



## GREEN BOND – METHODOLOGY FOR BANQUE INTERNATIONALE À LUXEMBOURG

SUSTAINABLE FINANCE METHODOLOGY –  
RESIDENTIAL BUILDINGS IN LUXEMBOURG

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# AGENDA

## 01 Management Summary

## 02 Luxembourg - Residential low carbon buildings

- 02.1 Nearly Zero Energy Building code
- 02.2 Cost-optimal level
- 02.3 Building energy codes and standards
- 02.4 Energy performance certificate

## 03 Luxembourg - Residential Methodology

- 03.1 Existing building stock
- 03.2 Eligibility criteria

## 04 Luxembourg - Residential benchmarks

- 04.1 Energy carrier
- 04.2 Primary energy and CO2-equivalents
- 04.3 National reference benchmarks



# BANQUE INTERNATIONALE À LUXEMBOURG – SUSTAINABLE FINANCE

## EU Taxonomy – eligibility criteria for climate change mitigation – residential assets in Luxembourg

<b>Economic activity</b>	<b>Screening criteria</b>	 <b>Single-Family houses<sup>1</sup></b>	 <b>Multi-Family houses<sup>2</sup></b>		
7.1 Construction of new buildings	<b>Nearly Zero-Energy Building</b> Primary energy demand minus 10%  Indicative reference values:	At least 10% lower than the requirements for the primary energy demand of the "Nearly Zero-Energy Building" standard (NZEB). Based on the "Energy Performance of Buildings Directive (EBPD)", the NZEB-standard is implemented in the "Règlement grand-ducal du 9 juin 2021 (RGD 2021)" requirements.			
		Small SFH: (163 m <sup>2</sup> )	Large SFH: (306 m <sup>2</sup> )	Small MFH: (1275 m <sup>2</sup> )	Large MFH: (3060 m <sup>2</sup> )
		PED ≤ 46.6 kWh/(m <sup>2</sup> a)	PED ≤ 41.8 kWh/(m <sup>2</sup> a)	PED ≤ 47.0 kWh/(m <sup>2</sup> a)	PED ≤ 41.7 kWh/(m <sup>2</sup> a)
7.2 Renovation of existing buildings	<b>Major Renovation</b> Cost optimal level	The building renovation complies with the applicable requirements for major renovations as defined in the Energy Performance of Buildings Directive (EBPD), based on the cost-optimal level as defined in "Règlement du 23 juillet 2016".			
	<b>Property Upgrade</b> Relative improvement ≥ 30% in primary energy demand	Relative improvement in primary energy demand ≥ 30% in comparison to the performance of the building before the renovation.  Reductions through renewable energy sources are not taken into account.			
7.7 Acquisition and ownership of buildings	<b>Energy Performance Certificate</b> EPC at least class A	Energy performance class A+ or A Final energy demand: A+ ≤ 22   A ≤ 41 kWh/(m <sup>2</sup> a)		Energy performance class A+ or A Final energy demand: A+ ≤ 16   A ≤ 41 kWh/(m <sup>2</sup> a)	
	<b>top 15%</b> of the national existing building stock	Primary energy demand: < 123 kWh/(m <sup>2</sup> a)		Primary energy demand: < 71 kWh/(m <sup>2</sup> a)	
		Final energy demand: < 107 kWh/(m <sup>2</sup> a)		Final energy demand: < 62 kWh/(m <sup>2</sup> a)	
		Primary energy demand: RGD 2016 or better		Primary energy demand: RGD 2019 or better	
		Year of construction: 2017 or newer based on RGD 2016		Year of construction: 2019 or newer based on RGD 2019	

SFH: Single-Family house with 1-2 units | MFH: Multi-Family house with >2 units



# ENERGY & CO2-BENCHMARKS

## Luxembourg – Residential buildings

Ø-Reference values: Energy		Ø-Reference values: CO <sub>2</sub>																																				
Building stock weighted reference benchmarks:  End energy: Ø186.5 kWh/(m <sup>2</sup> a)  Primary energy factor: Ø1.147  Primary energy demand: Ø214 kWh/(m <sup>2</sup> a)	<table border="1"><thead><tr><th rowspan="2">Label</th><th colspan="2">End energy demand</th></tr><tr><th>MFH</th><th>SFH</th></tr></thead><tbody><tr><td>A+</td><td>≤ 16 kWh/(m<sup>2</sup>a)</td><td>≤ 22 kWh/(m<sup>2</sup>a)</td></tr><tr><td>A</td><td>≤ 41 kWh/(m<sup>2</sup>a)</td><td>≤ 41 kWh/(m<sup>2</sup>a)</td></tr><tr><td>B</td><td>≤ 71 kWh/(m<sup>2</sup>a)</td><td>≤ 90 kWh/(m<sup>2</sup>a)</td></tr><tr><td>C</td><td>≤ 84 kWh/(m<sup>2</sup>a)</td><td>≤ 123 kWh/(m<sup>2</sup>a)</td></tr><tr><td>D</td><td>≤ 98 kWh/(m<sup>2</sup>a)</td><td>≤ 142 kWh/(m<sup>2</sup>a)</td></tr><tr><td>E</td><td>≤ 154 kWh/(m<sup>2</sup>a)</td><td>≤ 208 kWh/(m<sup>2</sup>a)</td></tr><tr><td>F</td><td>≤ 225 kWh/(m<sup>2</sup>a)</td><td>≤ 295 kWh/(m<sup>2</sup>a)</td></tr><tr><td>G</td><td>≤ 280 kWh/(m<sup>2</sup>a)</td><td>≤ 395 kWh/(m<sup>2</sup>a)</td></tr><tr><td>H</td><td>≤ 355 kWh/(m<sup>2</sup>a)</td><td>≤ 530 kWh/(m<sup>2</sup>a)</td></tr><tr><td>I</td><td>&gt; 355 kWh/(m<sup>2</sup>a)</td><td>&gt; 530 kWh/(m<sup>2</sup>a)</td></tr></tbody></table>	Label	End energy demand		MFH	SFH	A+	≤ 16 kWh/(m <sup>2</sup> a)	≤ 22 kWh/(m <sup>2</sup> a)	A	≤ 41 kWh/(m <sup>2</sup> a)	≤ 41 kWh/(m <sup>2</sup> a)	B	≤ 71 kWh/(m <sup>2</sup> a)	≤ 90 kWh/(m <sup>2</sup> a)	C	≤ 84 kWh/(m <sup>2</sup> a)	≤ 123 kWh/(m <sup>2</sup> a)	D	≤ 98 kWh/(m <sup>2</sup> a)	≤ 142 kWh/(m <sup>2</sup> a)	E	≤ 154 kWh/(m <sup>2</sup> a)	≤ 208 kWh/(m <sup>2</sup> a)	F	≤ 225 kWh/(m <sup>2</sup> a)	≤ 295 kWh/(m <sup>2</sup> a)	G	≤ 280 kWh/(m <sup>2</sup> a)	≤ 395 kWh/(m <sup>2</sup> a)	H	≤ 355 kWh/(m <sup>2</sup> a)	≤ 530 kWh/(m <sup>2</sup> a)	I	> 355 kWh/(m <sup>2</sup> a)	> 530 kWh/(m <sup>2</sup> a)	Building stock weighted reference benchmark:  CO <sub>2</sub> -Intensity: Ø0.273 kgCO <sub>2</sub> /kWh	Building stock weighted reference benchmark:  Carbon emissions 50.9 kgCO <sub>2</sub> /(m <sup>2</sup> a)
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# SUSTAINABLE FINANCE

## Energy standards - Nearly-Zero-Energy-Building (NZEB)

### Directive 2010/31/EU:

- Implementation of a "Nearly-Zero-Energy-Building" as a standard for all new buildings since 2021, for public authority buildings already since 2019: This standard describes a building that has a very high energy performance. "Near-zero or very low energy demand should be met to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby." (Article 9)
- Calculation of the "cost-optimal level" for energy requirements for new and existing buildings by the member states and comparison with the currently valid minimum requirements.

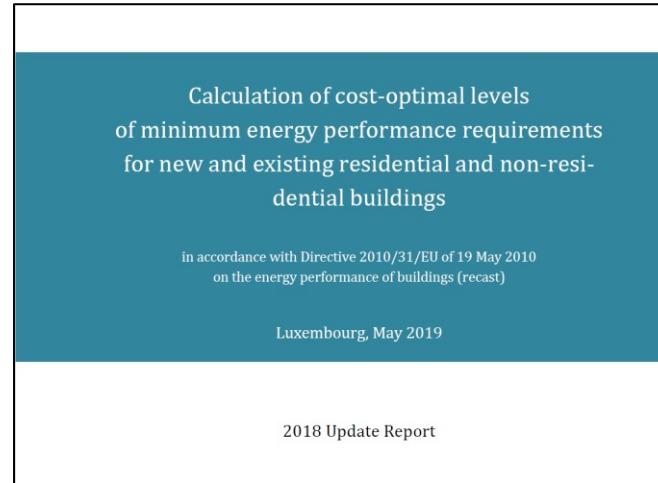
### „Nearly-Zero-Energy-Building“ NZEB:

Each member state of the EU is obliged to implement the requirements of the EPBD Directive ("European Performance of Buildings Directive") in national law by 2018. This also includes the obligation to define a new energy standard for buildings since 2021, which is defined as "**NZEB = Nearly-Zero-Energy-Buildings**". In Luxembourg, this was fulfilled by the "**Règlement grand-ducal du 23 juillet 2016 modifiant – RGD 2016**", which introduced the residential **NZEB-standard**. The current energy standard is defined in **RGD 2021**.



# SUSTAINABLE FINANCE

## Energy standards – EU-cost optimal level in Luxembourg

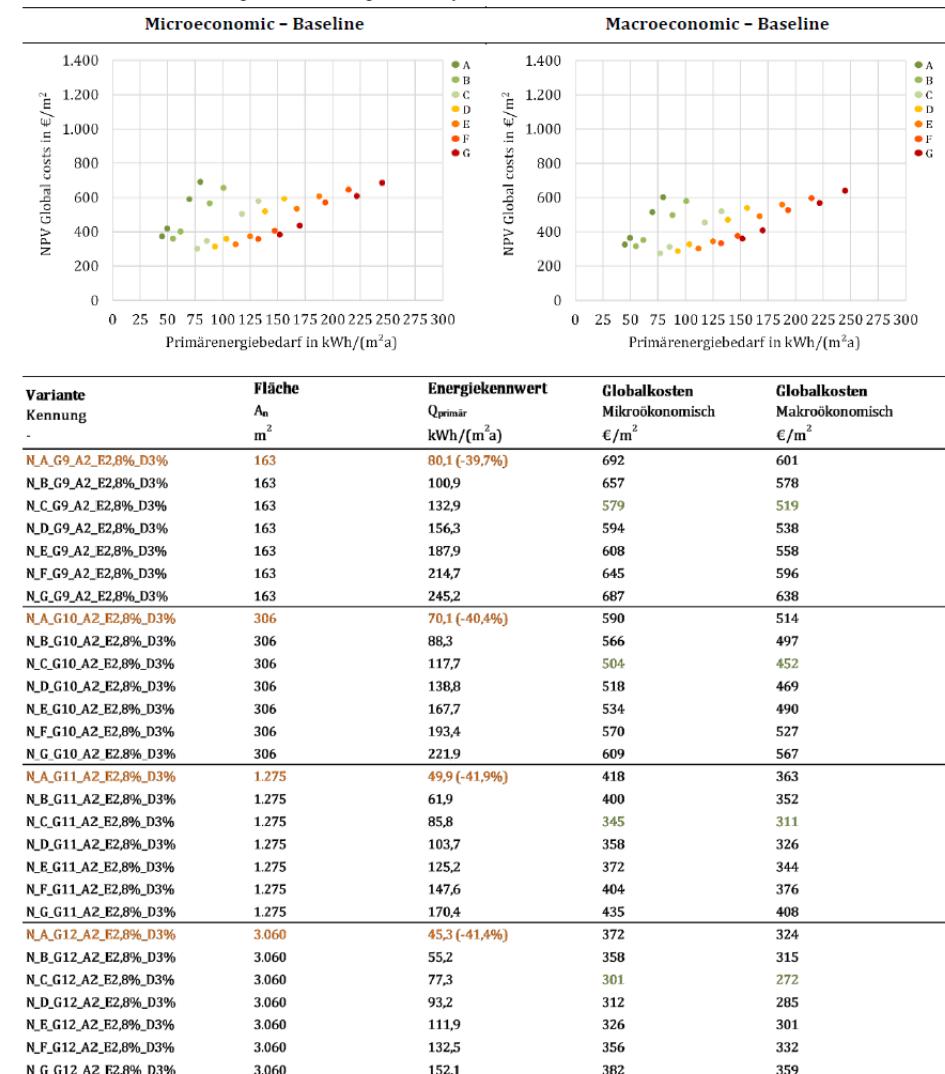


“...the primary energy requirements for new residential buildings in Luxembourg are already considerably below the cost-optimal primary energy requirements.”

The calculation of the **cost-optimal level** provides the basis for whether a member state has to tighten the energy standards (energy requirements) or not.

In 2019, Luxembourg published a report on this subject ("**Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-residential buildings**"), which confirms that the **RGD 2016** as an energy standard does **not need to be tightened** to meet the "cost-optimal level" for residential buildings.

Table 18: Residential buildings – New buildings – Development scenario S1 – Micro- and macroeconomic.



Extract of the Calculation of cost-optimal levels of minimum energy performance requirements 2019



# SUSTAINABLE FINANCE

## Energy standards – EU-cost optimal level and NZEB in Luxembourg

<p>Calculation of cost-optimal levels of minimum energy performance requirements for new and existing residential and non-resi- dential buildings</p> <p>in accordance with Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (recast)</p> <p>Luxembourg, May 2019</p>
2018 Update Report

“...the primary energy requirements for new residential buildings in Luxembourg are already considerably below the cost-optimal primary energy requirements.”

Building type	Compactness (A/Ve)	Total Primary Energy Demand Cost-Optimal level	Requirements RGD 2016 (NZEB)	RGD 2016 below Cost optimal level
SFH	0,77	125 kWh/m <sup>2</sup> a	46,64 kWh/m <sup>2</sup> a	63%
	0,62		41,84 kWh/m <sup>2</sup> a	67%
MFH	0,39	85 kWh/m <sup>2</sup> a	47,01 kWh/m <sup>2</sup> a	45%
	0,3		41,70 kWh/m <sup>2</sup> a	51%

<sup>1</sup> Drees & Sommer figure based on Cost-optimal report Luxembourg 2019

- SFH: Single-Family-House
- MFH: Multi-Family-House

The results for the residential **cost-optimal levels** are shown in the table on the right.

The **cost-optimal** for thermal insulation corresponds with a level C class which is significantly lower than the legally required level A class.

The **cost-optimal** for technical systems is **achieved** when using a **condensing boiler** with fossil fuels. However, to comply with the **NZEB-standard** it is generally necessary to include **renewable energies**.



# SUSTAINABLE FINANCE

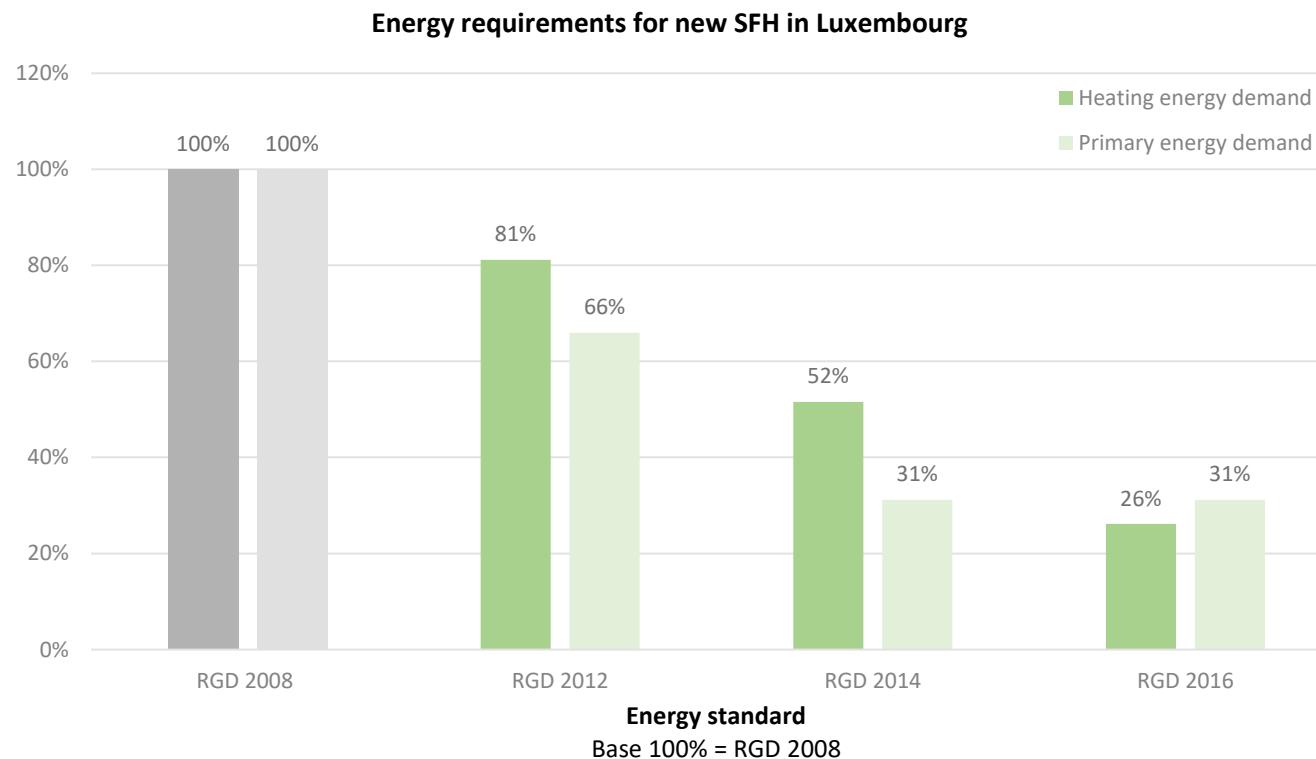
## Building energy codes in Luxembourg

- Règlement grand-ducal du 22 novembre 1995 concernant l'isolation thermique des immeubles – **RGD 1995**
- Règlement grand-ducal du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation et modifiant – **RGD 2007**
- Règlement grand-ducal du 19 août 2008 modifiant :
  1. le règlement grand-ducal du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation;
  2. le règlement grand-ducal modifié du 22 novembre 1995 concernant l'isolation thermique des immeubles;
  3. le règlement grand-ducal modifié du 10 février 1999 relatif à l'agrément de personnes physiques ou morales privées ou publiques, autres que l'Etat, pour l'accomplissement de tâches techniques d'étude et de contrôle dans le domaine de l'énergie. – **RGD 2008**
- Règlement grand-ducal du 8 janvier 2010 modifiant le règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation. – **RGD 2010**
- Règlement grand-ducal du 5 mai 2012 modifiant :
  1. le règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation;
  2. le règlement grand-ducal du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels. – **RGD 2012**
- Règlement grand-ducal du 26 mai 2014 modifiant :
  1. le règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation;
  2. le règlement grand-ducal modifié du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels; et
  3. le règlement grand-ducal du 27 février 2010 concernant les installations à gaz. – **RGD 2014**
- Règlement grand-ducal du 23 juillet 2016 modifiant :
  1. le règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation;
  2. le règlement grand-ducal modifié du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels; et
  3. le règlement grand-ducal du 12 décembre 2012 instituant un régime d'aides pour la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des énergies renouvelables dans le domaine du logement. – **RGD 2016**
- Règlement grand-ducal du 7 mars 2019 modifiant :
  1. le règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation ; et
  2. le règlement grand-ducal modifié du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels. – **RGD 2019**
- Règlement grand-ducal du 9 juin 2021 concernant la performance énergétique des bâtiments. – **RGD 2021**



# SUSTAINABLE FINANCE

## Building energy codes – RGD



Drees & Sommer figure based on the Règlement grand-ducal

The **heating energy demand** for single-family houses defined in the RGD 2012 is 19% lower than prescribed in the RGD 2008.

The requirement for the heating demand in RGD 2014 is 29% lower than in RGD 2012.

Finally, in the RGD 2016, the heating demand was tightened by 26% compared to RGD 2014.

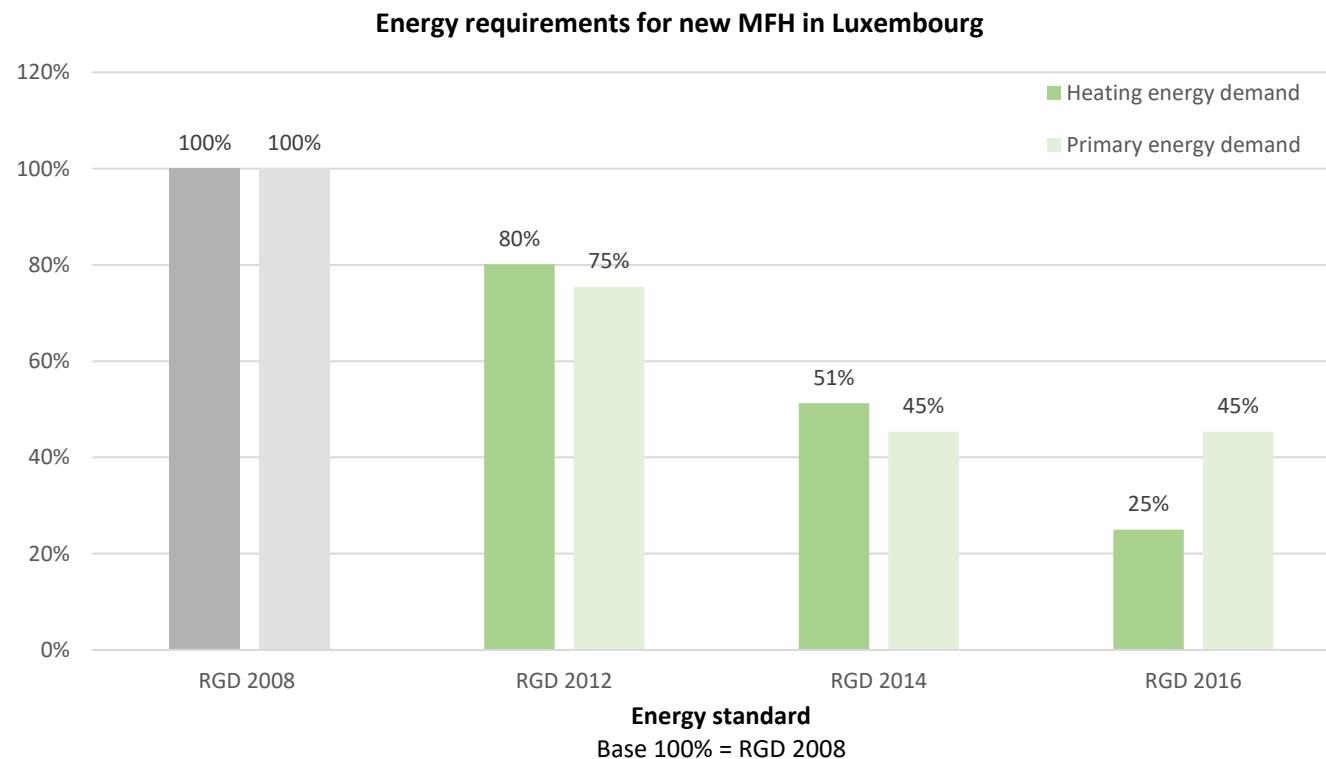
The **primary energy demand** defined in the RGD 2012 is 34% lower than prescribed in the RGD 2008.

For RGD 2014 and RGD 2016, the primary energy demand requirement is 35% lower than prescribed in RGD 2012.



# SUSTAINABLE FINANCE

## Building energy codes – RGD



The **heating energy demand** for multi-family houses defined in the RGD 2012 is 20% lower than prescribed in the RGD 2008.

The requirement for the heating demand in RGD 2014 is 29% lower than in RGD 2012.

Finally, in the RGD 2016, the heating demand was tightened by 26% compared to RGD 2014.

The **primary energy demand** defined in the RGD 2012 is 25% lower than prescribed in the RGD 2008.

For RGD 2014 and RGD 2016, the primary energy demand requirement is 30% lower than prescribed in RGD 2012.



# SUSTAINABLE FINANCE

## Energy Performance Certificate – Luxembourg

<p><b>1</b></p> <p><b>2</b></p> <p>Angaben zum Gebäude Nutzungstyp: Wohnen Anzahl der Wohneinheiten: 1 Name: Neubau Adresse (Straße): 1234, Test Baujahr Gebäude: 2008 Baujahr Heizungsanlage: 2008 Energiebezugsfläche: 154,0 m²</p> <p><b>3</b></p> <p><b>4</b></p> <p>Energieeffizienzklasse geringer Energiebedarf Wärmeschutzklasse B Niedrigenergiehaus Energieeffizienzklasse: Die Einstufung in die Energieeffizienzklasse erfolgt nach dem sogenannten Primärenergiebedarf. Dieser berücksichtigt neben dem Wärmeschutz des Gebäudes auch die Wärmedämmung und die Umweltverträglichkeit der eingesetzten Energieträger in einer Gesamtbetrachtung. Die Einstufung in die Wärmeschutzklasse erfolgt nach dem sogenannten Heizwärmeverbrauch. Diese Klasse ist die Qualität des Gebäudes, die Wärmedämmung in Wänden, Dach, Boden und Fenster, die Bauweise und Bauausführung bestimmt und die Orientierung.</p> <p>Klassen: Die Klasseneinteilung erfolgt von A (beste Klasse) bis I (schlechteste Klasse). Niedrigenergiehaus - alle Klassen ≤ B Energiesparhaus - alle Klassen ≤ C</p> <p><b>5</b></p> <p><b>6</b></p> <p><b>7</b></p> <p><b>8</b></p> <p>Energieeffizienzklasse: Primärenergiebedarf (bezogen auf <math>A_0</math>) Heizwärmeverbrauch (bezogen auf <math>A_0</math>) Effizienzklassen für die Umweltwirkung: CO<sub>2</sub>-Emissionen (bezogen auf <math>A_0</math>) Jährlicher Energiebedarf und CO<sub>2</sub>-Emissionen: Primärenergiebedarf: 14.212 kWh/Jahr Heizwärmeverbrauch (Transmission- und Lüftung): 6.539 kWh/Jahr CO<sub>2</sub>-Emissionen: 3,1 t CO<sub>2</sub>/Jahr Der <b>Primärenergiebedarf</b> entspricht der Energiemenge, die zur Deckung des Heizenergiebedarfs und des Warmwasserbedarfs (nur sofern der Wärmebedarf nicht abgeschlossen) benötigt wird und berücksichtigt die zusätzlichen Energiemengen, die durch vorgelegte Prozessketten (Gewinnung, Transport, Aufbereitung, etc.) der jeweils eingesetzten Energieträger entstehen. Der <b>Heizwärmeverbrauch</b> entspricht der Wärmemenge, die den beheizten Räumen zugeführt werden muss, um die gewünschte Solltemperatur aufrecht zu erhalten. Die CO<sub>2</sub>-Emissionen geben die bei der Verbrennung fossiler Energien freiwerdende Menge an klimaschädlichen Gasen an und werden als CO<sub>2</sub>-Äquivalent angegeben. Dann werden Kohendioxid (CO<sub>2</sub>) auch anderen klimaschädigenden Gase (Methan,...) berücksichtigt, die bei Energiegewinnung, -aufbereitung und -transport freigesetzt werden. Je geringer die durch die Beheizung eines Gebäudes entstehenden CO<sub>2</sub>-Emissionen sind, desto weniger wird das globale Klima belastet. <math>A_0</math> entspricht der <b>Energiebezugsfläche</b> (d.h. die beheizte Wohnfläche) des Gebäudes in m<sup>2</sup>.</p> <p><b>9</b></p> <p><b>10</b></p> <p><b>11</b></p> <p><b>12</b></p> <p><b>13</b></p> <p><b>14</b></p> <p><b>15</b></p> <p><b>16</b></p> <p><b>17</b></p> <p><b>18</b></p> <p><b>19</b></p> <p><b>20</b></p> <p><b>21</b></p> <p><b>22</b></p> <p><b>23</b></p> <p><b>24</b></p> <p><b>25</b></p> <p><b>26</b></p> <p><b>27</b></p> <p><b>28</b></p> <p><b>29</b></p> <p><b>30</b></p> <p><b>31</b></p> <p><b>32</b></p> <p><b>33</b></p> <p><b>34</b></p> <p><b>35</b></p> <p><b>36</b></p> <p><b>37</b></p> <p><b>38</b></p> <p><b>39</b></p> <p><b>40</b></p> <p><b>41</b></p> <p><b>42</b></p> <p><b>43</b></p> <p><b>44</b></p> <p><b>45</b></p> <p><b>46</b></p> <p><b>47</b></p> <p><b>48</b></p> <p><b>49</b></p> <p><b>50</b></p> <p><b>51</b></p> <p><b>52</b></p> <p><b>53</b></p> <p><b>54</b></p> <p><b>55</b></p> <p><b>56</b></p> <p><b>57</b></p> <p><b>58</b></p> <p><b>59</b></p> <p><b>60</b></p> <p><b>61</b></p> <p><b>62</b></p> <p><b>63</b></p> <p><b>64</b></p> <p><b>65</b></p> <p><b>66</b></p> <p><b>67</b></p> <p><b>68</b></p> <p><b>69</b></p> <p><b>70</b></p> <p><b>71</b></p> <p><b>72</b></p> <p><b>73</b></p> <p><b>74</b></p> <p><b>75</b></p> <p><b>76</b></p> <p><b>77</b></p> <p><b>78</b></p> <p><b>79</b></p> <p><b>80</b></p> <p><b>81</b></p> <p><b>82</b></p> <p><b>83</b></p> <p><b>84</b></p> <p><b>85</b></p> <p><b>86</b></p> <p><b>87</b></p> <p><b>88</b></p> <p><b>89</b></p> <p><b>90</b></p> <p><b>91</b></p> <p><b>92</b></p> <p><b>93</b></p> <p><b>94</b></p> <p><b>95</b></p> <p><b>96</b></p> <p><b>97</b></p> <p><b>98</b></p> <p><b>99</b></p> <p><b>100</b></p> <p><b>101</b></p> <p><b>102</b></p> <p><b>103</b></p> <p><b>104</b></p> <p><b>105</b></p> <p><b>106</b></p> <p><b>107</b></p> <p><b>108</b></p> <p><b>109</b></p> <p><b>110</b></p> <p><b>111</b></p> <p><b>112</b></p> <p><b>113</b></p> <p><b>114</b></p> <p><b>115</b></p> <p><b>116</b></p> <p><b>117</b></p> <p><b>118</b></p> <p><b>119</b></p> <p><b>120</b></p> <p><b>121</b></p> <p><b>122</b></p> <p><b>123</b></p> <p><b>124</b></p> <p><b>125</b></p> <p><b>126</b></p> <p><b>127</b></p> <p><b>128</b></p> <p><b>129</b></p> <p><b>130</b></p> <p><b>131</b></p> <p><b>132</b></p> <p><b>133</b></p> <p><b>134</b></p> <p><b>135</b></p> <p><b>136</b></p> <p><b>137</b></p> <p><b>138</b></p> <p><b>139</b></p> <p><b>140</b></p> <p><b>141</b></p> <p><b>142</b></p> <p><b>143</b></p> <p><b>144</b></p> <p><b>145</b></p> <p><b>146</b></p> <p><b>147</b></p> <p><b>148</b></p> <p><b>149</b></p> <p><b>150</b></p> <p><b>151</b></p> <p><b>152</b></p> <p><b>153</b></p> <p><b>154</b></p> <p><b>155</b></p> <p><b>156</b></p> <p><b>157</b></p> <p><b>158</b></p> <p><b>159</b></p> <p><b>160</b></p> <p><b>161</b></p> <p><b>162</b></p> <p><b>163</b></p> <p><b>164</b></p> 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<p><b>660</b></p> <p><b>661</b></p> <p><b>662</b></p> <p><b>663</b></p> <p><b>664</b></p> <p><b>665</b></p> <p><b>666</b></p> <p><b>667</b></p> <p><b>668</b></p> <p><b>669</b></p> <p><b>670</b></p> <p><b>671</b></p> <p><b>672</b></p> <p><b>673</b></p> <p><b>674</b></p> <p><b>675</b></p> <p><b>676</b></p> <p><b>677</b></p> <p><b>678</b></p> <p><b>679</b></p> <p><b>680</b></p> <p><b>681</b></p> <p><b>682</b></p> <p><b>683</b></p> <p><b>684</b></p> <p><b>685</b></p> <p><b>686</b></p> <p><b>687</b></p> <p><b>688</b></p> <p><b>689</b></p> <p><b>690</b></p> <p><b>691</b></p> <p><b>692</b></p> <p><b>693</b></p> <p><b>694</b></p> <p><b>695</b></p> <p><b>696</b></p> <p><b>697</b></p> <p><b>698</b></p> <p><b>699</b></p> <p><b>700</b></p> <p><b>701</b></p> <p><b>702</b></p> <p><b>703</b></p> <p><b>704</b></p> <p><b>705</b></p> <p><b>706</b></p> <p><b>707</b></p> <p><b>708</b></p> <p><b>709</b></p> <p><b>710</b></p> <p><b>711</b></p> <p><b>712</b></p> <p><b>713</b></p> <p><b>714</b></p> <p><b>715</b></p> <p><b>716</b></p> <p><b>717</b></p> <p><b>718</b></p> <p><b>719</b></p> <p><b>720</b></p> <p><b>721</b></p> <p><b>722</b></p> <p><b>723</b></p> <p><b>724</b></p> <p><b>725</b></p> <p><b>726</b></p> <p><b>727</b></p> <p><b>728</b></p> <p><b>729</b></p> <p><b>730</b></p> <p><b>731</b></p> <p><b>732</b></p> <p><b>733</b></p> <p><b>734</b></p> <p><b>735</b></p> <p><b>736</b></p> <p><b>737</b></p> <p><b>738</b></p> <p><b>739</b></p> <p><b>740</b></p> <p><b>741</b></p> <p><b>742</b></p> <p><b>743</b></p> <p><b>744</b></p> <p><b>745</b></p> <p><b>746</b></p> <p><b>747</b></p> <p><b>748</b></p> <p><b>749</b></p> <p><b>750</b></p> <p><b>751</b></p> <p><b>752</b></p> <p><b>753</b></p> <p><b>754</b></p> <p><b>755</b></p> <p><b>756</b></p> <p><b>757</b></p> <p><b>758</b></p> <p><b>759</b></p> <p><b>760</b></p> <p><b>761</b></p> <p><b>762</b></p> <p><b>763</b></p> <p><b>764</b></p> <p><b>765</b></p> <p><b>766</b></p> <p><b>767</b></p> <p><b>768</b></p> <p><b>769</b></p> <p><b>770</b></p> <p><b>771</b></p> <p><b>772</b></p> <p><b>773</b></p> <p><b>774</b></p> <p><b>775</b></p> <p><b>776</b></p> <p><b>777</b></p> <p><b>778</b></p> <p><b>779</b></p> <p><b>780</b></p> <p><b>781</b></p> <p><b>782</b></p> <p><b>783</b></p> <p><b>784</b></p> <p><b>785</b></p> <p><b>786</b></p> <p><b>787</b></p> <p><b>788</b></p> <p><b>789</b></p> <p><b>790</b></p> <p><b>791</b></p> <p><b>792</b></p> <p><b>793</b></p> <p><b>794</b></p> <p><b>795</b></p> <p><b>796</b></p> <p><b>797</b></p> <p><b>798</b></p> <p><b>799</b></p> <p><b>800</b></p> <p><b>801</b></p> <p><b>802</b></p> <p><b>803</b></p> <p><b>804</b></p> <p><b>805</b></p> <p><b>806</b></p> <p><b>807</b></p> <p><b>808</b></p> <p><b>809</b></p> <p><b>810</b></p> <p><b>811</b></p> <p><b>812</b></p> <p><b>813</b></p> <p><b>814</b></p> <p><b>815</b></p> <p><b>816</b></p> <p><b>817</b></p> <p><b>818</b></p> <p><b>819</b></p> <p><b>820</b></p> <p><b>821</b></p> <p><b>822</b></p> <p><b>823</b></p> <p><b>824</b></p> <p><b>825</b></p> <p><b>826</b></p> <p><b>827</b></p> <p><b>828</b></p> <p><b>829</b></p> <p><b>830</b></p> <p><b>831</b></p> <p><b>832</b></p> <p><b>833</b></p> <p><b>834</b></p> <p><b>835</b></p> <p><b>836</b></p> <p><b>837</b></p> <p><b>838</b></p> <p><b>839</b></p> <p><b>840</b></p> <p><b>8</b></p>
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# AGENDA

01 Management Summary

02 Luxembourg - Residential low carbon buildings

- 02.1 Nearly Zero Energy Building code
- 02.2 Cost-optimal level
- 02.3 Building energy codes and standards
- 02.4 Energy performance certificate

**03 Luxembourg - Residential Methodology**

- 03.1 Existing building stock
- 03.2 Eligibility criteria

04 Luxembourg - Residential benchmarks

- 04.1 Energy carrier
- 04.2 Primary energy and CO2-equivalents
- 04.3 National reference benchmarks



# SUSTAINABLE FINANCE

## Indication – Residential Building Stock – Luxembourg

The screenshot shows the Guichet.lu website interface. At the top, there is a banner featuring a diverse group of professionals (construction workers, pilot, etc.) and the text "Zesumme Vereinfachen". Below the banner, the main navigation menu includes "Guichet.lu", "Démarches par secteur", and "BESOIN D'AIDE ?". The page title is "Accès experts". A social media sharing bar is present below the title. The main content area contains text about energy performance experts and links to various resources. At the bottom, a footer note states "Dernière modification le 02.03.2022".

LE GOUVERNEMENT  
DU GRAND-DUCHÉ DE LUXEMBOURG

Guichet.lu

Démarches par secteur

Zesumme Vereinfachen

BESOIN D'AIDE ?

Accès experts

f | t | s

Les experts en matière de performance énergétique des bâtiments d'habitation et fonctionnels peuvent accéder à deux espaces experts sécurisés qui leur sont dédiés où ils trouvent toutes les informations relatives aux bâtiments d'habitation, respectivement fonctionnels en utilisant un des liens ci-dessous :

- > Accès pour les experts des bâtiments d'habitation
- > Accès pour les experts des bâtiments fonctionnels
- > Registre des certificats de performance énergétique

Dernière modification le 02.03.2022

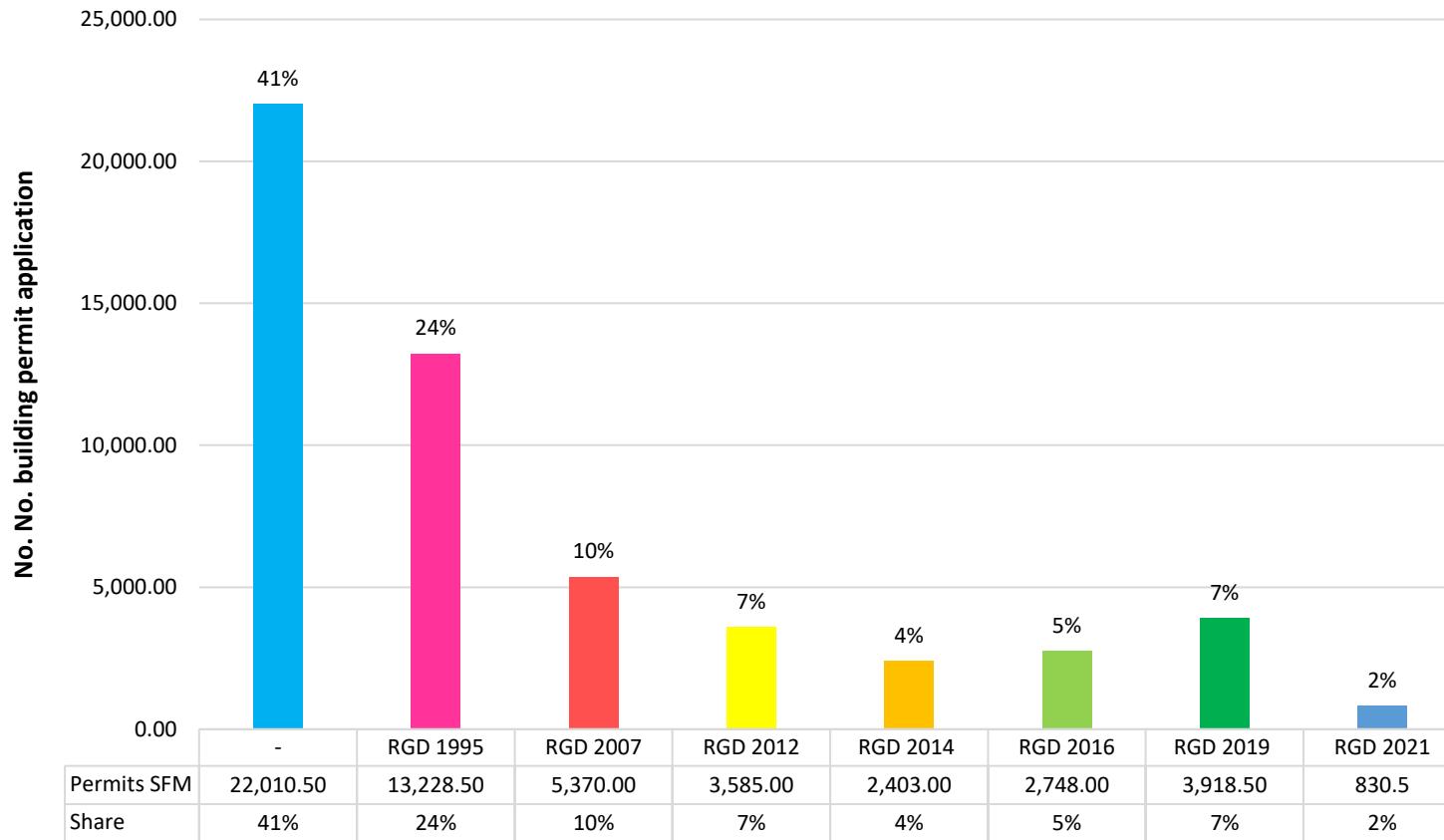
**"Régistre des certificats de performance énergétique"** gives users the opportunity to provide Energy Performance Certificate (EPC) of their building for a national building database.

Access to the database could not be granted in the scope of this study.



# SUSTAINABLE FINANCE

## Residential Building Stock – Single Family House – Luxembourg



Information and data is based on:

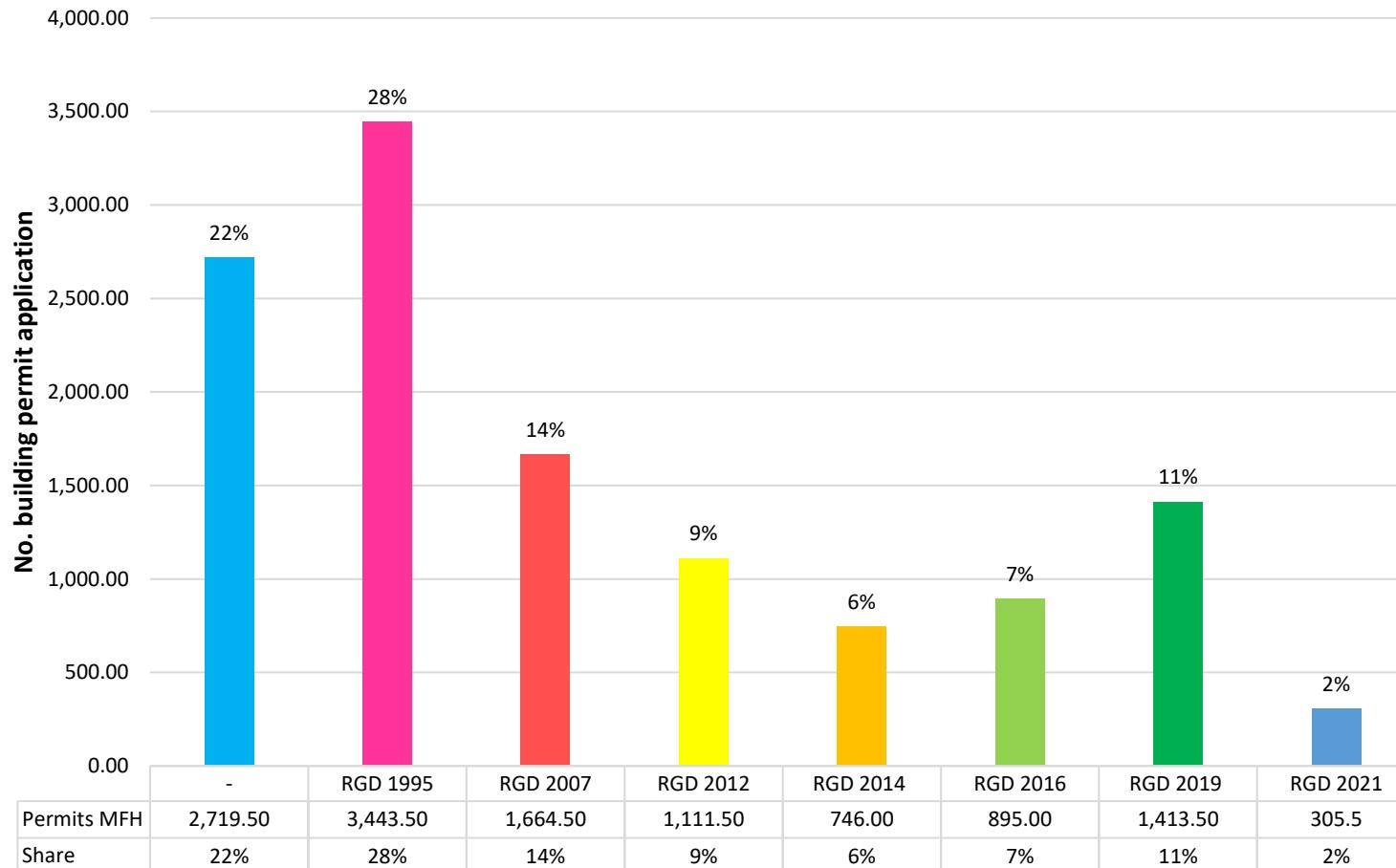
- Statistics portal of the Grand-Duchy of Luxembourg "Statistiques.lu"
- The data consists of the approved building permits from 1970 until 2021

Number of buildings, which have undergone an energy efficient retrofit, are not included.



## SUSTAINABLE FINANCE

### Residential Building Stock – Multi-Family House – Luxembourg



Information and data is based on:

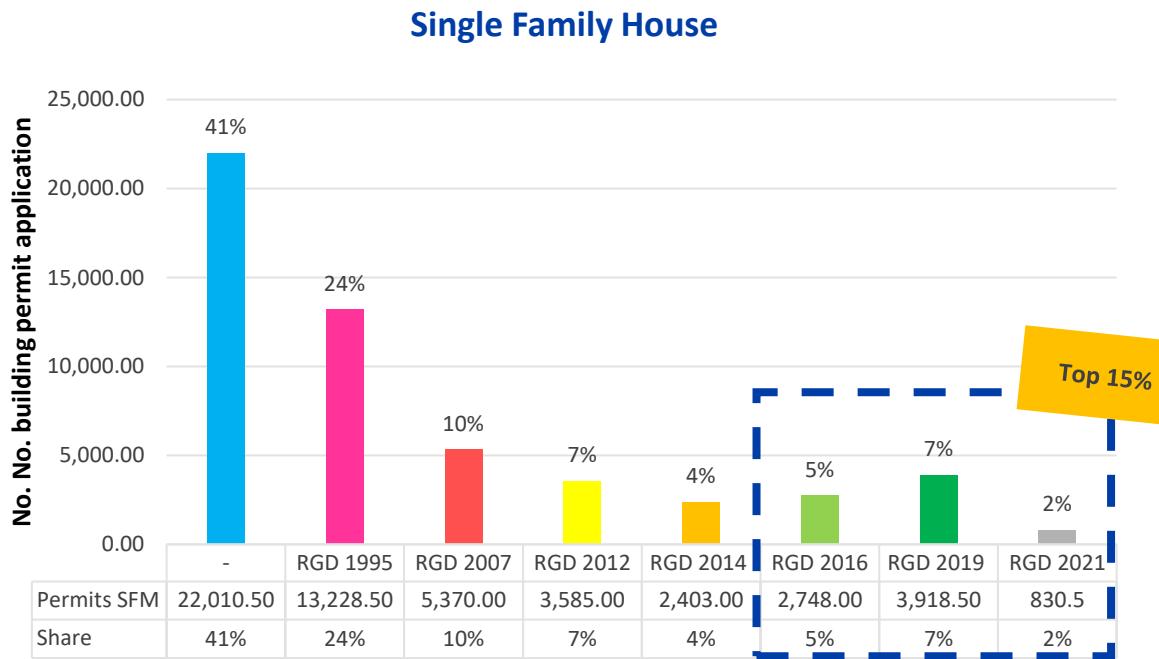
- Statistics portal of the Grand-Duchy of Luxembourg "Statistiques.lu"
- The data consists of the approved building permits from 1970 until 2021

Number of buildings, which have undergone an energy efficient retrofit, are not included.

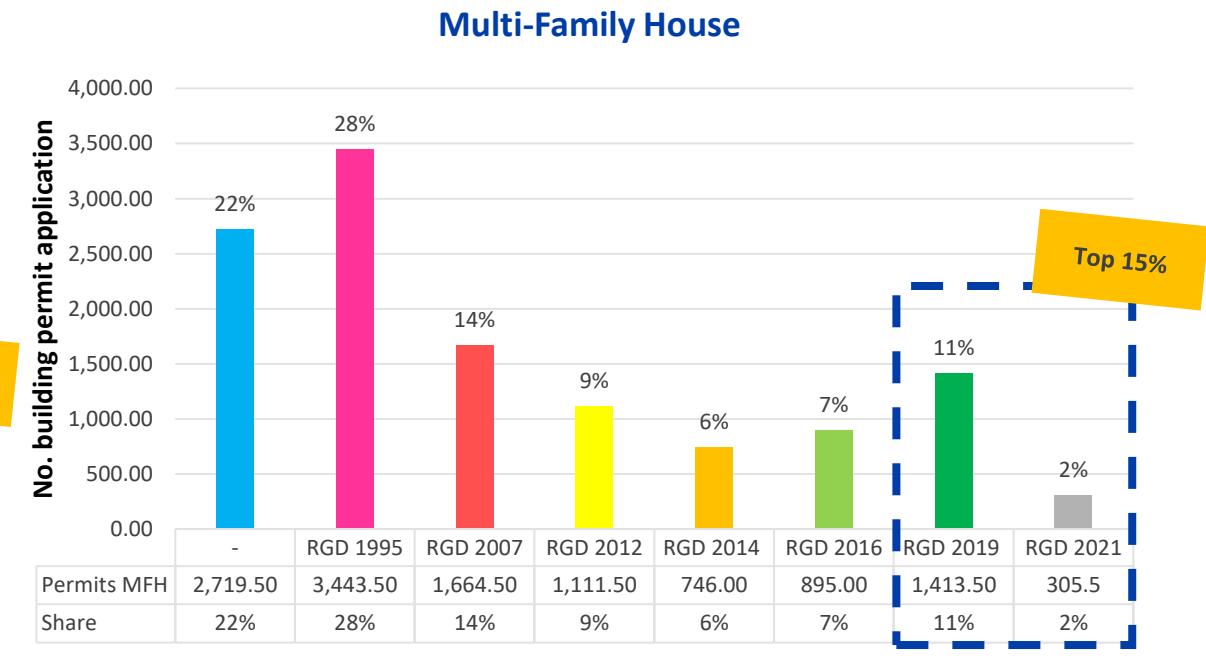


## SUSTAINABLE FINANCE

### Residential Building Stock – Single & Multi-Family House – Luxembourg



**Single Family Houses** build according to **RGD 2016** or better represent the **Top 14%** of its local market with a construction year 2017 or newer.



**Multi-Family Houses** built according to **RGD 2019** or better represent the **Top 13%** of its local market with a construction year of construction 2019 or newer.



# AGENDA

01 Management Summary

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- 02.1 Nearly Zero Energy Building code
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- 02.4 Energy performance certificate

03 Luxembourg - Residential Methodology

- 03.1 Existing building stock
- 03.2 Eligibility criteria

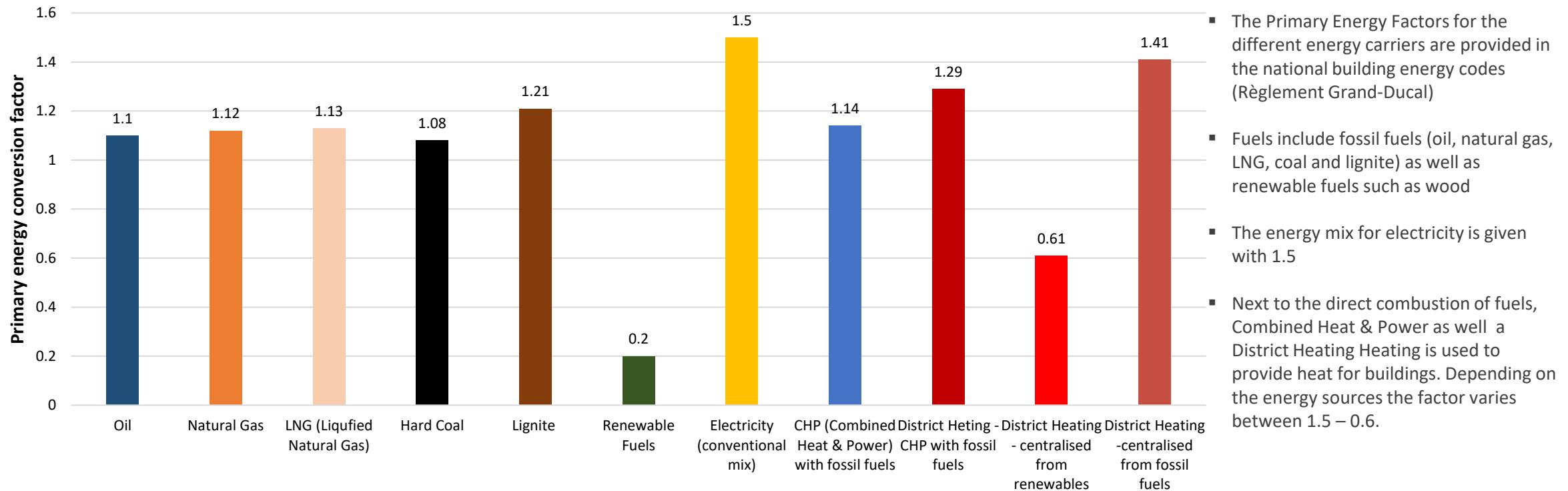
04 Luxembourg - Residential benchmarks

- 04.1 Energy carrier
- 04.2 Primary energy and CO2-equivalents
- 04.3 National reference benchmarks



# SUSTAINABLE FINANCE

## Luxembourg – primary energy factors (PEF)



Drees und Sommer figure based on Règlement Grand-Ducal du 9 Juin 2021

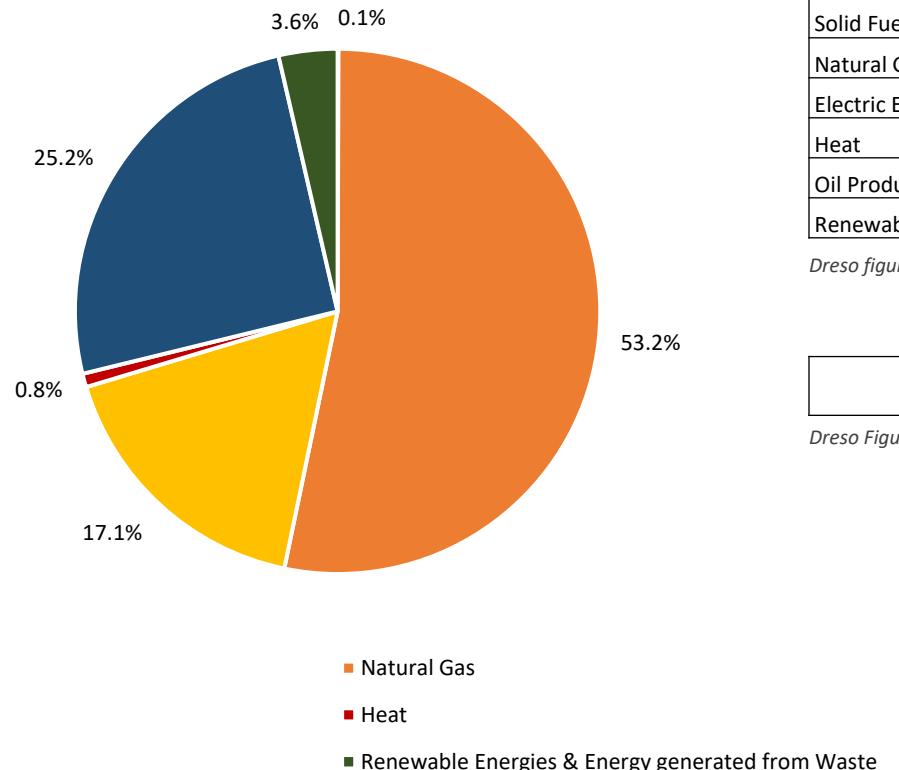
- The Primary Energy Factors for the different energy carriers are provided in the national building energy codes (Règlement Grand-Ducal)
- Fuels include fossil fuels (oil, natural gas, LNG, coal and lignite) as well as renewable fuels such as wood
- The energy mix for electricity is given with 1.5
- Next to the direct combustion of fuels, Combined Heat & Power as well as District Heating Heating is used to provide heat for buildings. Depending on the energy sources the factor varies between 1.5 – 0.6.



# DISTRIBUTED ENERGY CARRIERS

## Weighted National Primary Energy Factor

Distributed Energy Carriers - Residential Buildings 2019



Energy Source	Distributed Energy Carriers 2019	Primary Energy Factor	Weighted Primary Energy Factor
Solid Fuels	0.1%	1.1	<b>1.147</b>
Natural Gas	53.2%	1.1	
Electric Energy	17.1%	1.5	
Heat	0.8%	1.1	
Oil Products	25.2%	1.1	
Renewable Energies & Energy generated from Waste	3.6%	0.2	

*Dreso figures based on „Bilan énergetique par type de produits – bâtiments résidentiel“ (lstat.statec) & RGD 2021*

Total Energy Consumption (2020)	5,765 GWh/a	186.5 kWh/(m <sup>2</sup> a)
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*Dreso Figures based on EU Building Database*

Building weighted national  
reference benchmark for end  
energy demand:  
- Ø 186.5 kWh/(m<sup>2</sup>a)

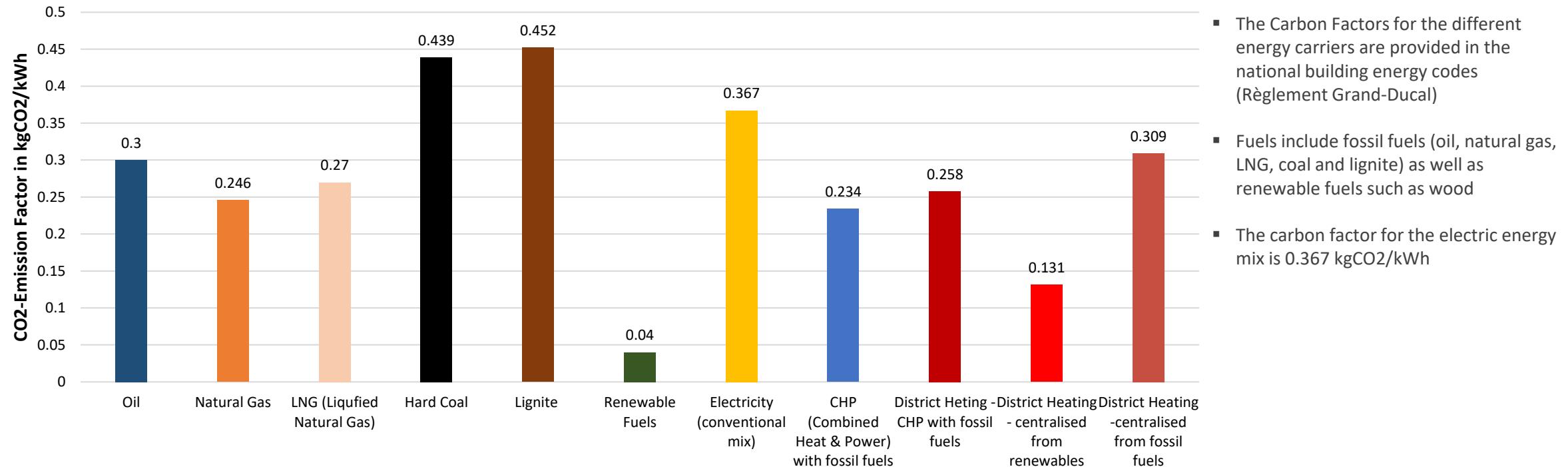
Primary energy factor:  
- **1.147**

Building weighted national  
reference benchmark for  
primary energy demand:  
- Ø 214 kWh/(m<sup>2</sup>a)



# SUSTAINABLE FINANCE

## Luxembourg – primary energy factors (PEF)



Drees und Sommer figure based on Règlement Grand-Ducal du 9 Juin 2021

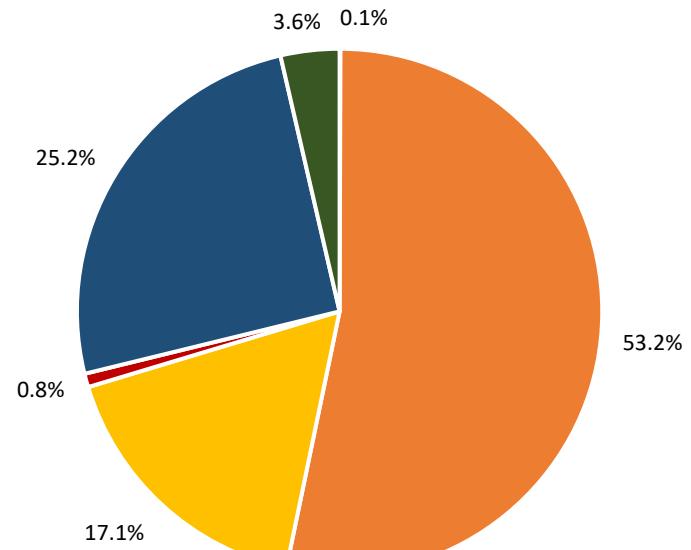
- The Carbon Factors for the different energy carriers are provided in the national building energy codes (Règlement Grand-Ducal)
- Fuels include fossil fuels (oil, natural gas, LNG, coal and lignite) as well as renewable fuels such as wood
- The carbon factor for the electric energy mix is 0.367 kgCO<sub>2</sub>/kWh



# DISTRIBUTED ENERGY CARRIERS

## Weighted National Carbon Factor

Distributed Energy Carriers - Residential Buildings 2019



- Solid Fuels
- Natural Gas
- Electric Energy
- Heat
- Oil Products
- Renewable Energies & Energy generated from Waste

Energy Source	Distributed Energy Carriers 2019	Carbon Emission Factor	Weighted Carbon Intensity
Solid Fuels	0.1%	0.446	<b>0.273</b>
Natural Gas		0.246	
Electric Energy		0.367	
Heat		0.233	
Oil Products		0.300	
Renewable Energies & Energy generated from Waste		0.040	

Dreso figures based on „Bilan énergetique par type de produits – bâtiments résidentiel“ (lstat.statec) & RGD 2021

Total Energy Consumption (2020)	5,765 GWh/a	186.5 kWh/(m <sup>2</sup> a)
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Dreso Figures based on EU Building Database

Building weighted national reference benchmark for end energy demand:  
- Ø 186.5 kWh/(m<sup>2</sup>a)

CO2-intensity:  
- **0.273**

Building weighted national reference benchmark for CO<sub>2</sub>-emissions:  
- Ø 50.9 kgCO<sub>2</sub>/(m<sup>2</sup>a)



# ENERGY & CO2-BENCHMARKS

## Luxembourg – Residential buildings

Ø-Reference values: Energy		Ø-Reference values: CO <sub>2</sub>																																				
Building stock weighted reference benchmarks:  End energy: Ø186.5 kWh/(m <sup>2</sup> a)  Primary energy factor: Ø1.147  Primary energy demand: Ø214 kWh/(m <sup>2</sup> a)	<table border="1"><thead><tr><th rowspan="2">Label</th><th colspan="2">End energy demand</th></tr><tr><th>MFH</th><th>SFH</th></tr></thead><tbody><tr><td>A+</td><td>≤ 16 kWh/(m<sup>2</sup>a)</td><td>≤ 22 kWh/(m<sup>2</sup>a)</td></tr><tr><td>A</td><td>≤ 41 kWh/(m<sup>2</sup>a)</td><td>≤ 41 kWh/(m<sup>2</sup>a)</td></tr><tr><td>B</td><td>≤ 71 kWh/(m<sup>2</sup>a)</td><td>≤ 90 kWh/(m<sup>2</sup>a)</td></tr><tr><td>C</td><td>≤ 84 kWh/(m<sup>2</sup>a)</td><td>≤ 123 kWh/(m<sup>2</sup>a)</td></tr><tr><td>D</td><td>≤ 98 kWh/(m<sup>2</sup>a)</td><td>≤ 142 kWh/(m<sup>2</sup>a)</td></tr><tr><td>E</td><td>≤ 154 kWh/(m<sup>2</sup>a)</td><td>≤ 208 kWh/(m<sup>2</sup>a)</td></tr><tr><td>F</td><td>≤ 225 kWh/(m<sup>2</sup>a)</td><td>≤ 295 kWh/(m<sup>2</sup>a)</td></tr><tr><td>G</td><td>≤ 280 kWh/(m<sup>2</sup>a)</td><td>≤ 395 kWh/(m<sup>2</sup>a)</td></tr><tr><td>H</td><td>≤ 355 kWh/(m<sup>2</sup>a)</td><td>≤ 530 kWh/(m<sup>2</sup>a)</td></tr><tr><td>I</td><td>&gt; 355 kWh/(m<sup>2</sup>a)</td><td>&gt; 530 kWh/(m<sup>2</sup>a)</td></tr></tbody></table>	Label	End energy demand		MFH	SFH	A+	≤ 16 kWh/(m <sup>2</sup> a)	≤ 22 kWh/(m <sup>2</sup> a)	A	≤ 41 kWh/(m <sup>2</sup> a)	≤ 41 kWh/(m <sup>2</sup> a)	B	≤ 71 kWh/(m <sup>2</sup> a)	≤ 90 kWh/(m <sup>2</sup> a)	C	≤ 84 kWh/(m <sup>2</sup> a)	≤ 123 kWh/(m <sup>2</sup> a)	D	≤ 98 kWh/(m <sup>2</sup> a)	≤ 142 kWh/(m <sup>2</sup> a)	E	≤ 154 kWh/(m <sup>2</sup> a)	≤ 208 kWh/(m <sup>2</sup> a)	F	≤ 225 kWh/(m <sup>2</sup> a)	≤ 295 kWh/(m <sup>2</sup> a)	G	≤ 280 kWh/(m <sup>2</sup> a)	≤ 395 kWh/(m <sup>2</sup> a)	H	≤ 355 kWh/(m <sup>2</sup> a)	≤ 530 kWh/(m <sup>2</sup> a)	I	> 355 kWh/(m <sup>2</sup> a)	> 530 kWh/(m <sup>2</sup> a)	Building stock weighted reference benchmark:  CO <sub>2</sub> -Intensity: Ø0.273 kgCO <sub>2</sub> /kWh	Building stock weighted reference benchmark:  Carbon emissions 50.9 kgCO <sub>2</sub> /(m <sup>2</sup> a)
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SFH: Single-Family house with 1-2 units | MFH: Multi-Family house with >2 units

SUCCESSFUL BUILDINGS  
LIVEABLE CITIES  
HIGH-YIELD PORTFOLIOS  
POWERFUL INFRASTRUCTURE  
FUTURE-ORIENTED CONSULTING



DREES &  
SOMMER