Comparative Tables: CGE Model Scenario Setup

## Italian CGE Model - BAU, ETS1, and ETS2 Scenarios

## Table 1: Overview of Scenario Definitions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Full Name** | **Time Period** | **Policy Description** | **Primary Objective** |
| BAU | Business as Usual | 2021-2050 | No additional climate policies beyond existing regulations | Baseline reference trajectory without carbon pricing |
| ETS1 | EU ETS Phase 4 | 2021-2050 | EU Emissions Trading System Phase 4 for industrial sectors | Decarbonize industry through carbon pricing with Market Stability Reserve (MSR) |
| ETS2 | EU ETS Phase 4 + Buildings/Transport | 2027-2050 (ETS2 component) | Extended ETS coverage including buildings and transport sectors | Comprehensive decarbonization across industry, buildings, and transport |

## Table 2: Carbon Pricing Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **BAU** | **ETS1** | **ETS2** |
| Carbon Price (2021) | €0/tCO₂e | €53.90/tCO₂e | €53.90/tCO₂e (ETS1) |
| Carbon Price (2027) | €0/tCO₂e | €69.72/tCO₂e | €69.72/tCO₂e (ETS1) €45.00/tCO₂e (ETS2) |
| Price Growth Rate | N/A | 4.0% annually | 4.0% (ETS1) 2.5% (ETS2) |
| Growth Rate Decline | N/A | 0.15% per year | 0.15% (ETS1) 0.10% (ETS2) |
| Maximum Price | N/A | €150/tCO₂e (practical limit) | €150/tCO₂e (ETS1) €100/tCO₂e (ETS2) |
| Price Mechanism | N/A | Market Stability Reserve (MSR) | MSR (ETS1) Price Stability Mechanism (PSM) (ETS2) |
| Price Floor | N/A | None (MSR managed) | None (ETS1) €22.00/tCO₂e (ETS2) |
| Price Cap | N/A | None (MSR prevents extremes) | None (ETS1) €45.00/tCO₂e (ETS2) |

## Table 3: Sectoral Coverage

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sector Code** | **Sector Name** | **BAU** | **ETS1** | **ETS2** |
| IND | Industry (Manufacturing) | ❌ | ✅ | ✅ |
| GAS | Gas Supply | ❌ | ✅ | ✅ |
| OENERGY | Other Energy | ❌ | ✅ | ✅ |
| AIR | Air Transport | ❌ | ✅ | ✅ |
| WATER | Water Transport | ❌ | ✅ | ✅ |
| ROAD | Road Transport | ❌ | ❌ | ✅ |
| OTRANS | Other Transport | ❌ | ❌ | ✅ |
| SERVICES | Services (Buildings) | ❌ | ❌ | ✅ |
| Total Covered | - | 0 | 5 sectors | 8 sectors |

**Coverage Legend:** ✅ = Covered by ETS carbon pricing | ❌ = Not covered

## Table 4: Free Allowance Allocation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **BAU** | **ETS1** | **ETS2 (ETS1 component)** | **ETS2 (ETS2 component)** |
| Initial Free Allocation Rate | N/A | 80% | 80% | 60% |
| Annual Decline Rate | N/A | 2% per year | 2% per year | 3% per year |
| Minimum Allocation | N/A | 10% | 10% | 5% |
| Free Allocation (2021) | N/A | 80% | 80% | N/A (starts 2027) |
| Free Allocation (2030) | N/A | 62% | 62% | 51% |
| Free Allocation (2050) | N/A | 22% (capped at 10%) | 22% (capped at 10%) | 9% (capped at 5%) |

## Table 5: Energy Efficiency and Technology Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **BAU** | **ETS1** | **ETS2** |
| AEEI (Covered Sectors) | 1.0% per year | 1.5% per year | 1.5% per year |
| AEEI (Non-Covered) | 1.0% per year | 1.0% per year | 1.0% per year |
| Electrification Rate Growth | 2.5% per year | 2.5% per year | 2.5% per year |
| Renewable Share Growth | 4.5% per year | 4.5% per year | 4.5% per year |
| Renewable Investment Acceleration | None (baseline) | 20% boost | 40% boost (industry) 60% boost (South/Islands) |
| Renewable Capacity (2021) | 60 GW | 60 GW | 60 GW |
| Target Renewable Share (2050) | ~70% | ~80% | ~90% |

**Note:** AEEI = Autonomous Energy Efficiency Improvement

## Table 6: Regional GDP Growth Rates (Base Assumptions)

|  |  |  |  |
| --- | --- | --- | --- |
| **Region** | **BAU Growth Rate** | **ETS1 Adjustment** | **ETS2 Adjustment** |
| Northwest | 1.5% per year | -0.4% (industrial costs) | -0.2% (offset by green investment) |
| Northeast | 1.8% per year | -0.4% (industrial costs) | -0.2% (offset by green investment) |
| Centre | 1.6% per year | +0.3% (green services) | +0.4% (green buildings) |
| South | 2.2% per year | +0.3% (green investment) | +0.4% (renewable projects) |
| Islands | 2.0% per year | +0.3% (green investment) | +0.4% (renewable projects) |

## Table 7: Expected Scenario Outcomes (2050 vs. Baseline)

|  |  |  |  |
| --- | --- | --- | --- |
| **Indicator** | **BAU (2050)** | **ETS1 (2050)** | **ETS2 (2050)** |
| GDP Impact | Baseline | -0.5% to -1.0% | -1.0% to -1.5% |
| CO₂ Emissions Reduction | 0% (baseline) | -15% to -20% | -35% to -45% |
| CO₂ Intensity Reduction | Natural decline | -25% to -30% | -45% to -55% |
| Renewable Electricity Share | ~70% | ~80% | ~90% |
| Carbon Revenue (€ billion) | €0 | €15-20 | €25-35 |
| Renewable Capacity (GW) | ~140 | ~160 | ~200 |
| Employment Effect (million) | Baseline | -0.1 to 0.0 | 0.0 to +0.2 |

## Table 8: Model Technical Specifications

|  |  |
| --- | --- |
| **Feature** | **Specification** |
| Model Type | Recursive dynamic CGE |
| Time Horizon | 2021-2050 (30 years, annual) |
| Sectoral Aggregation | 5 aggregate sectors (Agriculture, Industry, Energy, Transport, Services) |
| Regional Disaggregation | 5 macro-regions (Northwest, Northeast, Centre, South, Islands) |
| Household Types | 5 regional households |
| Energy Carriers | 3 types (Electricity, Gas, Other Energy) |
| Production Technology | Nested CES functions (VA-Energy-Materials) |
| Trade Specification | Armington (imports) + CET (exports) |
| Solution Algorithm | IPOPT nonlinear solver |
| Equilibrium Concept | Walrasian general equilibrium |

## Summary of Key Differences

### BAU (Business as Usual):

* No carbon pricing
* Natural technological progress only
* Renewable growth from market forces
* Serves as baseline reference

### ETS1 (EU ETS Phase 4):

* Industrial carbon pricing from 2021
* Initial price: €53.90/tCO₂, growing at 4% p.a.
* Market Stability Reserve (no hard price cap)
* 51% emissions coverage
* Moderate renewable investment boost (20%)

### ETS2 (Comprehensive ETS):

* Extended to buildings and transport from 2027
* Dual price system: ETS1 + ETS2 (€45/tCO₂ initial)
* Price Stability Mechanism with €45 ceiling, €22 floor
* 75% emissions coverage
* Strong renewable investment boost (40-60%)
* Greater regional equity (benefits South/Islands)

*Source: Italian CGE Model Configuration Files (2024)*