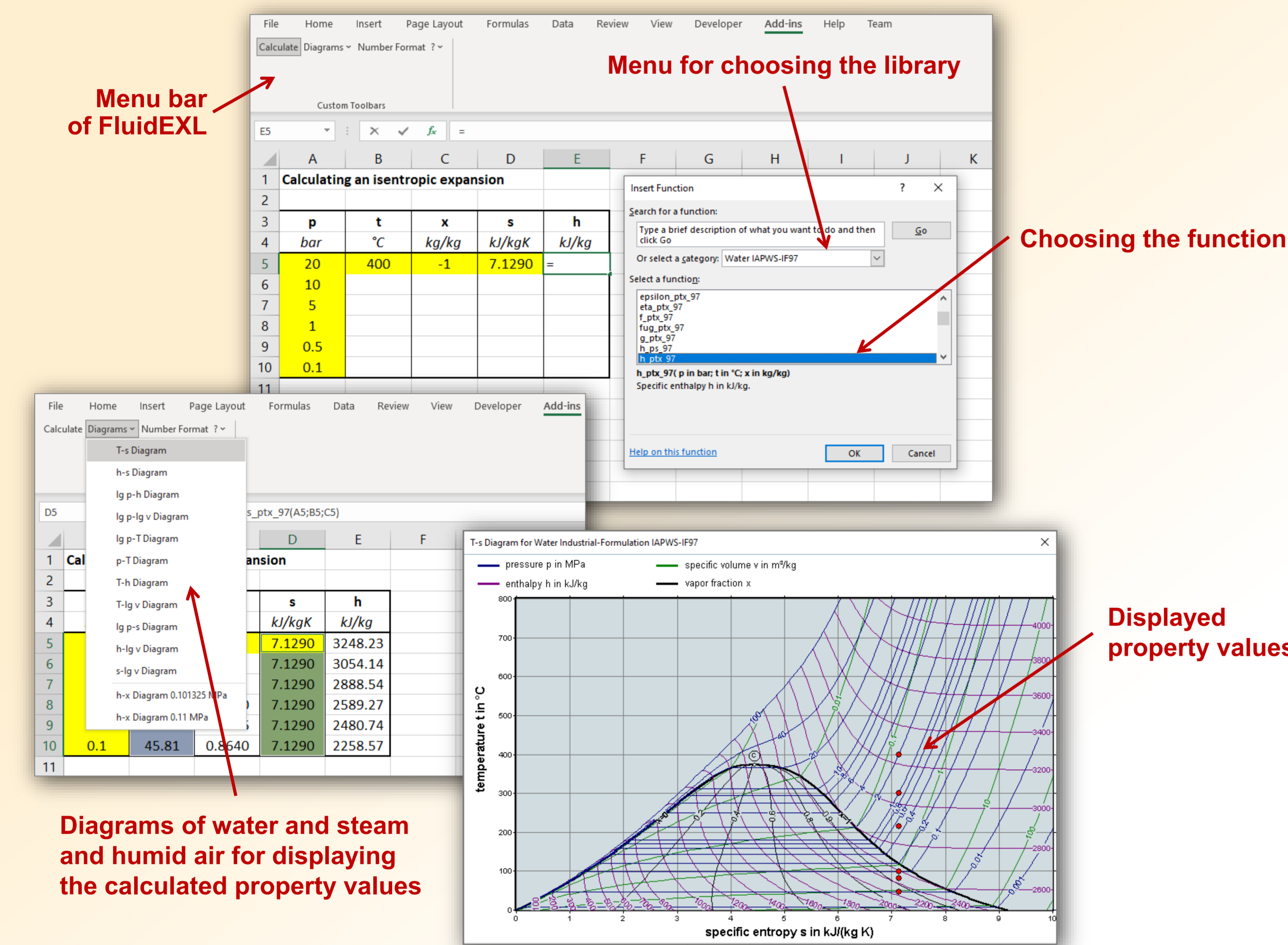


# Property Libraries and Software Interfaces for Working Fluids in Energy Conversion Processes

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## Add-Ons for Using the Property Libraries

### FluidEXL<sup>Graphics</sup> for Excel including VBA



**Menu bar of FluidEXL**

**Menu for choosing the library**

**Choosing the function**

**Diagrams of water and steam and humid air for displaying the calculated property values**

**Displayed property values**

p	t	x	s	h
bar	°C	kg/kg	kJ/kgK	kJ/kg
20	400	-1	7.1290	
10				3248.23
5				3054.14
1				2888.54
0.5				2589.27
0.1				2480.74
			7.1290	2258.57

## Property Libraries for Fast Process Calculations Using the Spline-Based Table Look-up Method (SBTL)

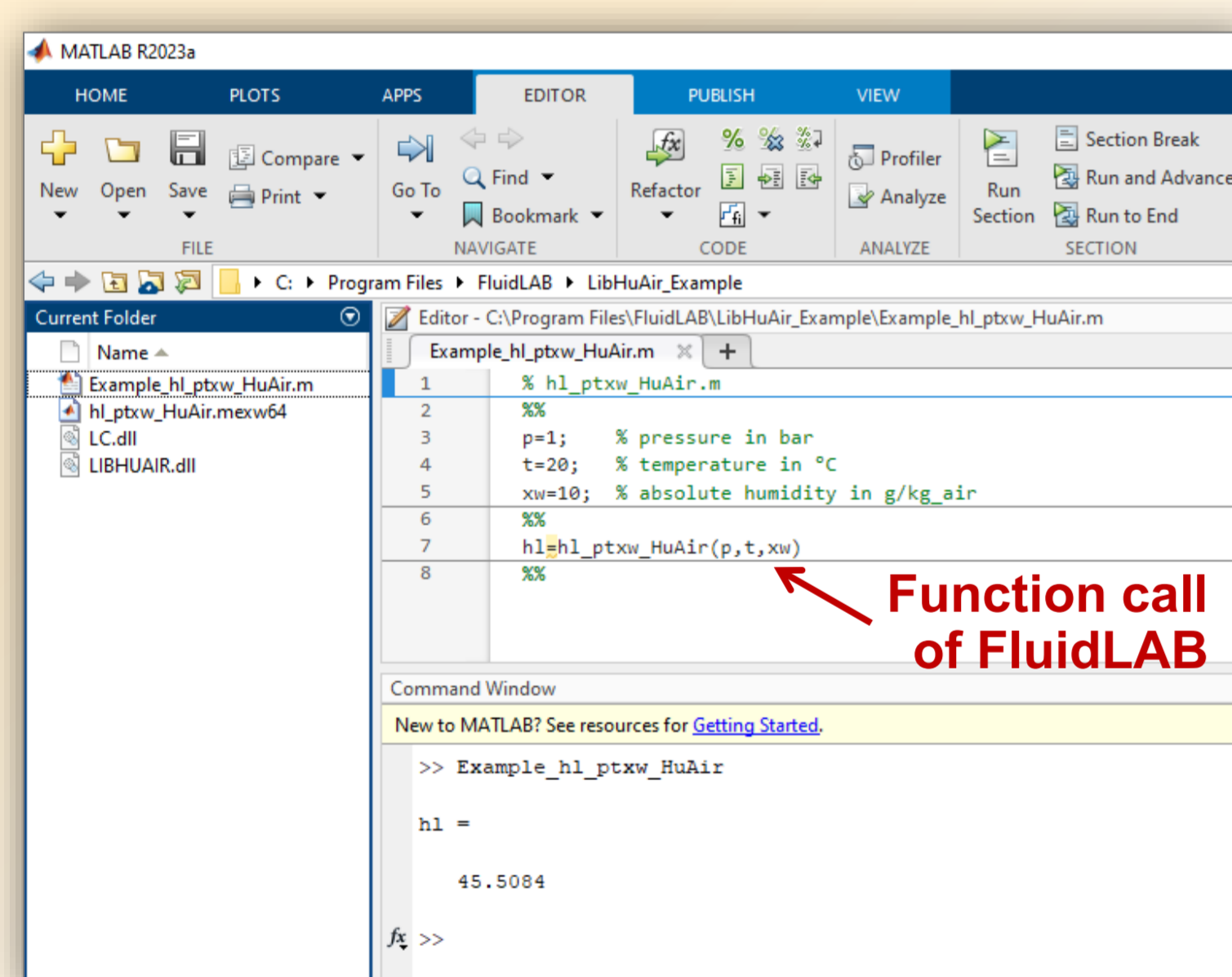
- |                 |                |
|-----------------|----------------|
| Water and Steam | LibSBTL_IF97   |
|                 | LibSBTL_95     |
| Carbon dioxide  | LibSBTL_CO2    |
| Parahydrogen    | LibSBTL_H2para |
| Humid air       | LibSBTL_HuAir  |

## Property Libraries

- |                                 |                   |
|---------------------------------|-------------------|
| Steam, water and ice            | LibIF97           |
|                                 | LibIF97_META      |
|                                 | LibICE            |
| Seawater                        | LibSeaWa          |
| Humid air                       | LibHuAir          |
| Humid combustion gas mixtures   | LibHuGas          |
|                                 | LibIdGasMix       |
| Carbon dioxide incl. dry ice    | LibCO2            |
| Hydrogen                        | LibH2             |
| Ammonia/water mixtures          | LibAmWa           |
| Water/lithium bromide mixtures  | LibWaLi           |
| Ammonia                         | LibNH3            |
| R134a                           | LibR134a          |
| Propane                         | LibPropane        |
| Isobutane, n-butane             | LibButane_Iso, _n |
| Liquid coolants                 | LibSecRef         |
| Ethanol                         | LibC2H5OH         |
| Methanol                        | LibCH3OH          |
| Siloxanes as ORC working fluids | LibD4 ...         |
|                                 | ... LibMM         |
| Helium                          | LibHe             |
| Dry air                         | LibRealAir        |
| Nitrogen and oxygen             | LibN2, LibO2      |
| Hydrocarbons                    | LibC5H10 ...      |
|                                 | ... LibC10H22     |
| Other fluids                    | LibCO ...         |
|                                 | ... LibSO2        |

## Other Add-Ons

### FluidLAB for MATLAB & Simulink



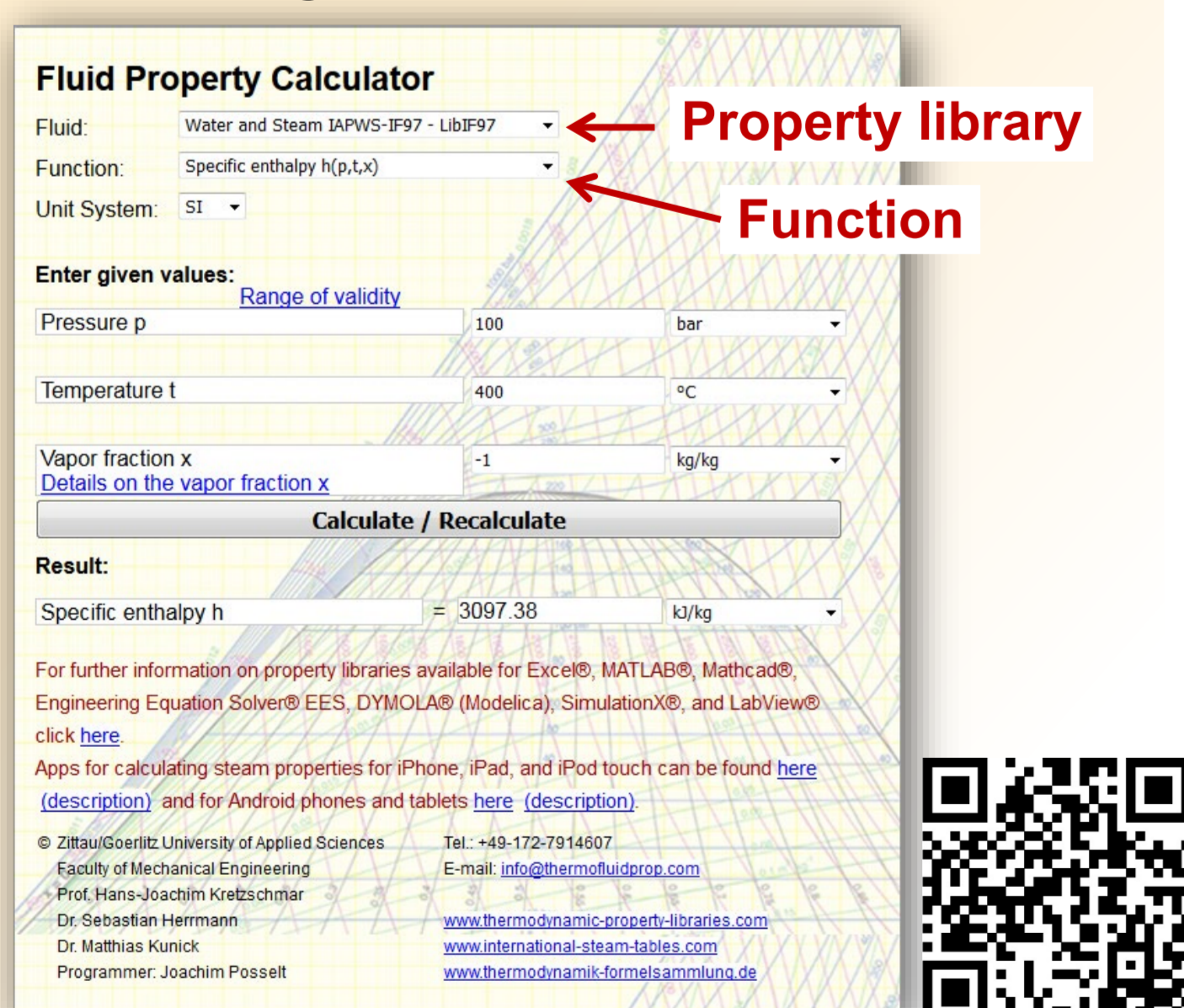
**Function call of FluidLAB**

```

h1 =
    45.5094
f1 >>
  
```

- FluidMAT for Mathcad
- FluidPRIME for Mathcad Prime
- FluidVIEW for LabVIEW
- FluidDYM for Dymola
- FluidEES for EES
- FluidPYT for Python
- FluidJAVA for Java
- FluidLINUX for Linux
- FluidMAC for macOS, etc.

## Online Property Calculator



**Property library**

**Function**

Fluid: Water and Steam IAPWS-IF97 - LibIF97

Function: Specific enthalpy h(p,t,x)

Unit System: SI

Enter given values:

Pressure p: 100 bar

Temperature t: 400 °C

Vapor fraction x: -1 kg/kg

Result:

Specific enthalpy h = 3097.36 kJ/kg

[www.fluid-property-calculator.com](http://www.fluid-property-calculator.com)

## App International Steam Tables for iPhone, iPad, Android Phones and Tablets



**International Steam Tables IAPWS-IF97**

Pressure: 100 bar

Temperature: 500 °C

Region: superheated vapor - region 2

Vapor fraction: -1.000 kg/kg

Specific volume: 0.0281993 m³/kg

Density: 35.47620 kg/m³

Internal energy: 3046.05014 kJ/kg

Enthalpy: 3275.05844 kJ/kg

Entropy: 6.5952253 kJ/kgK

Specific heat capacity: 2.5833874 kJ/kgK

Isobaric heat capacity: 1.84774027 kJ/kgK

Isentropic exponent: 1.2702143

[www.thermodynamic-property-libraries.com](http://www.thermodynamic-property-libraries.com)

[www.international-steam-tables.com](http://www.international-steam-tables.com)

## The following thermodynamic and transport properties can be calculated<sup>a</sup>:

### Thermodynamic Properties

- Vapor pressure  $p_s$
- Saturation temperature  $T_s$
- Density  $\rho$
- Specific volume  $v$
- Enthalpy  $h$
- Internal energy  $u$
- Entropy  $s$
- Exergy  $e$
- Isobaric heat capacity  $c_p$
- Isochoric heat capacity  $c_v$

### Transport Properties

- Isentropic exponent  $\kappa$
- Speed of sound  $w$
- Surface tension  $\sigma$
- Dynamic viscosity  $\eta$
- Kinematic viscosity  $\nu$
- Thermal conductivity  $\lambda$
- Prandtl number  $Pr$
- Thermal diffusivity  $a$

### Inverse Functions

- $T, v, s(p, h)$
- $T, v, h(p, s)$
- $p, T, v(h, s)$
- $p, T(v, h)$
- $p, T(v, u)$

### Thermodynamic Derivatives

- Typically required partial derivatives are also calculable.

<sup>a</sup> Not all of these property functions are available in all property libraries listed before.

