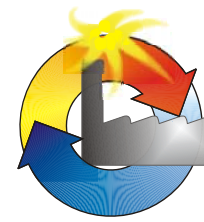




Università degli Studi di Roma
"La Sapienza"



The potential of Solar Heat for Industrial Processes



Riccardo Battisti

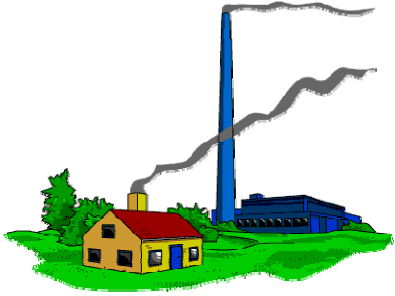
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IEA Solar Heating and Cooling and SolarPACES Programme – Task 33/IV

SHIP – Industry Workshop
Lisboa, 13/10/06

Really a huge potential?

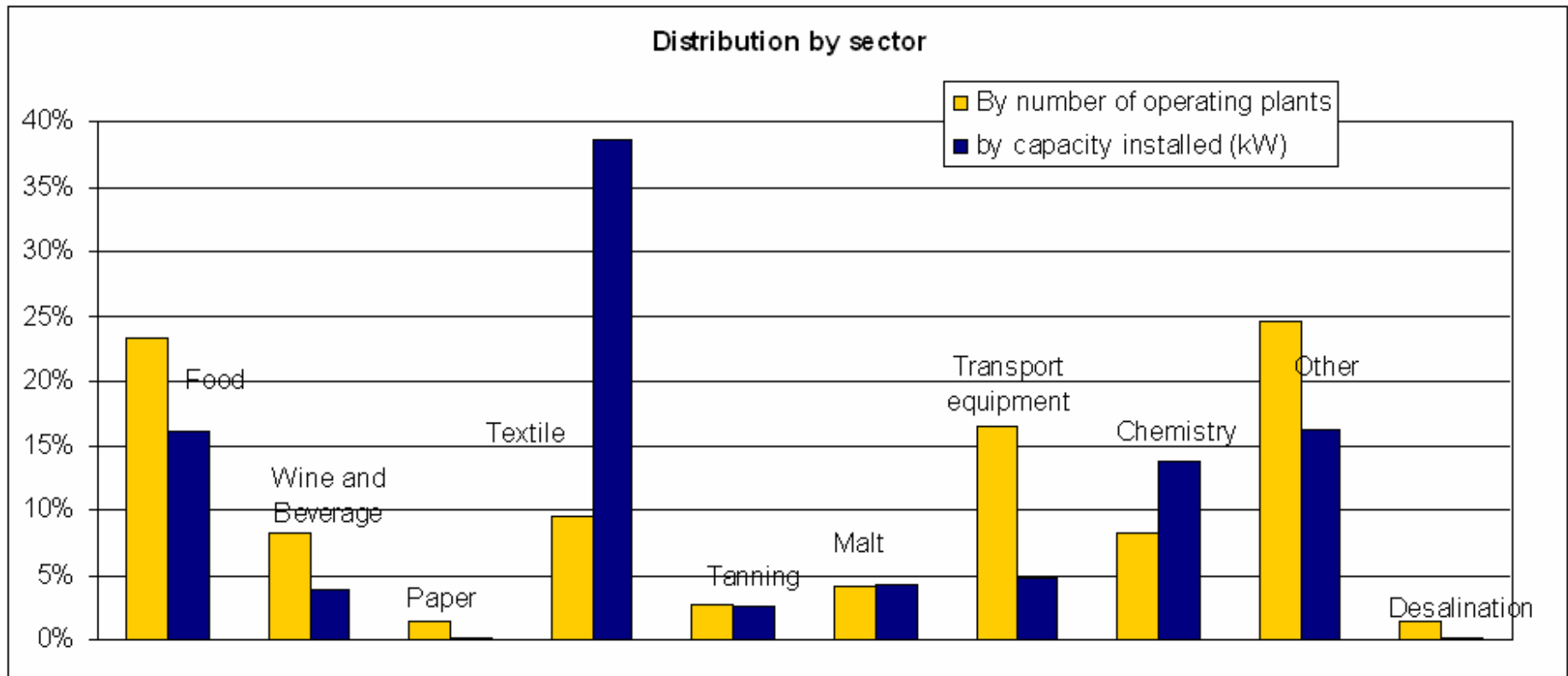


- The residential sector offers a huge potential for solar sanitary hot water production and space heating, but...
- ...if one compares the energy consumption of the industrial, transportation, household and service sectors in OECD countries, the industrial sector has the highest energy consumption at approximately 30%
- Therefore, process heat is a huge potential market for solar thermal...

...but how huge is it?

How many solar process heat plants are installed worldwide?

- **84** operating plants
- Total installed capacity: **23.8 MW** (33,991 m²)
- **19** Countries included and **11** industrial sectors
- 0.03% of the installed solar capacity

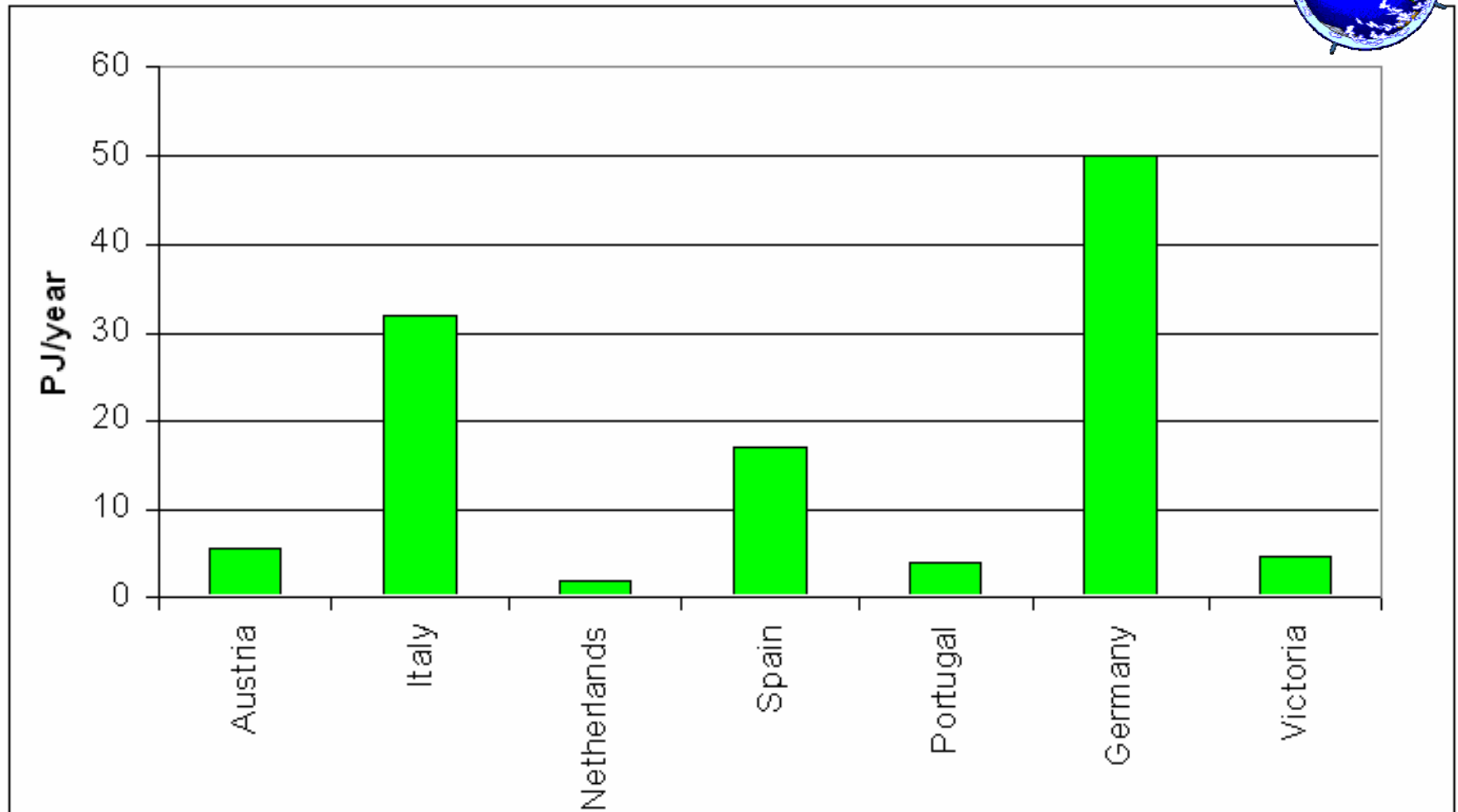
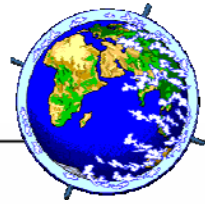


Unexploited potential in many sectors

Generation of low-temperature process steam and hot water for washing, dyeing, drying, cooking, boiling and chemical processes, but also factory buildings space heating and cooling. ...

| Industry sector | Austria | Iberian Peninsula | Italy | Netherlands | Greece | Germany | Belgium |
|-----------------------|---------|-------------------|-------|-------------|--------|---------|---------|
| Food processing | x | x | x | x | x | | x |
| Wine and beverages | x | x | x | x | | | x |
| Beer brewing and malt | | x | x | x | | x | x |
| Textile | x | x | x | x | x | | x |
| Tanning | | x | x | | x | | |
| Paper | | x | x | x | x | x | x |
| Tobacco | | x | x | | x | | x |
| Chemical | | x | x | | x | | x |
| Transport equipment | x | x | x | | x | x | |
| Other | x | | | | x | | x |

Results of the potential studies



Results of the potential studies



| | Industrial final energy consumption in 2002 (Source: Eurostat) [PJ/year] | Industrial heat demand in 2002 (Source: Eurostat ^[1]) [PJ/year] | Industrial heat demand on total final consumption [%] | Solar process heat potential (including medium temp. application) [PJ/year] | Solar heat on industrial heat demand [%] | Solar process heat potential [Mio m ²] | Solar process heat potential [GW] |
|--------------|--|---|---|---|--|--|-----------------------------------|
| Austria | 297 | 220 | 74.1 | 5.4 | 2.4 | 4.3 | 3 |
| Spain | 1175 | 841 | 71.5 | 17 | 2.0 | 10 | 7 |
| Portugal | 243 | 184 | 75.6 | 4 | 2.2 | 2.5 | 1.7 |
| Italy | 1652 | 1136 | 68.8 | 32 | 2.8 | 14.3 | 10 |
| Netherlands | 573 | 425 | 74.2 | 1.5 - 1.95 ^[2] | 0.3 - 0.5 | 0.8 - 1 | 0.7 |
| Germany | 2416 | 1575 | 65.2 | 50 | 3.2 | 35 | 24.5 |
| EU 15 | 11372 | 7880 | 69.3 | 199 | 2.5 | 110 – 138 | 77 - 97 |
| EU 25 | 12964 | 9145 | 70.5 | 230 | 2.5 | 128 - 160 | 90 - 112 |



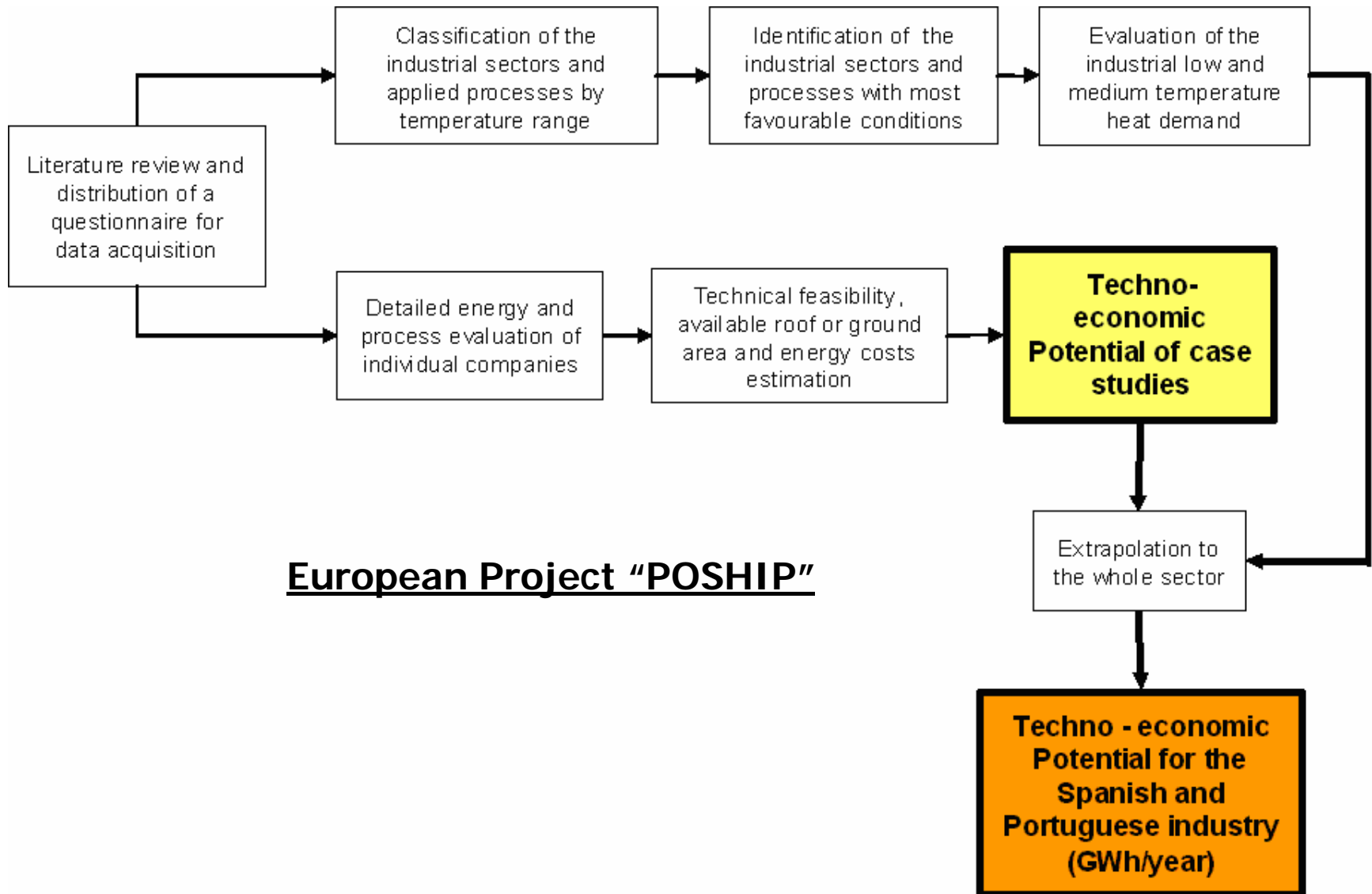
Results of the potential studies – EU25

- SHIP plants could deliver to industry up to **64 TWh/year**
- Renewable Energy Target for Europe (EREC): 279 TWh/year by 2020 (**about 1/4 from SHIP plants**)

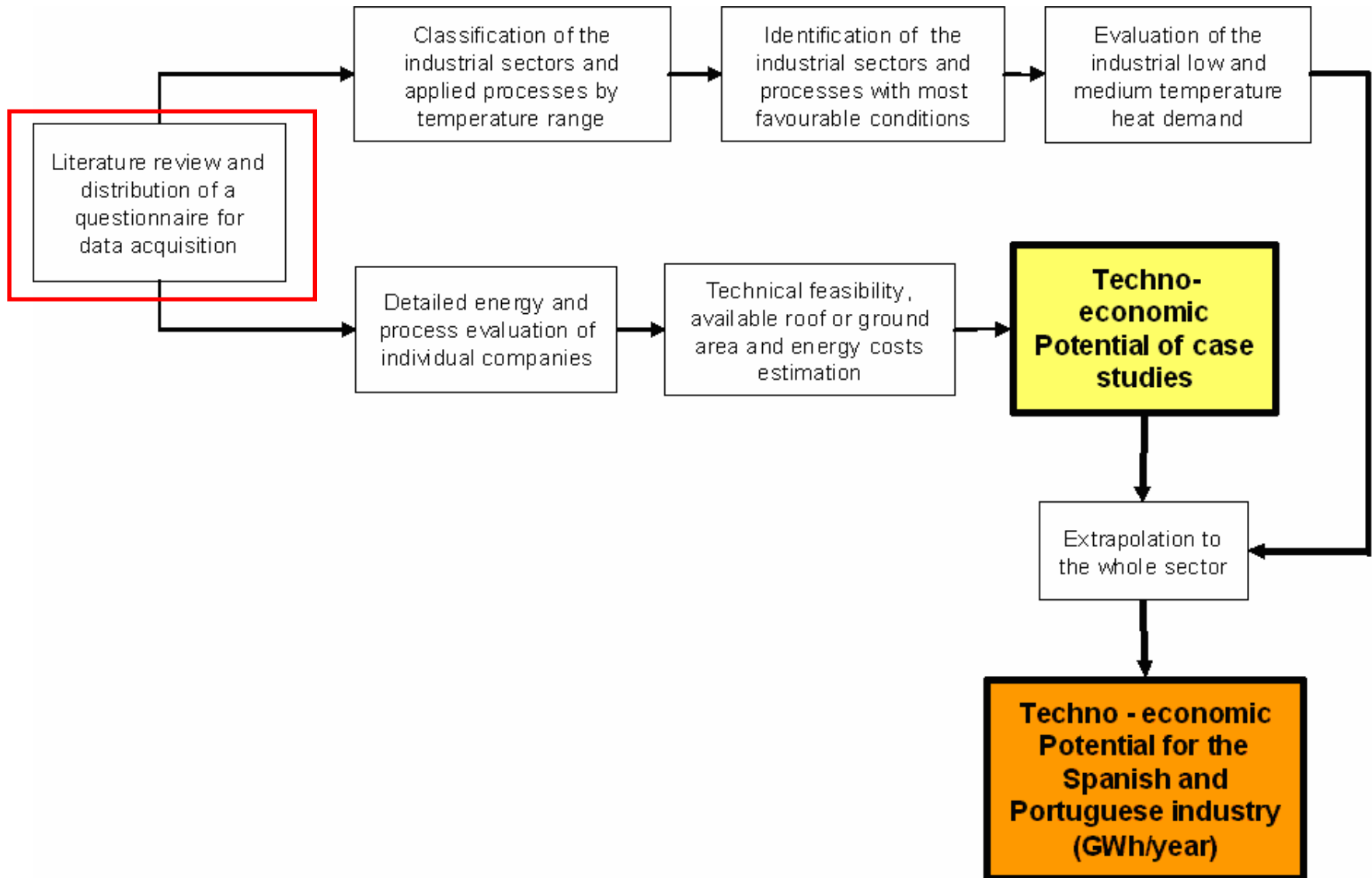
- Market volume: **160,000,000 m²** (**112 GW** of new capacity installed) for the European solar industry
- Target of EC White Paper: 100,000,000 m² by 2010

- Conservative scenario: penetration rate of 10% of the overall potential
- Total volume: 16,000,000 m²
- Ten years installation program of about 1,600,000 m² of collectors (European annual solar market volume: 2,000,000 m² in 2005)
- Occupational impact: 160,000 new jobs in ten years (1 job per 100 m²)

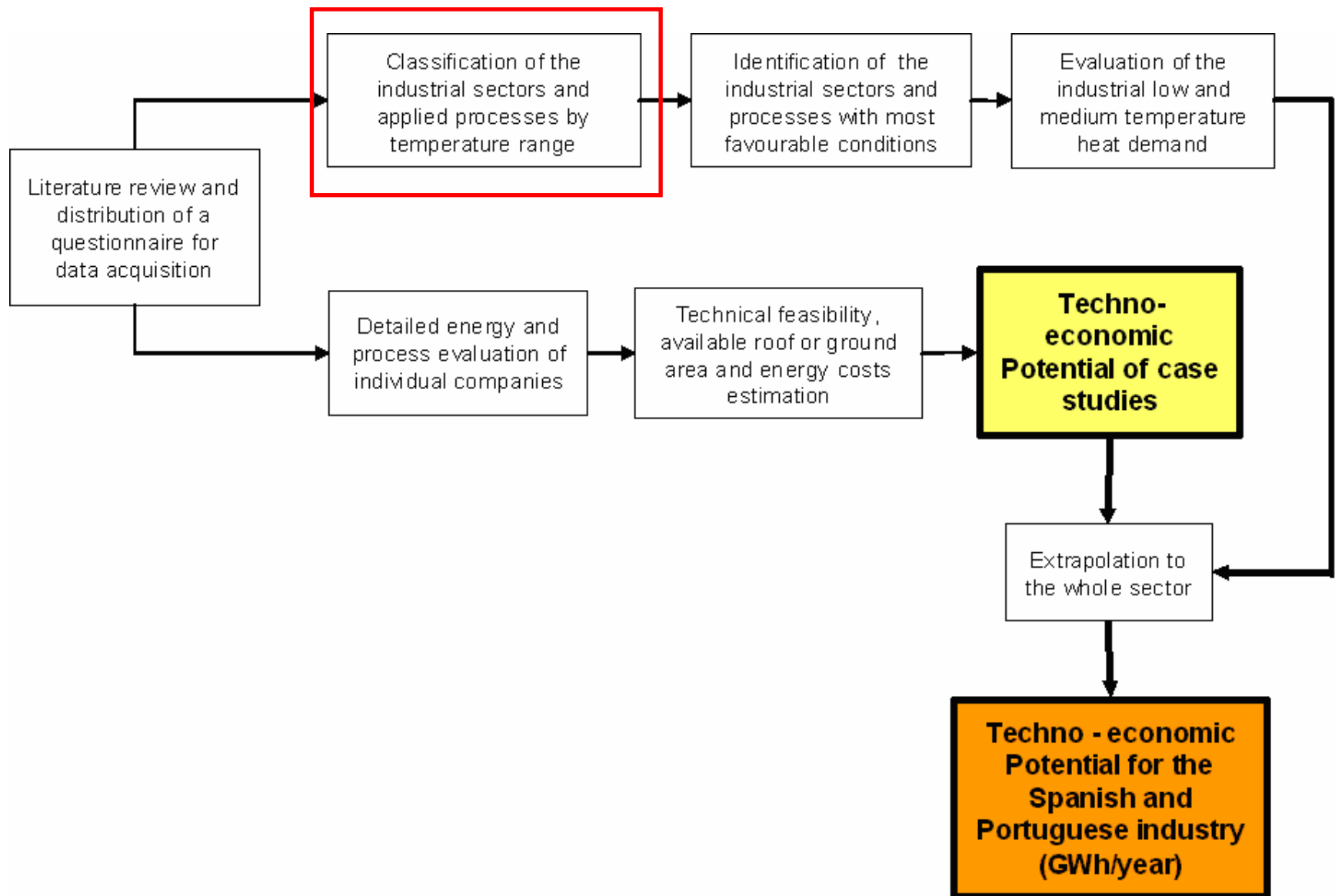
An example: Iberian Peninsula (Portugal&Spain)



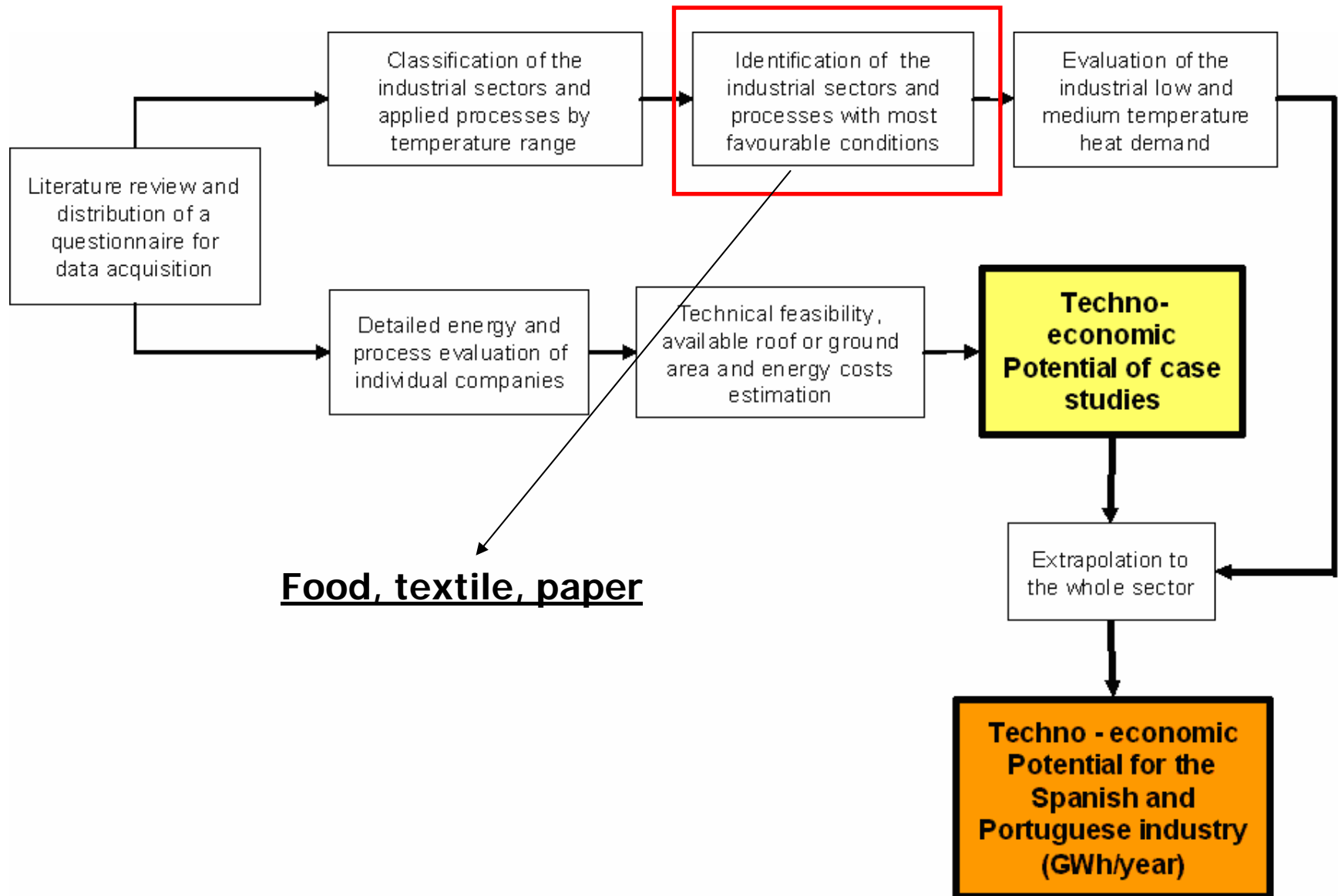
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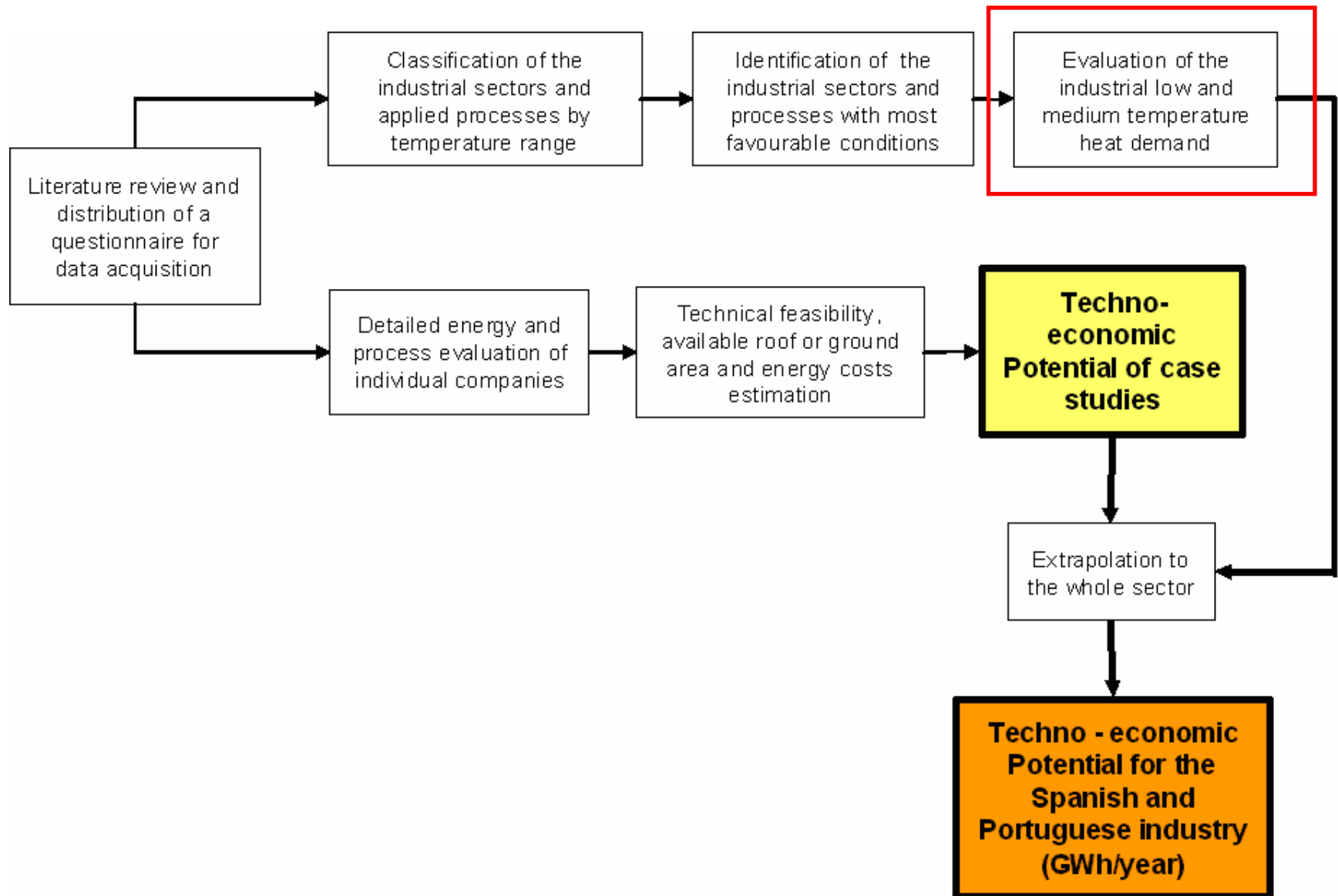
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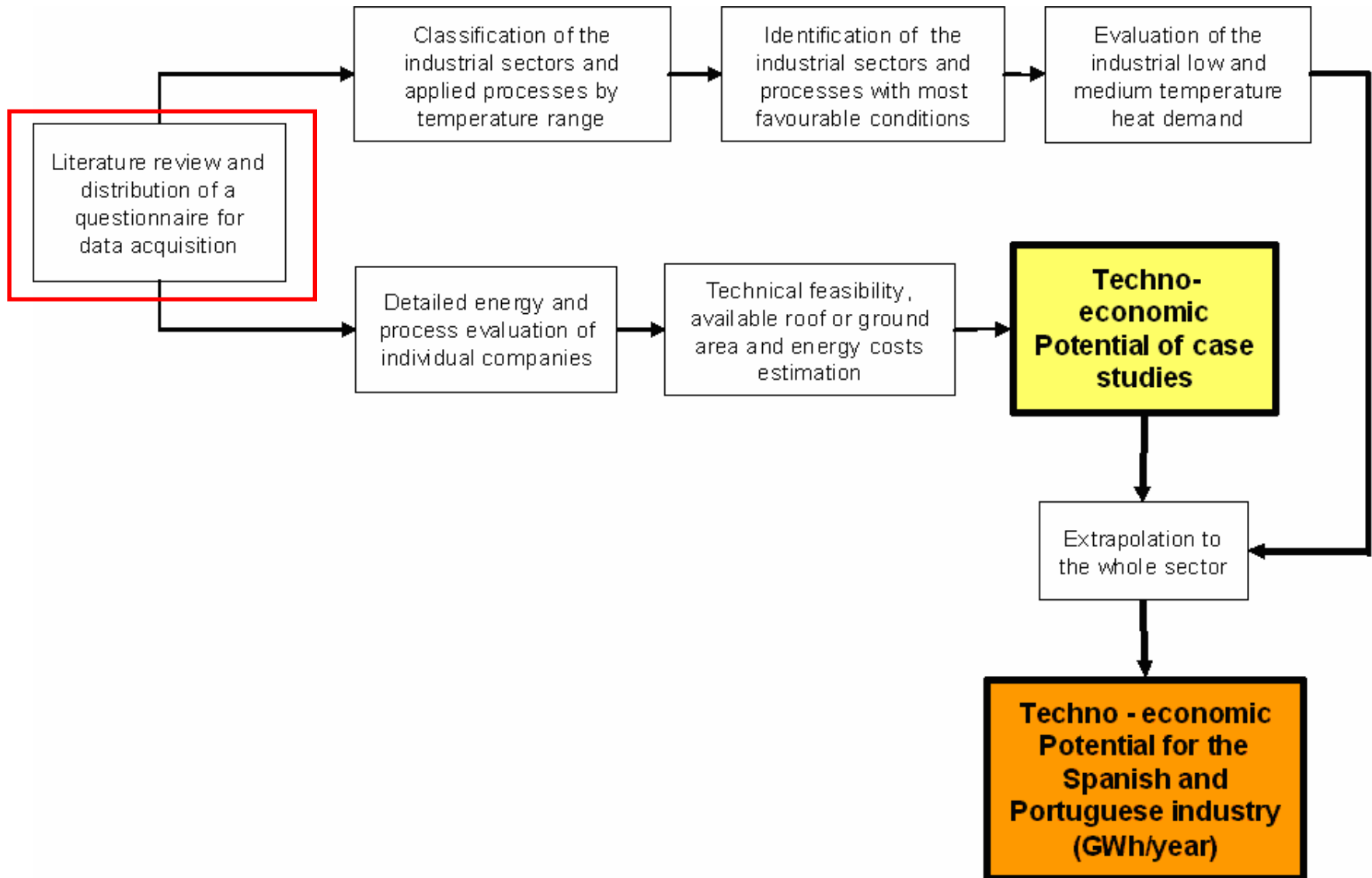
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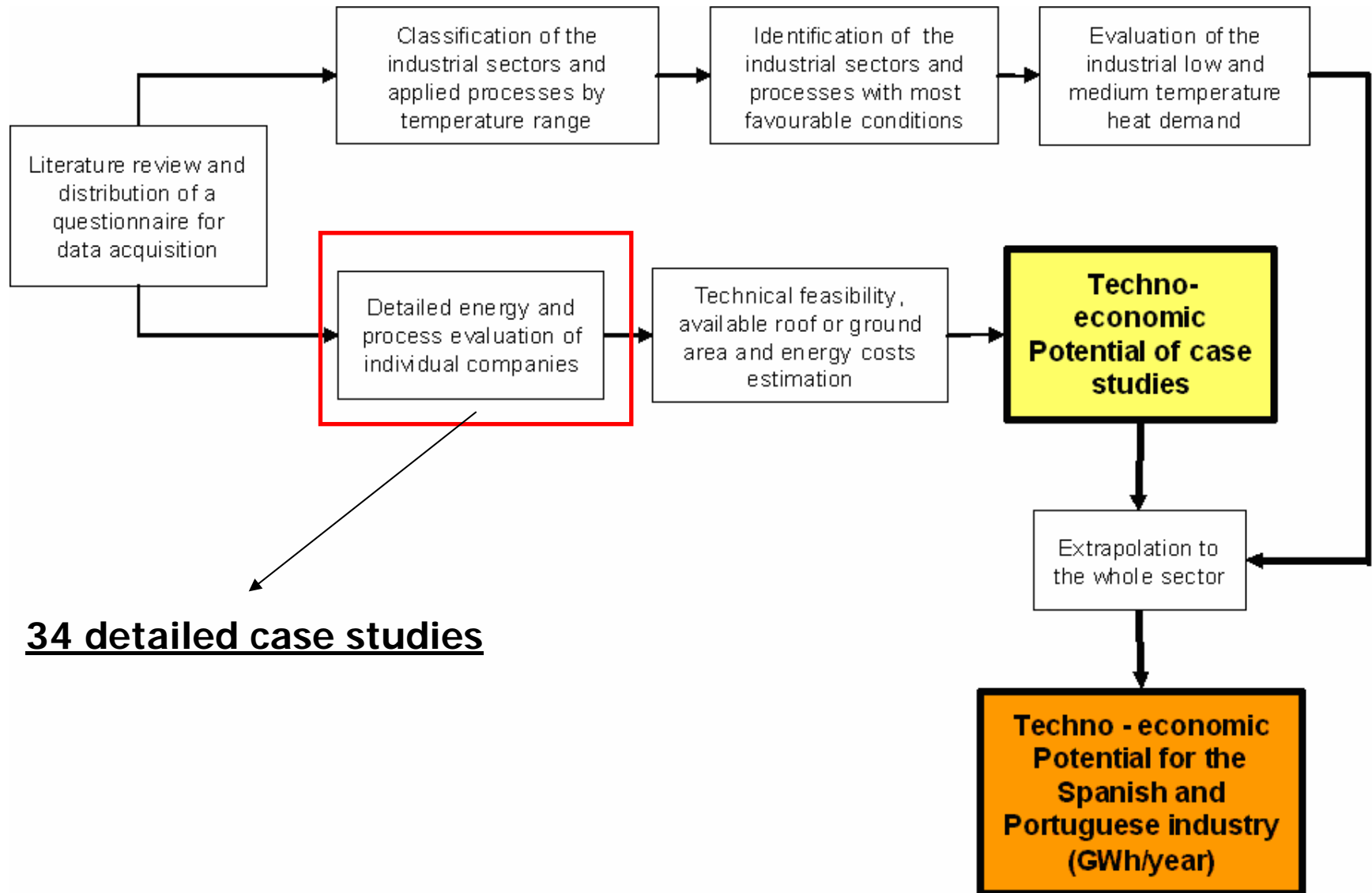
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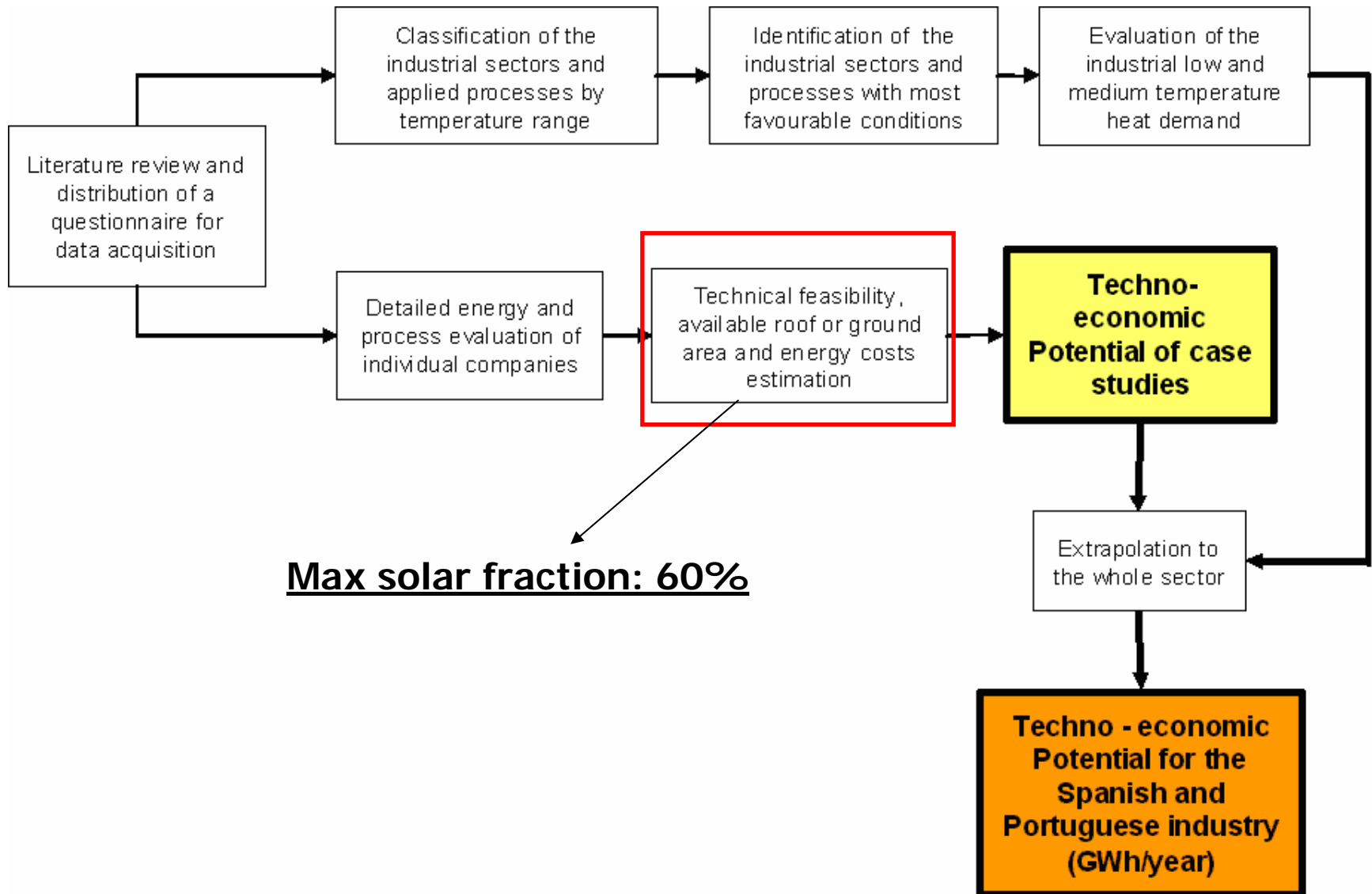
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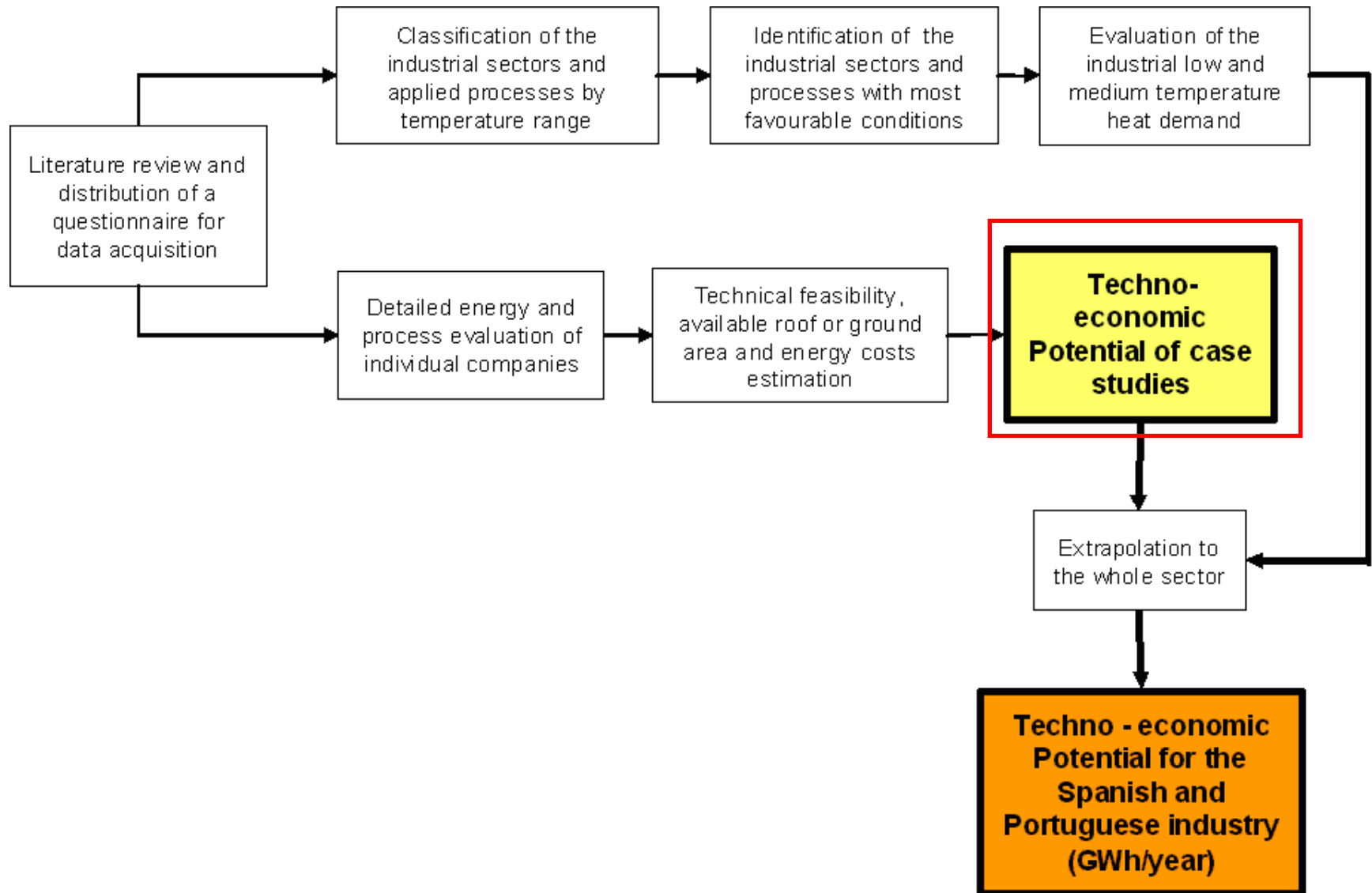
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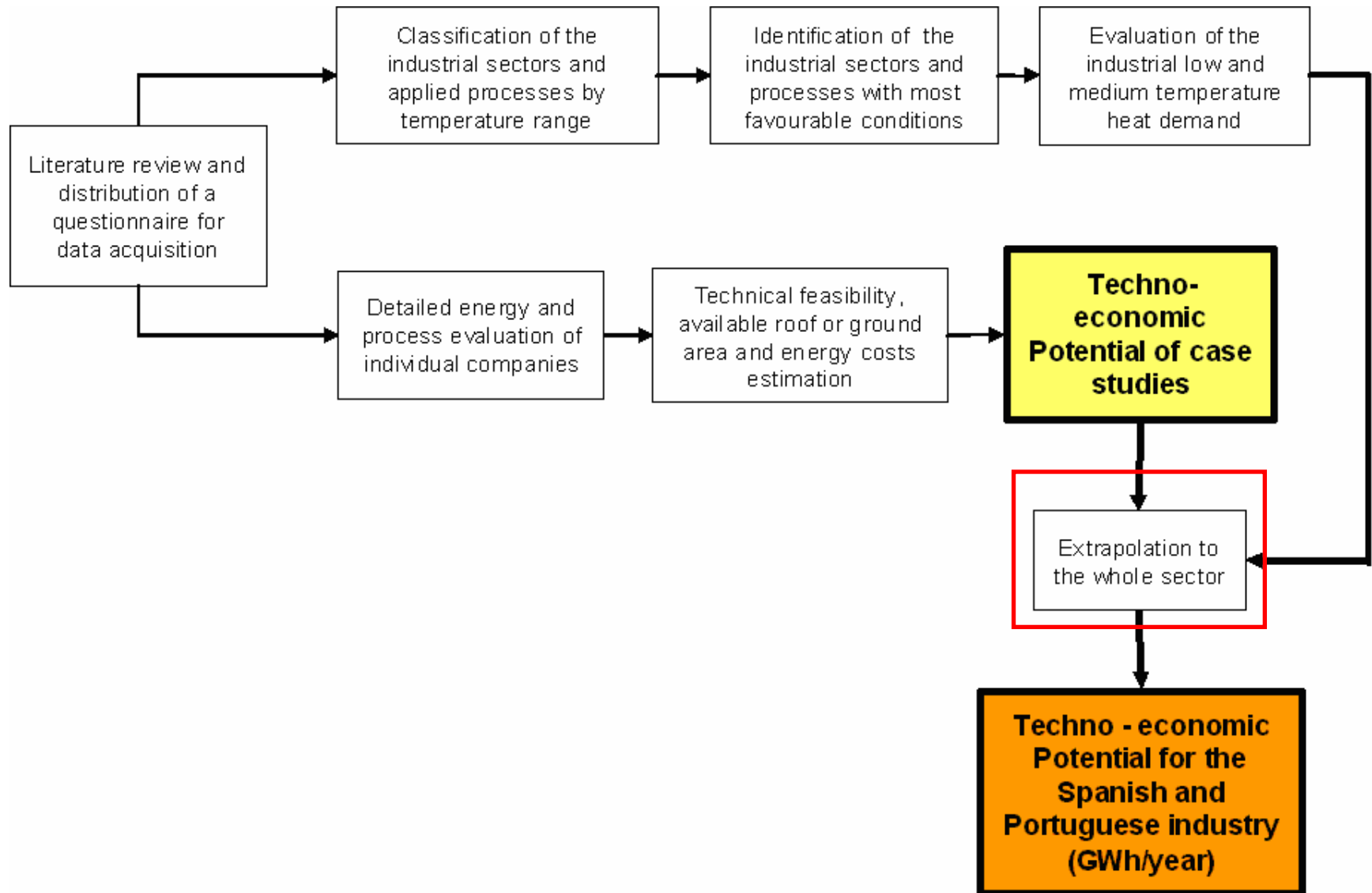
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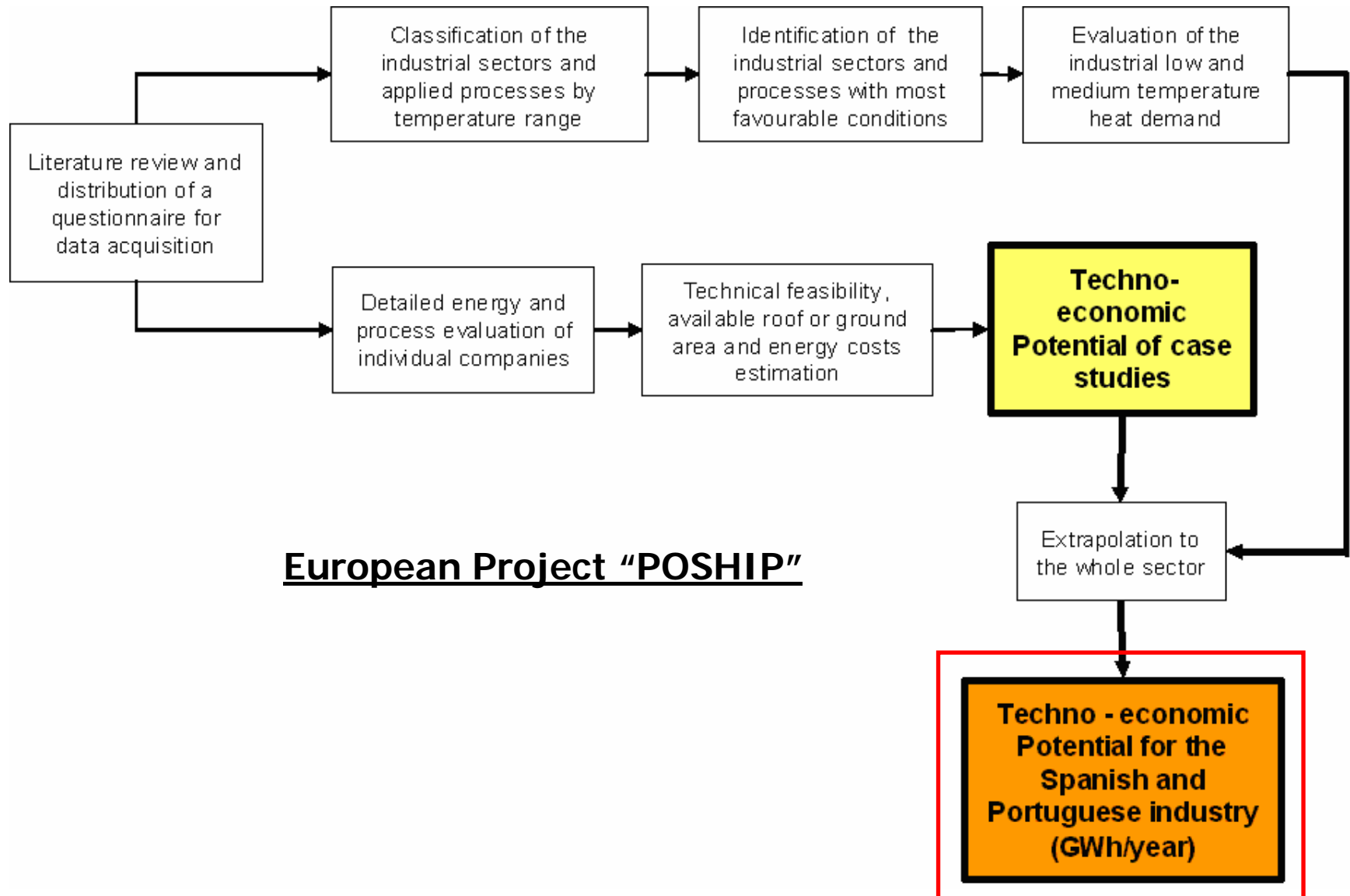
An example: Iberian Peninsula (Portugal&Spain)



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An example: Iberian Peninsula (Portugal&Spain)

| Industrial Sectors | TWh |
|----------------------------|------------|
| Food, beverage and tobacco | 1.4 |
| Textile, Leather and shoes | 0.4 |
| Paper | 1.6 |
| Transport equipment | 0.6 |
| Chemistry* | 0.8 |

An example: Iberian Peninsula (Portugal&Spain)



Portugal

- 4 PJ/year
- 2.5 millions m²
- 1.5 GW
- 4.4 % of the industrial heat demand

Iberian Peninsula

- 20.9 PJ/year
- 12.5 millions m²
- 8.1 GW
- 3.6 % of the industrial heat demand

Information on POSHIP: www.aiguasol.com/poship.htm

Conclusions

- Several industrial sectors with high heat demand at $T < 150$ °C
- High potential market volume: **2.5 millions m² only in Portugal**
- Important contribution to fulfil the EU target

- In spring 2007, a detailed report on the potential of solar heat for industrial processes will be available from Task 33/IV...
- ...use it to show policy makers and energy planners how large is the potential for solar process heat!

Report available in spring 2007: www.iea-ship.org