SMARt CHP
Biomass energy

Demonstration of a **S**mall scale **M**obile **A**gricultural **R**esidue decen**t**ralized **C**ombined **H**eat and **P**ower unit

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Roadmap to 2020: Focus on Investment and Technologies

Biomass Group
LABORATORY OF CHEMICAL PROCESS AND PLANT DESIGN

Ε.Α.Σ. ΑΜΥΝΤΑΙΟΥ
από το 1946

http://smartchp.eng.auth.gr

Project overview

- ✓ Duration: 1/1/2010 – 31/12/2012
- ✓ Budget: 947,287 € (EC co-funding: 47.52%)
- ✓ Location: Thessaloniki & W. Macedonia

Project's Aims

- ❑ Technology application in real conditions
- ❑ Promotion to local actors & entrepreneurs
- ❑ Biomass energy potential evaluation

The team

Aristotle University of Thessaloniki

- Laboratory of Applied Thermodynamics
  - Prof. Z. Samaras – Leader
- Laboratory of Chemical Process and Plant Design
  - Ass. Prof. A. Zabaniotou – Vice Leader

District Heating Company of Ptolemaida

- D. Kalaitzidou, N. Petridis, Th. Chatziavgoustis

Union of Agricultural Cooperative of Amyntaion

- P. Papadopoulou, Th. Chatziavgoustis

Project Actions

- ✓ Regional biomass availability profile
  - ☐ Detailed survey of generated agricultural residue streams in the region of Western Macedonia & estimation of selected species' suitability for gasification
- ✓ SMARt – CHP unit development
  - ☐ Design and manufacture of a 5kWel/12kWth mobile unit which consists of a gasifier combined with a power generator set
- ✓ Demonstrative operation
  - ☐ Demonstrative operation at 4 locations for 2 weeks each & preparation of a report concerning technical and administrative aspects
- ✓ Demonstration results & sustainability analysis
  - ☐ Evaluation of system performance and highlight of technical and administrative obstacles
- ✓ Dissemination of project issues and results
  - ☐ Create awareness about the project results through high publicity events and documentation

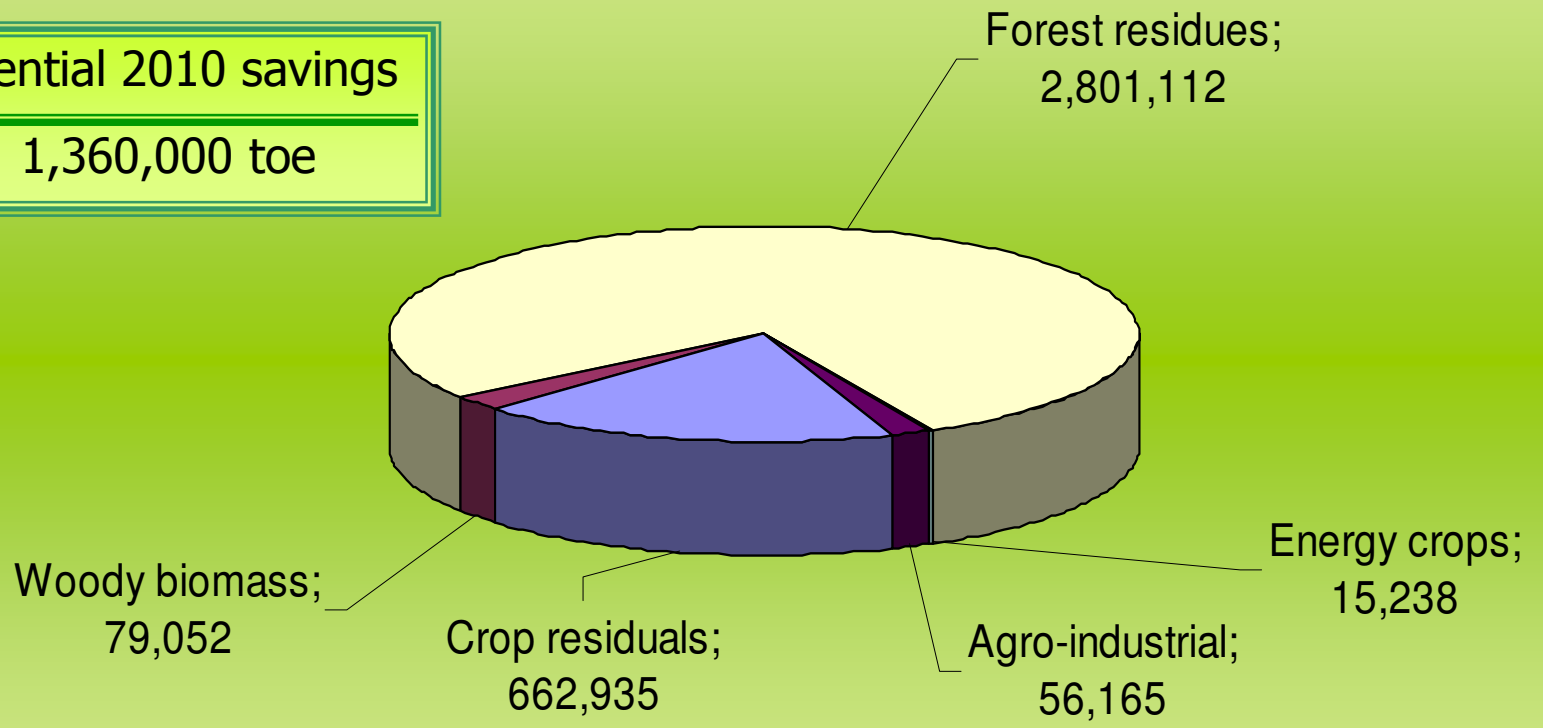
Expected results

- ✓ Technical & management issues unravelling
- ✓ Residual utilisation potential promotion to stakeholders and target groups
- ✓ Knowledge transfer between beneficiaries, target groups & key players
- ✓ SMARt-CHP debate initiation
- ✓ Increase general public awareness
- ✓ Promotion & development of SMARt-CHP units

Residual biomass in W. Macedonia

2009 Residual biomass in W. Macedonia (tn)

Potential 2010 savings
1,360,000 toe

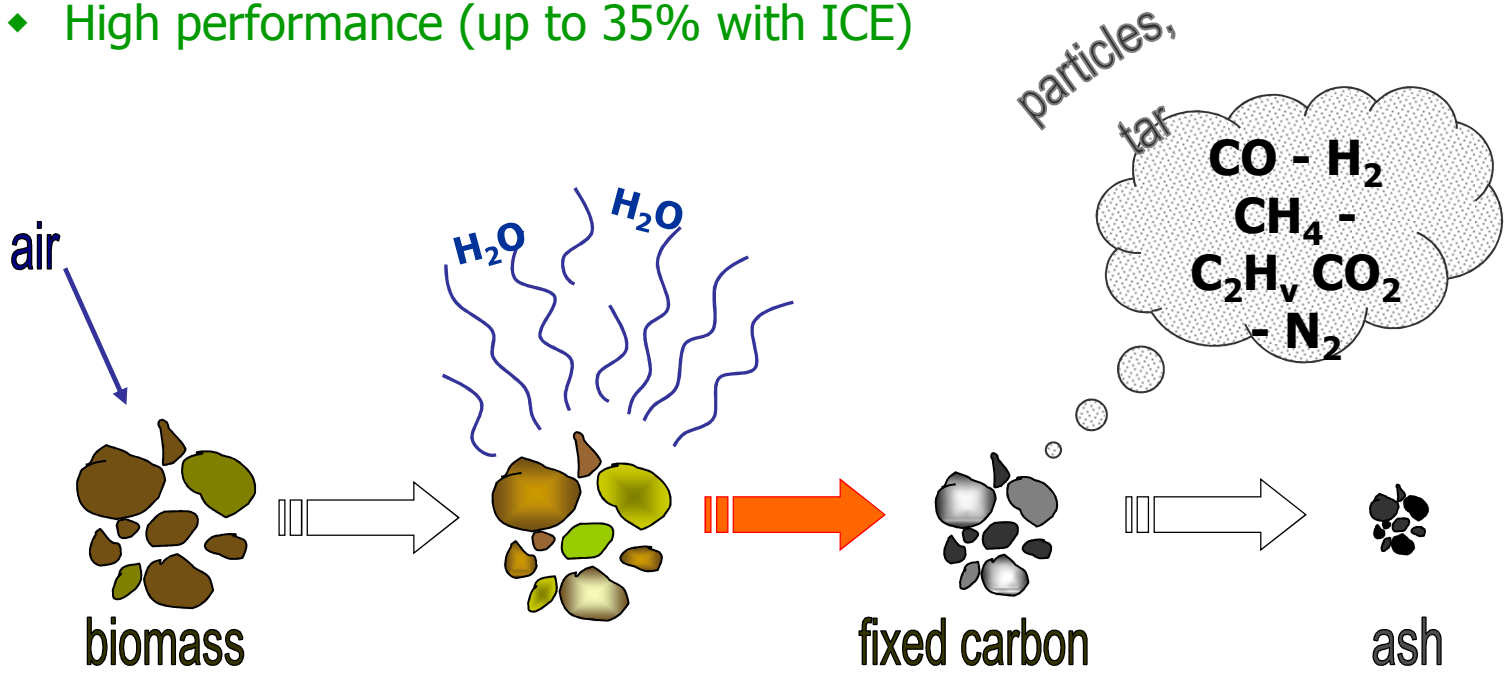


What happens to residual biomass?

- ✓ Combustion to produce heat
- ✓ Discard – burn on the field
- ✓ Heating product (e.g. olive kernels)
- ✓ High quality organic fertilizers
- ✓ Activated carbon production
- ✓ Animal food

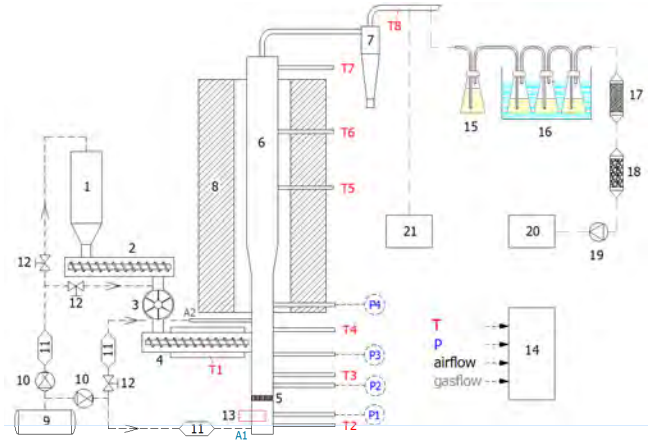
Gasification

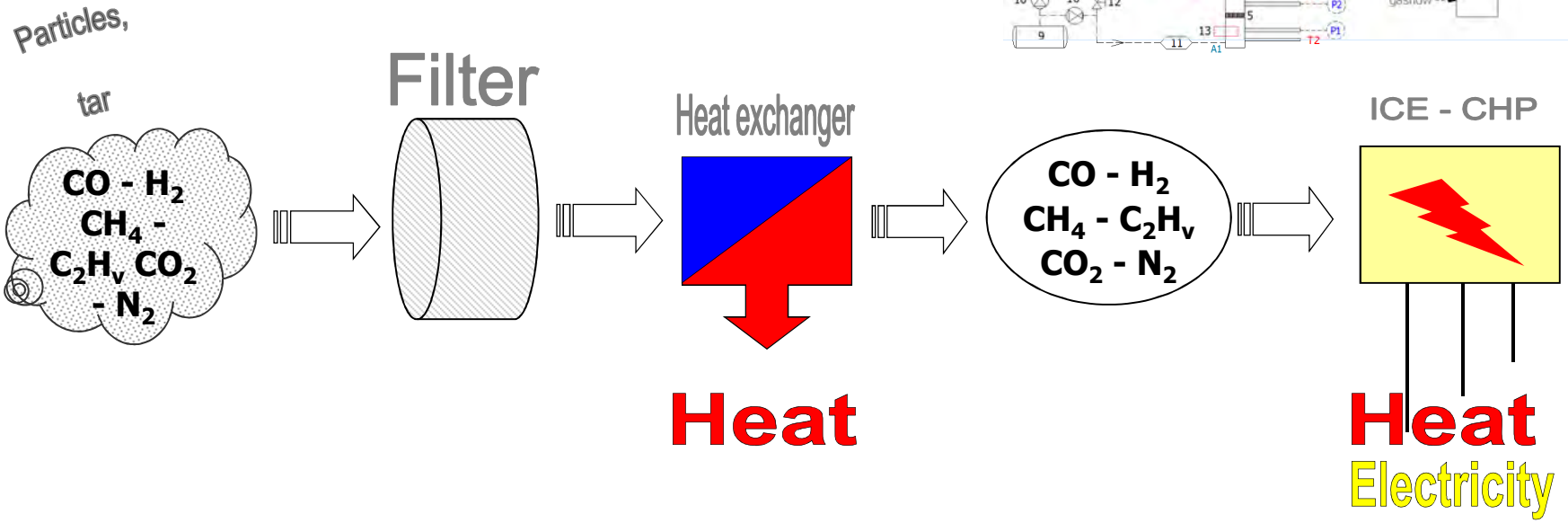
- ✓ Gasification advantages
  - High efficiency for electricity production at small scale
  - Good prospects for use in CHP
  - High performance (up to 35% with ICE)



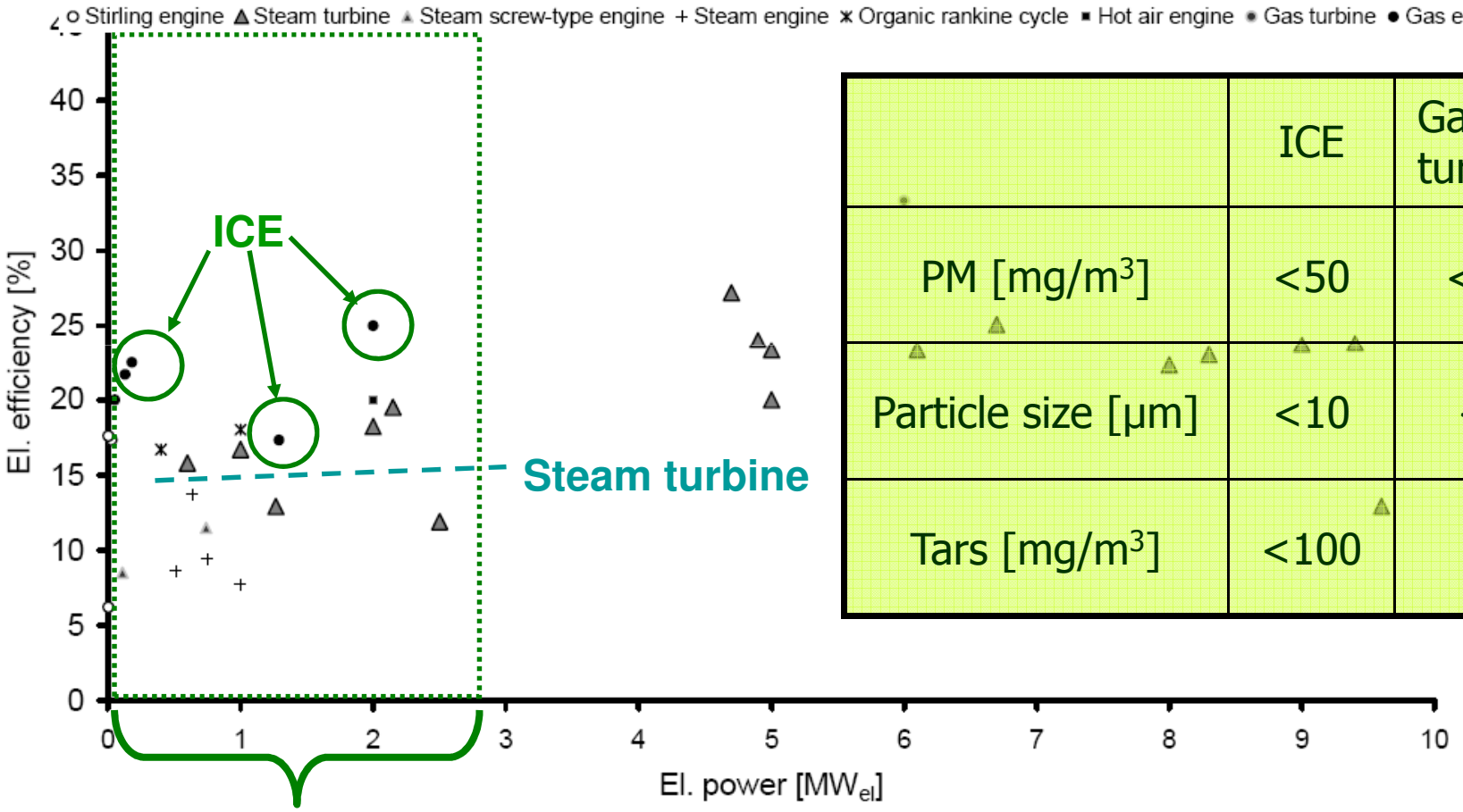
Gasifier – ICE coupling

- ✓ SMARt-CHP gasifier
  - Bubbling fluidized bed technology
  - Thermal efficiency → 85%
- ✓ ICE
  - Otto LPG engine with CHP capability





Why gas engine? (1/2)

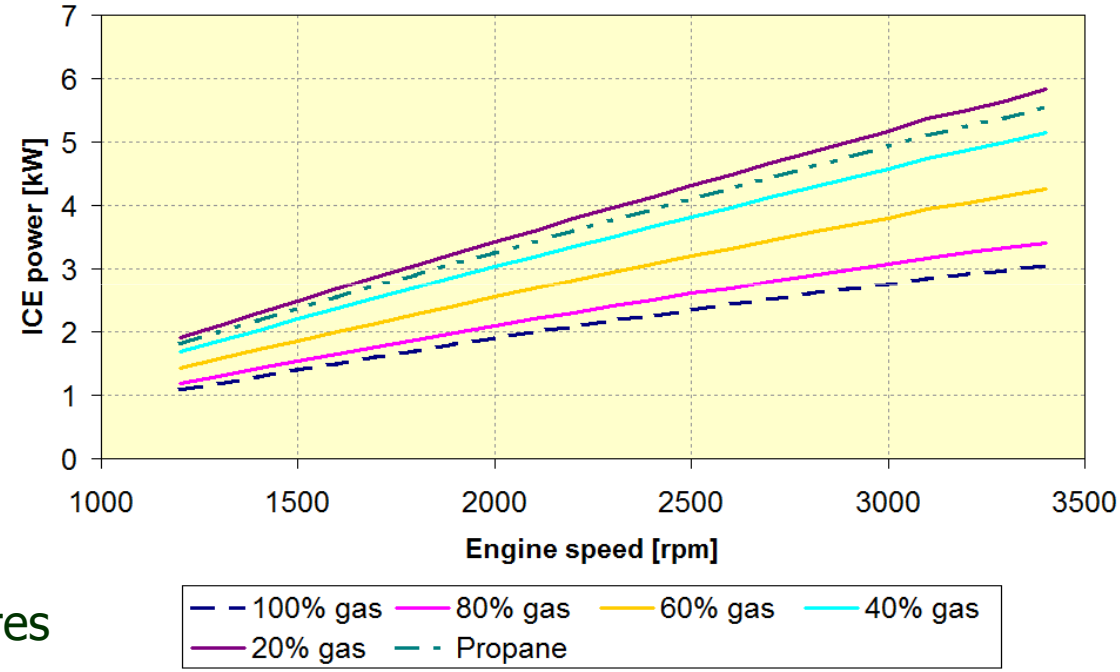


	ICE	Gas turbine
PM [mg/m^3]	<50	<30
Particle size [μm]	<10	<5
Tars [mg/m^3]	<100	-

Why gas engine? (2/2)

- ✓ Propane AF = 15.67
- ✓ SynGas AF ~ 1.12

- ✓ Gas turbine
  - Oversized compressor
- ✓ ICE
  - Same output for mixtures up to 40% w/w



SMARt – CHP unit

Gasifier

ICE

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Preliminary economic analysis

Scenario	Best
Net electr. Production	4.3 kW
Net heat production	15.8 kW
El. efficiency	19%
Total eff.	89%
Subsidy	40%
Capex	35,000 €
Biomass cost	0 €/tn
Sales tariff, electricity	200 €/MWh
Sales tariff, heat	50 €/MWh
IRR	**42.1%**
NPV	**67.8**
Payback	**3 years**

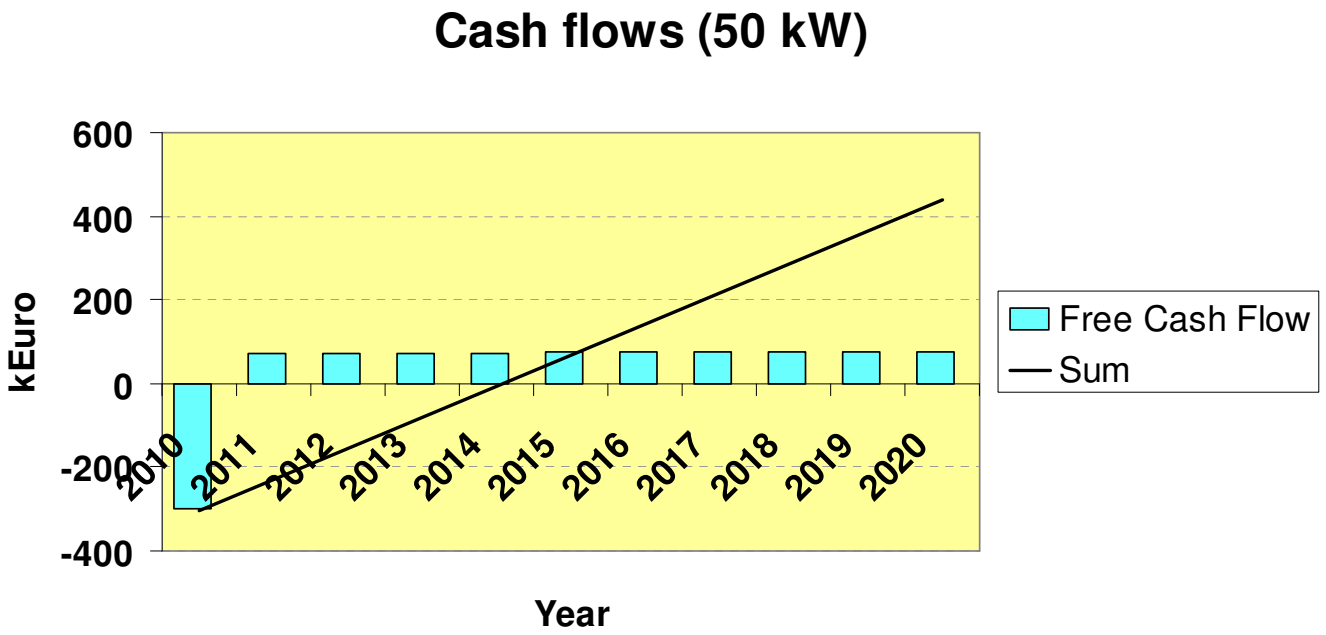
Scenario	Worst
Net electr. Production	4.3 kW
Net heat production	15.8 kW
El. Efficiency	19%
Total eff.	89%
Subsidy	0
Capex	35,000 €
Biomass cost	50 €/tn
Sales tariff, electricity	75 €/MWh
Sales tariff, heat	50 €/MWh
IRR	**11.8%**
NPV	**10.1**
Payback	**8 years**

Scale–up

Type	Mobile CHP
Net electr. Production	50 kW
Net heat production	120 kW
El. efficiency	22%
Biomass/yr	350 tn
Subsidy	0%
Capex	300,000 €
Biomass cost	10 €/tn
Sales tariff, electricity	175 €/MWh
Sales tariff, heat	50 €/MWh
IRR	**24.4%**
NPV	**413.6**
Payback	**5 years**

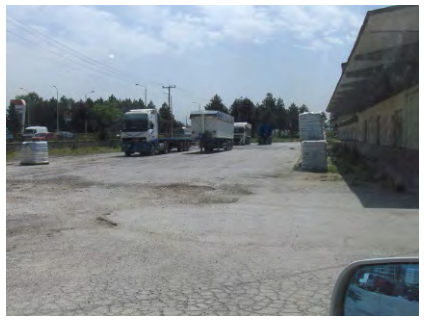
CO_2 reduction

175 tn/year



2011 timetable

- ✓ 8/12/2010
  - Workshop at Amyntaion regarding Action 1 results
- ✓ March 2011
  - SMARt-CHP unit completion
- ✓ April 2011 – June 2011
  - Demonstration at Amyntaion (2 locations, 2 weeks each)
- ✓ July – October 2011
  - Demonstration at Ptolemaida (2 locations, 2 weeks each)



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Thank you!

Visit our website!! → http://smartchp.eng.auth.gr

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