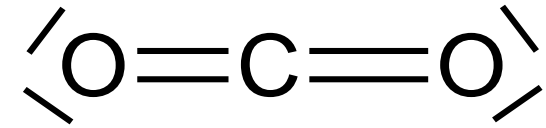


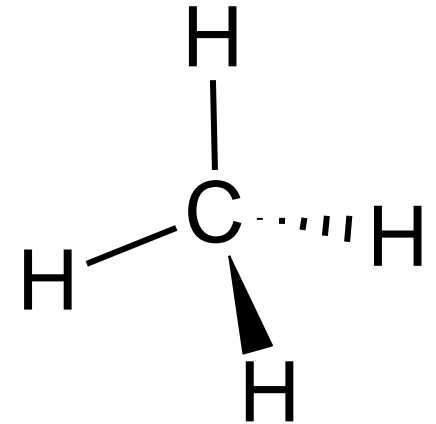
# **BIOCHEMISTRY OF BIOGAS** **PRODUCTION**

# What is biogas?

- Biogas is a mixture of **CO<sub>2</sub>** and **CH<sub>4</sub>**



- **CH<sub>4</sub> + 2 O<sub>2</sub> → CO<sub>2</sub> + 2 H<sub>2</sub>O + Energy**



- Only CH<sub>4</sub>, is suitable, biogas should contain at least 50%
- Biogas is produced of organic products using anaerobic conditions and several microorganisms

# **From what is biogas produced?**

- **In nature:**
  - Wetlands
  - Rice fields
  - Intestines of animals
  - Manures
- **Biogas can also be produced of organic products like:**
  - Waste from agro-industrial units
  - Energy crops (corn, sorghum)
  - Effluent from wastewater treatment
  - Decomposition of organic waste fraction

# **The production contains 4 steps:**

- |           |                       |                      |
|-----------|-----------------------|----------------------|
| <b>1.</b> | <b>Hydrolysis</b>     | Hydrolases           |
| <b>2.</b> | <b>Acidogenesis</b>   | Acidogenic bacteria  |
| <b>3.</b> | <b>Acetogenesis</b>   | Acetogenic bacteria  |
| <b>4.</b> | <b>Methanogenesis</b> | Methanogenic Archaea |

# Archaea

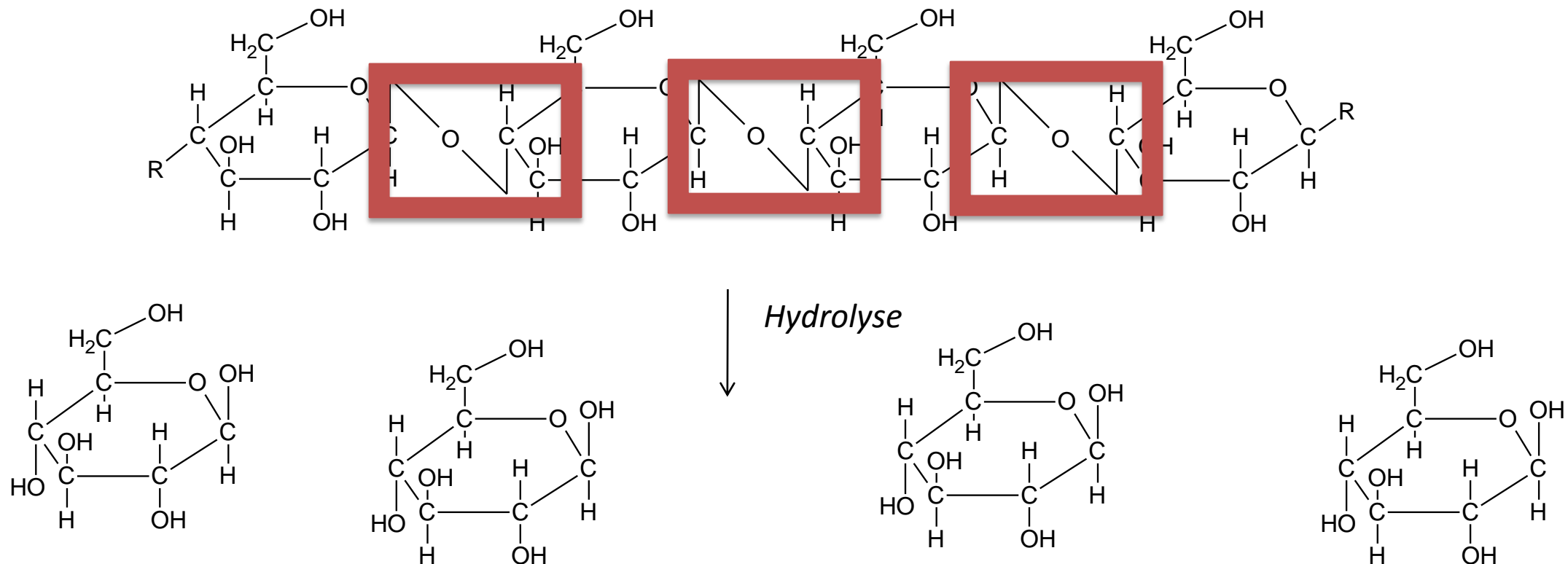
- Constructed like procaryotes, but aren't bacteria!!!
- Anerobic
- Occur in extreme conditions e.g. geyser

## Methanic archaea

- Swamps
- Sludge facilities
- Animal digestive organs

# Step 1: Hydrolysis

- Macromolecules (carbohydrates, fat, proteins) are decomposed by enzymes, which are hydrolases.



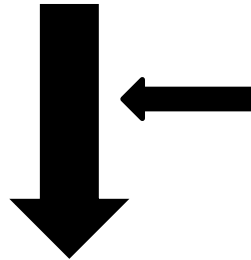
# Step 2: Acidogenesis

Small organic  
molecules to  
carbonic acids

**Oligomers  
(Soluble organic  
molecules)  
sugars, amino-acids, fatty  
acids**

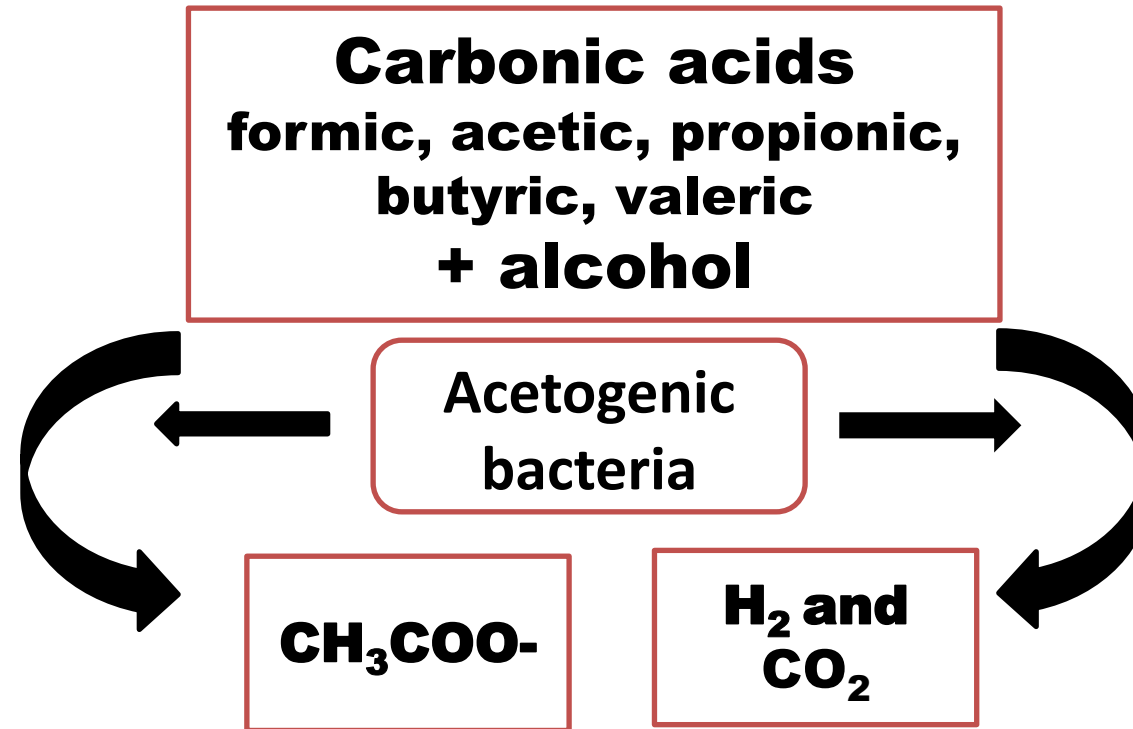
**Acidogenic  
bacteria**

**Volatile fatty acids  
(Carbonic acids:  
formic, acetic, propionic  
butyric, valeric)  
+ alcohol**



# Step 3: Acetogenesis

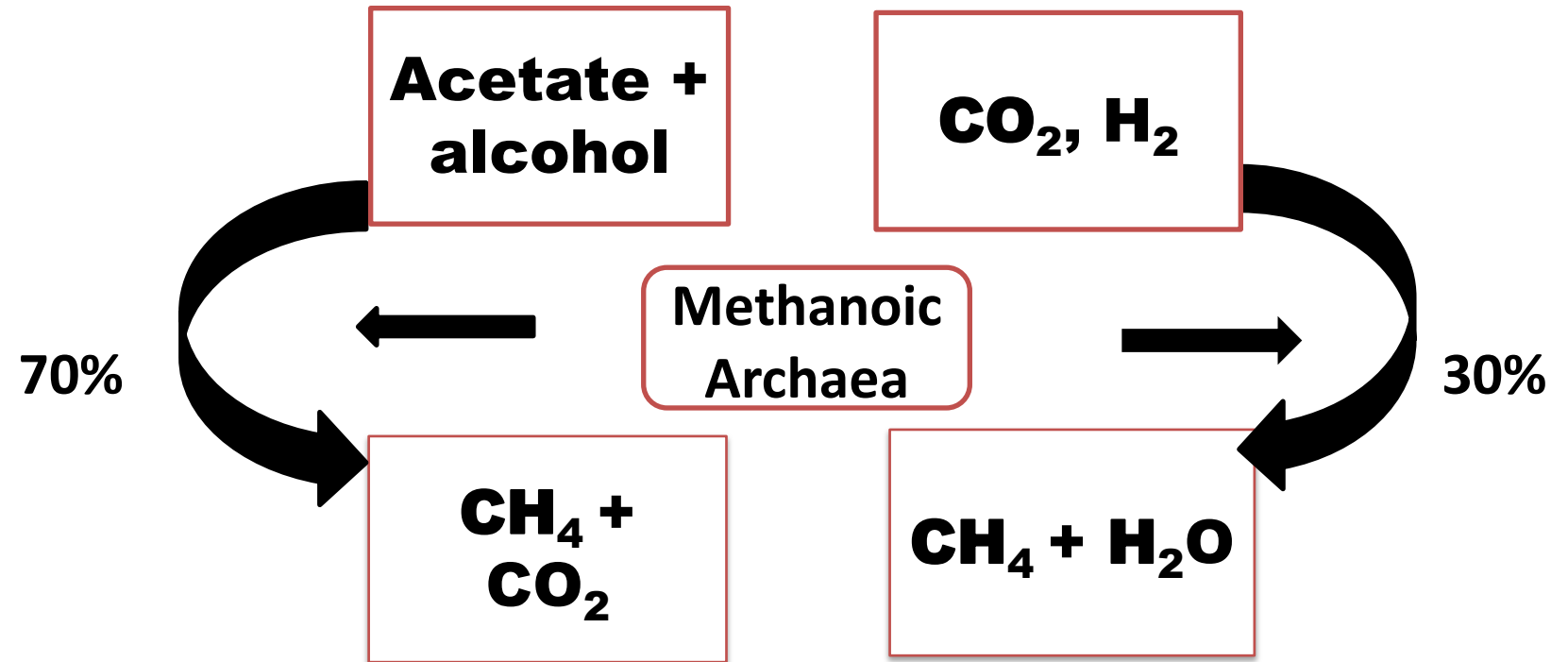
conversion to  
acetate and CO<sub>2</sub>





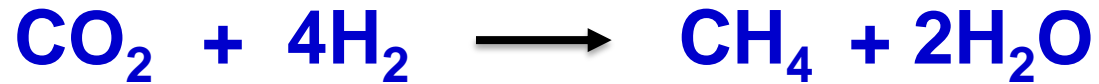
# Step 4: Methanogenesis

final conversion  
to  $\text{CH}_4$



# Methanogenesis:

1) methane is made of formate (HCOO-) or CO<sub>2</sub>:



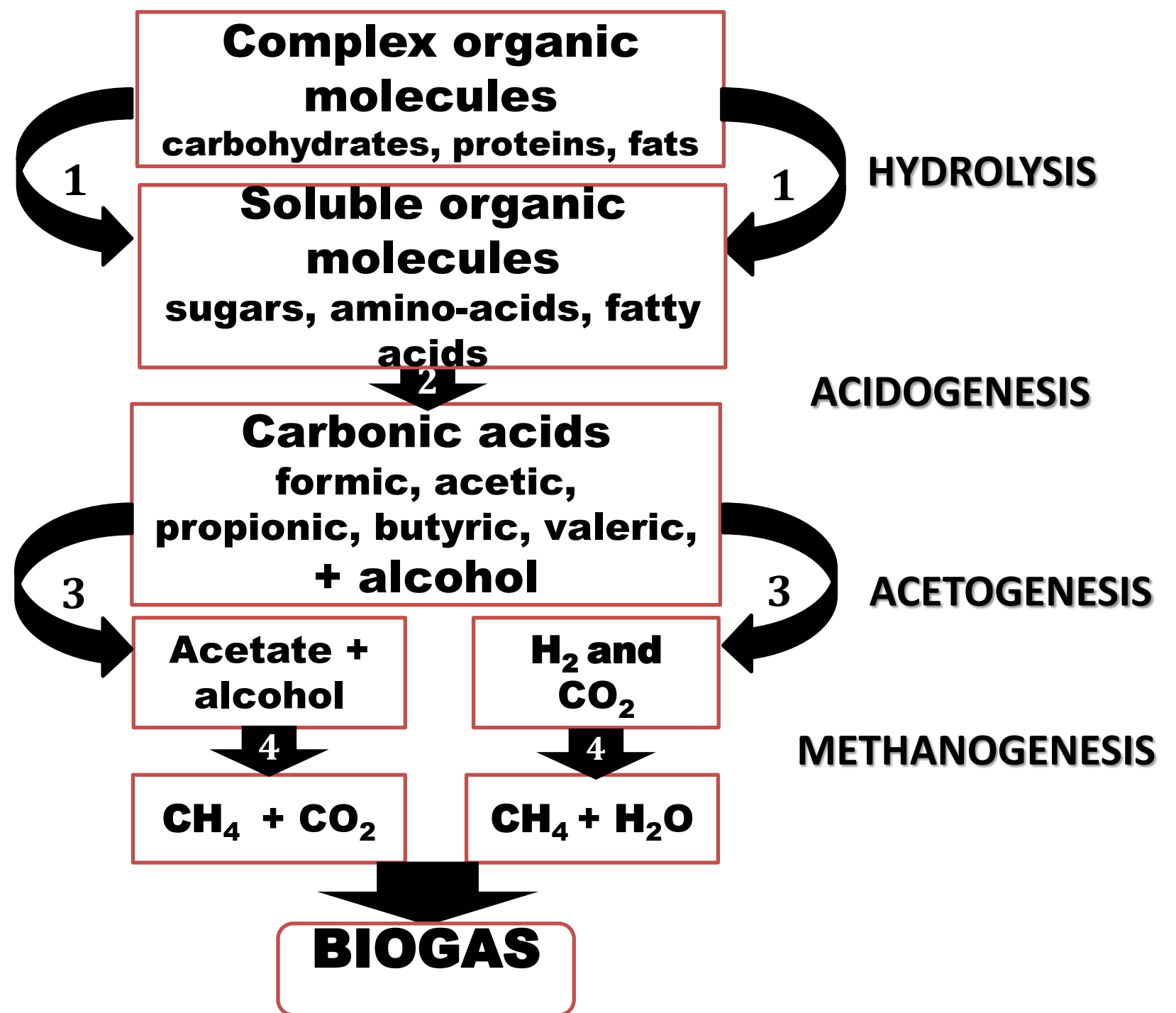
2) methane is made of acetate(CH<sub>3</sub>COO-) witch is the salt of acetic acid:



3) methane is made of alcohols like methanol:



# Summary of the steps



**THANK YOU FOR YOUR ATTENTION!!!**