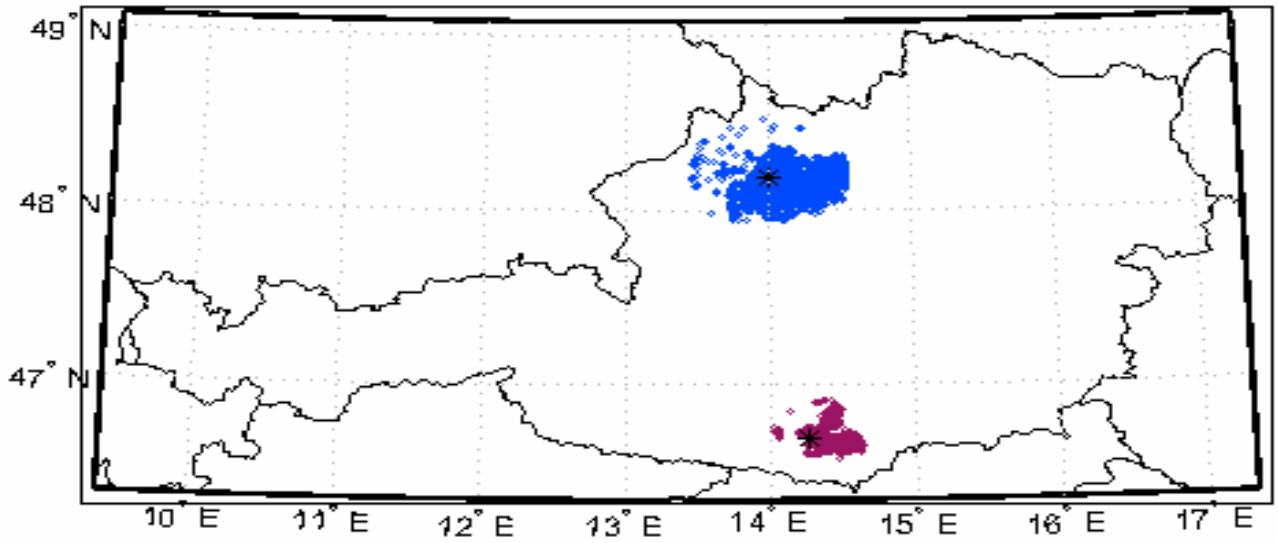
1-week ahead forecasts of heat demand by M9 (17-23 April)



Potential Locations (incl. heat demand)



Optimal Locations&Size



Longitude	Latitude	Size ($MW_{biomass}$)	Efficiency	Economical lifetime	Interest rate	Load hours	Methanol sold (m3)	Area (ha)	Gas stations
14	48,19	240,4	0,45	20	0,1	7800	192478	39675	386
14,27	46,69	50,0	0,4	20	0,1	7200	32850	9100	66

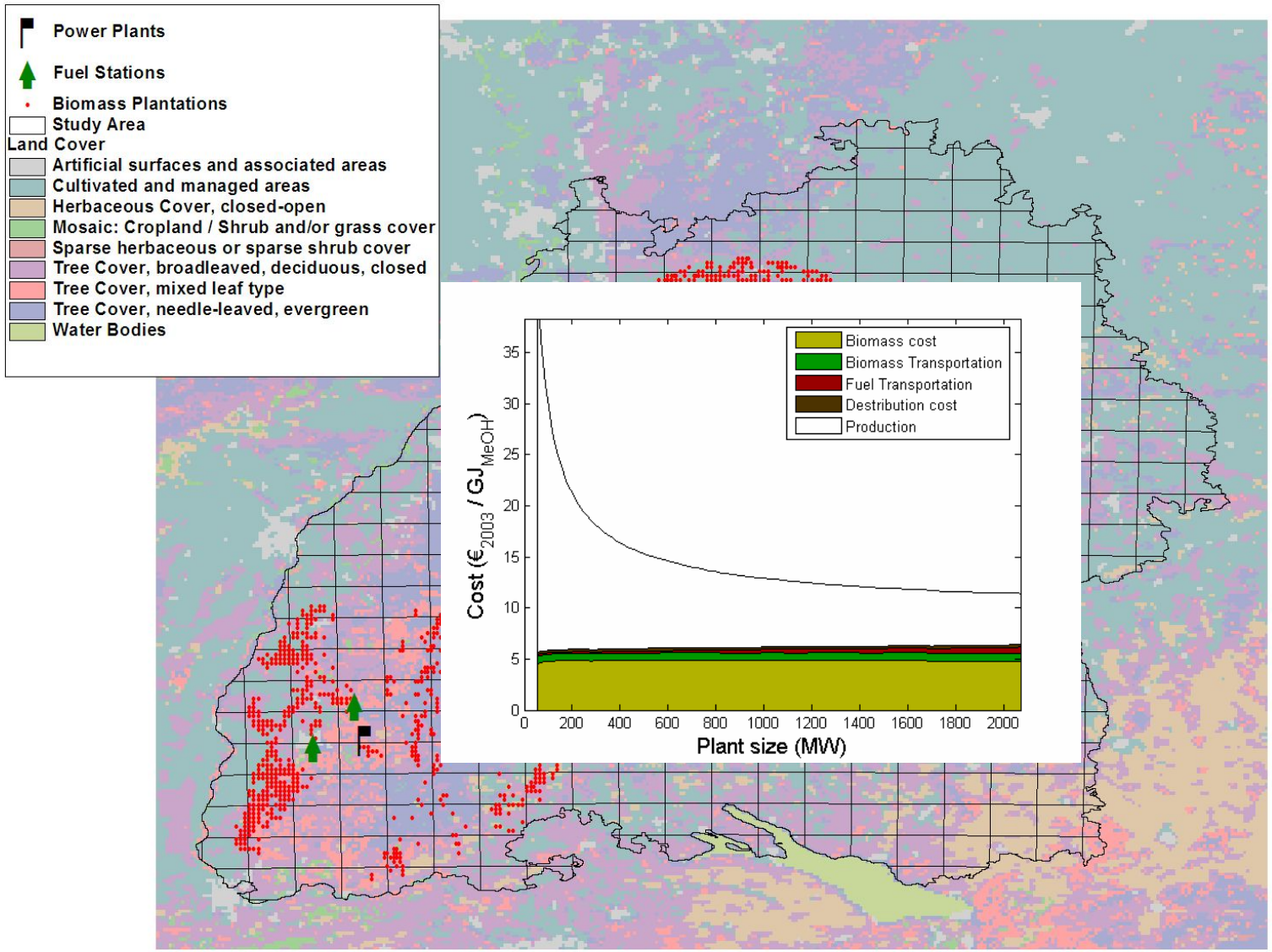
Scenarios

Scenario II:

Find Optimal Size&Location

- 10% Car Fleet,
- 25ha Plantation / 100ha

Plant Size


Power Plants
Fuel Stations
Biomass Plantations
Study Area
Land Cover
Artificial surfaces and associated areas
Cultivated and managed areas
Herbaceous Cover, closed-open
Mosaic: Cropland / Shrub and/or grass cover
Sparse herbaceous or sparse shrub cover
Tree Cover, broadleaved, deciduous, closed
Tree Cover, mixed leaf type
Tree Cover, needle-leaved, evergreen
Water Bodies
Biomass cost
Biomass Transportation
Fuel Transportation
Destribution cost
Production
Cost (€2003 / GJMeOH)
Plant size (MW)
0
5
10
15
20
25
30
35
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Future Work

- Ligno-cellolosic Ethanol production
- DME
- Fischer-Tropsch Diesel

- Global Application
- Stochastic Investment Calculus (Real Options Deliverable)