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# **Domestic Heating with Biomass**

## *State-of-the-Art and Strategic Research Needs*

**Walter Haslinger**

*Vice Chair of Biomass Panel of RHC-Platform  
Issue group II – Residential Technologies*

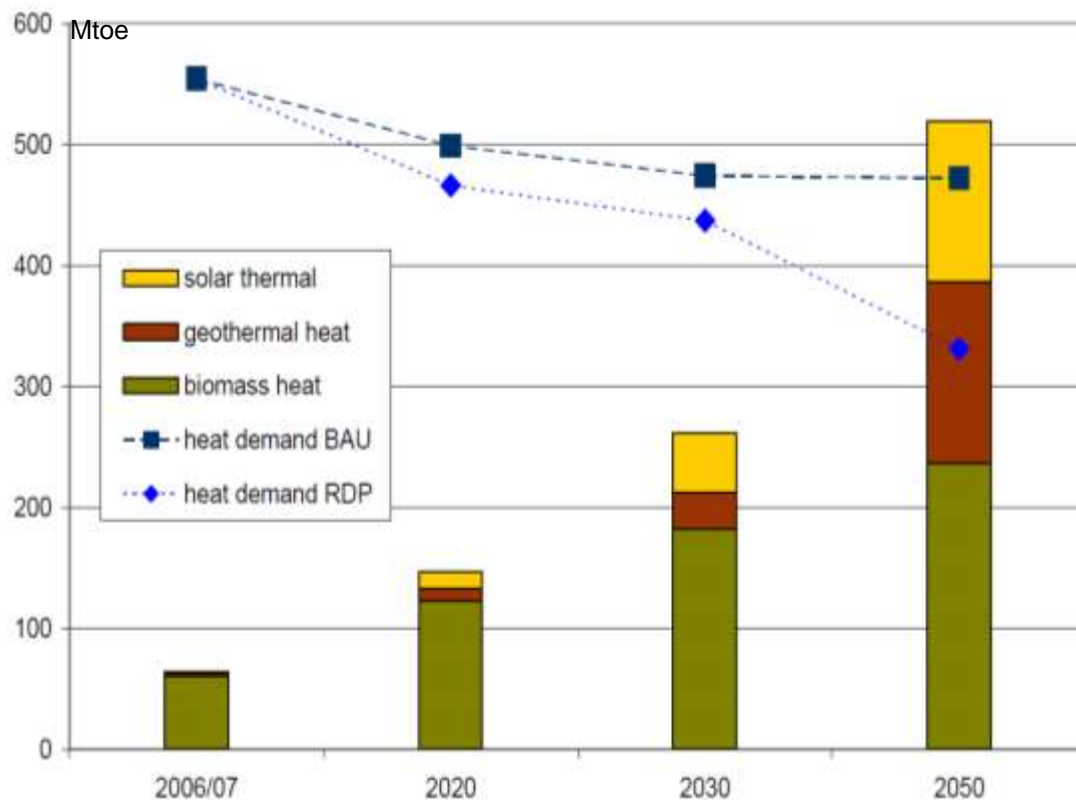
# Content of presentation

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- Background and relevance
- Vision
- State-of-the-art
- Strategic R&D needs
- Summary

# Background and relevance – Bioenergy

- **Bioenergy** – most relevant renewable energy source
- **Bioheat** – most relevant application of bioenergy
- **Residential heating** – most relevant bioheat application
- **Residential heating** – biggest absolute potential to contribute to 20/20/20 goals



Source: Sanner, Burkhard; Bilbao 2010

# Background and relevance – Small scale biomass heating

- Biomass for household energy ~ 200 Mm<sup>3</sup> = 35 Mtoe (excl. DH)
  - Target for 2020: > 400 Mm<sup>3</sup> = 70 Mtoe
  - 86% of household energy consumption used for heat
  - Biomass covers 97% of renewable heat market
- Market: small scale combustion systems:

Appliance	Stock	Sales
Fireplaces	30 Mio.	1.7 Mio.
Stoves	25 Mio.	1.3 Mio.
Cookers	7.5 Mio.	0.5 Mio.
Boilers	8 Mio.	0.3 Mio.



Sources: *European Biomass Statistics, AEBIOM 2010, Reference year: 2007*  
*LOT 15 Preparatory study, Bio Intelligence Service, 2012*

# A simple vision for 2020

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- For **residential heating** with bioenergy
  - **Solid biofuels replace heating oil totally**
  - ... and **strongly compete with natural gas**

# The vision for 2050

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- **100 % renewable heat – no fossil energy for space heating** anymore
- No biomass combustion without **power production**
- **Smart energy houses** integrate sun & biomass & geothermal sources
  - Energy use
  - Energy recovery
  - Energy for smart grid
  - Heat and power store
- **High hanging fruits to be planted now**

# Biomass fuels for domestic heating

- **Standardized fuels – EN 14961-x**
  - Fire wood
  - Wood pellets
  - Wood chips
  - ...
  - incl characterization methods
- National standards and technical guidelines for **pellets logistics and storage**
- **Quality label for wood pellets - ENplus**



# Biomass combustion technologies for domestic heating

- Big variety of technologies available
  - Central heating
  - Room heating
  - Cooking
  - Combinations
  - Lifestyle and well-being
- Good performance under steady state operation
- Well established standards
  - EN 303-5
  - EN 13240

[www.rika.at](http://www.rika.at)



[www.kwb.at](http://www.kwb.at)

[www.ortner-cc.at](http://www.ortner-cc.at)





# Status of $\mu$ CHPs based on solid biomass fuels

- Component and system development
- First demo units in operation
- Technologies under development
  - Steam cycle technologies
  - Stirling engine
  - Thermoelectrics



www.okofen-e.com



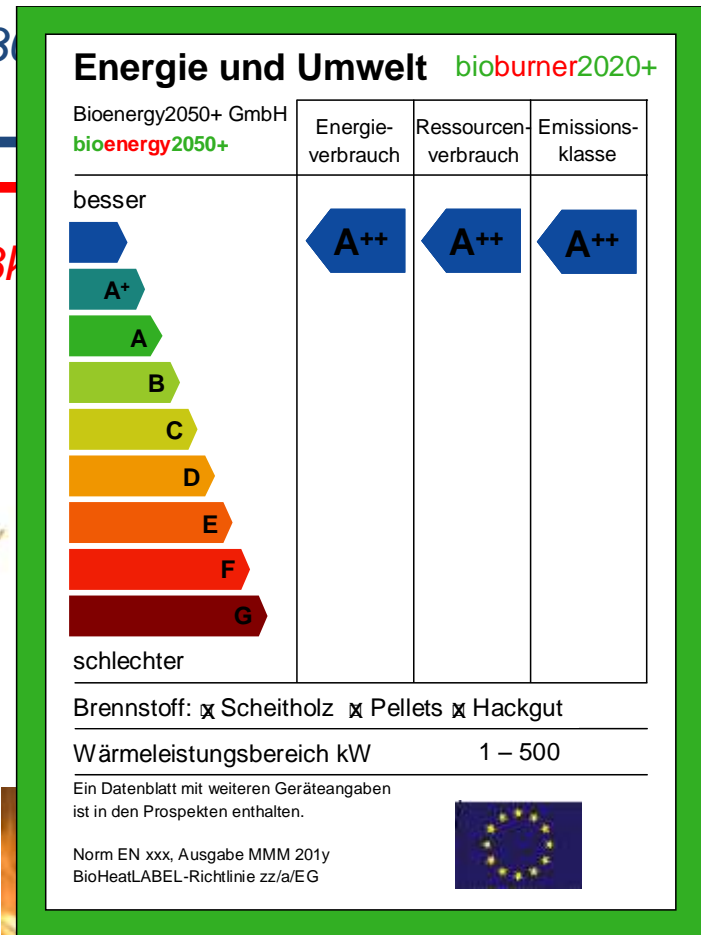
# Our final goal for biomass combustion systems Isn't it simple?

## Biomass combustion systems:

- 100% Efficiency
- 100% Renewable
- Zero Emission
- In real life operation
- **Triple A++**
- **Reliable**
- **At competitive prices**

$t = 3-30$

$\Delta H = -18$



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# R&D for biomass fuels (supply) and characterization methods

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- **Sustainability criteria**
- **New resources and fuels**
  - High-quality agro fuels and mixed resource fuels
  - SRF and energy crops
  - Upgraded biomass fuels (torrefied materials, biochar,...)
- **Advanced and new characterization methods**
  - Ash melting / slagging
  - Off-gassing
- **Fuel indexes**
  - PM and NOx emissions
  - Corrosion
  - Ash melting

# R&D for domestic biomass heating systems

## Method Development

### Lab-testing methods boilers

- annual efficiency testing
- emission factor testing
- evaluation methods for hybrid systems
- field measurements for evaluation

### Lab-testing methods stoves

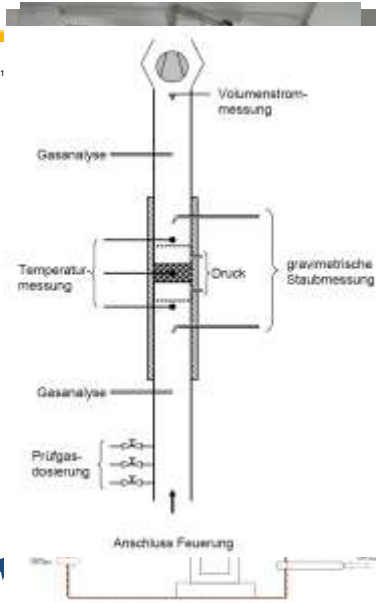
- real life testing
- measurement methods (e.g. dust)
- efficiency testing

### Other methods

- field testing methods
- methods for evaluation of secondary measures

### Advanced control systems

- central control systems for all HVAC components
- model based
- intelligent



## System Approach

### Integration in buildings

- load control
- heat storage concepts
- external combustion air supply
- airtight combustion appliances
- chimney system development

### Combination with other systems

- hybrid systems
- HVAC – all in one solutions
- heat storage control
- central control systems

## Combustion Technology

### Primary measures

- fuel feeding
- grate / pot
- combustion chamber
- air flow
- heat exchanger
- combustion control

### Secondary measures

- secondary combustion
- catalysts
- particle filters
  - ceramic
  - electrostatic
  - fabric filters

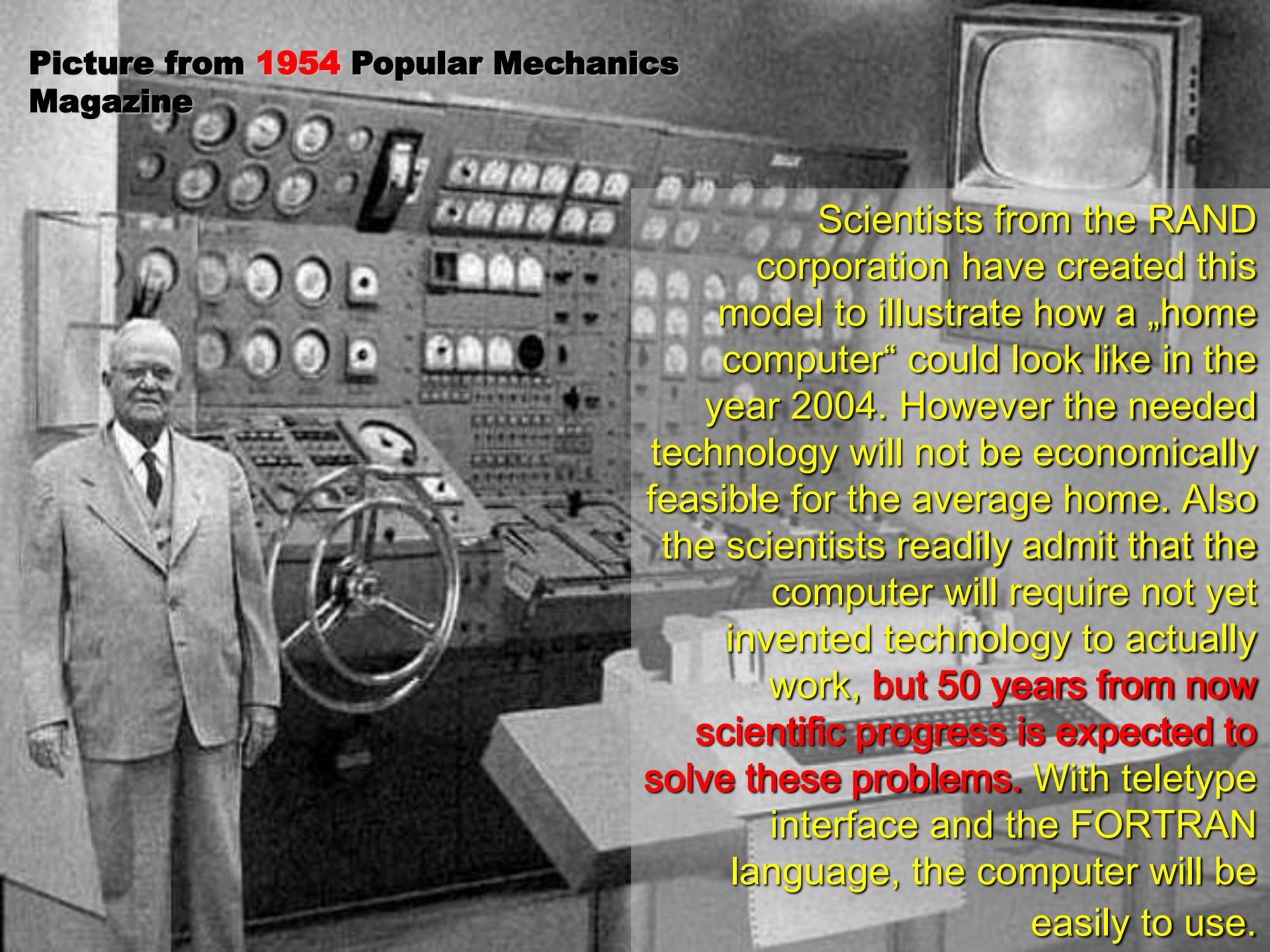
Demonstration

Basic research

# Summary of strategic R&D needs

- New fuels and new characterization
- Fuel flexible combustion technologies
- Zero emission technologies
- Highest efficiency technologies
  - Advanced load following systems
  - Heat storage
- (Hybrid) power generation systems
  - Advanced load following systems
- Accompanied by (further) development of standards for
  - assuring quality and safety along the supply chains
  - characterizing fuels
  - testing of appliances and systems
    - more realistic
    - system behaviour
- System development and demonstration

Picture from **1954 Popular Mechanics Magazine**



Scientists from the RAND corporation have created this model to illustrate how a „home computer“ could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, **but 50 years from now scientific progress is expected to solve these problems.** With teletype interface and the FORTRAN language, the computer will be easily to use.

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# Thank you for your attention!

Walter Haslinger  
Area Manager  
Small-scale combustion systems  
BIOENERGY 2020+  
Location Wieselburg  
Tel: +43 7416 52238 20  
[walter.haslinger@bioenergy2020.eu](mailto:walter.haslinger@bioenergy2020.eu)